TRANSPORTABLE DEBRIS WASHING SYSTEM: FIELD DEMONSTRATION RESULTS AND STATUS OF FULL-SCALE DESIGN

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INTRODUCTION

EPA recently published (Federal Register, May 30, 1991) an Advanced Notice of Rule Making (ANPR) in which Potential Best Demonstrated Available Technology for Contaminated Debris was addressed. In this publication, EPA sets forth suggested regulatory definitions for debris and contaminated debris, indicates the applicability of existing Land Disposal Restriction Treatment Standards as well as Superfund 6A and 6B Guidelines and describes in general the available technologies for treating contaminated debris.

The suggested definitions for debris and contaminated debris are quoted below.

> Debris means solid material that: (1) has been originally manufactured or processed, except for solids that are listed wastes or can be identified as being residues from treatment of wastes and/or wastewaters, or air pollution control devices; or (2) is plant and animal matter; or (3) is natural geologic material exceeding a 9.5 mm sieve size including gravel, cobbles, and boulders (sizes as classified by the U.S. Soil Conservation Service), or is a mixture of such materials with soil or solid waste materials, such as liquids or sludges, and is inseparable by simple mechanical removal processes.
>
> Contaminated Debris means debris which contains RCRA hazardous waste(s) listed in 40 CFR Part 261, Subpart D, or debris which otherwise exhibits one or more characteristics of a hazardous waste (as a result of contamination) as defined in 40 CFR Part 261, Subpart C.

In the ANPR it is stated that "promulgating land disposal restrictions (LDRs) including treatment standards for solvents and dioxins, California list wastes and the First Third, Second Third, and Third Third wastes, the Agency regulated debris contaminated with these restricted wastes. The land disposal restrictions in 40 CFR 268 thus generally apply to contaminated debris, including such debris generated from corrective actions and closures at RCRA-regulated land disposal sites, remedial and removal actions at Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) (Superfund) sites; and private party cleanups."

In conjunction with the promulgation of LDR's, the EPA Risk Reduction Engineering Laboratory funded a project under the SITE program to develop technology which could be applied on-site for the decontamination of debris. The results of initial field testing of the pilot scale Debris Washing System (DWS) [Performed at the Ned Gray Site (PCB/transformers)] were presented at this conference in May 1990.[1]

In this paper we describe results of a second field demonstration in which the utility of the pilot scale DWS was demonstrated for decontaminating debris found at a pesticide-contaminated site in Northern Georgia.

DEMONSTRATION OF DWS AT SHAVER'S FARM DRUM DISPOSAL SITE

A demonstration of the DWS was conducted in August 1990 at the Shaver's Farm drum-disposal site in Chickamauga, Georgia. Fifty-five gallon drums containing varying amounts of a herbicide, Dicamba (2-methoxy-3,6-dichlorobenzoic acid), and benzonitrile, a precursor in the manufacture of Dicamba, were buried on this 5-acre site. An estimated 12,000 drums containing solid and liquid chemical residues from the manufacture of Dicamba were buried there during August 1973 to January 1974. EPA Region IV had excavated more than 4000 drums from one location on the site when this demonstration occurred in August 1990. Figure 1 presents an aerial photograph of the site.

The pilot-scale DWS and the steel-framed temporary enclosure were transported to this site on a 48-foot semi-trailer and assembled on a 24 ft x 24 ft concrete pad. Both the temporary enclosure and the DWS had previously been erected and used at a PCB-contaminated site in Kentucky. Figure 2 shows the temporary enclosure and the assembled DWS at the Shaver's Farm site. Ambient temperature at the site during the demonstration ranged from 75 to 105 degrees Fahrenheit.

Prior to the initiation of the cleaning process, the EPA removed the 55-gallon, pesticide-contaminated drums from the burial site. The contaminated drums were cut into four sections and the contaminated surfaces were sampled using a surface wipe technique.[2] Pretreatment surface-wipe samples were obtained from each section.

The drum pieces were placed into the spray tank of the DWS, which was equipped with multiple water jets that blast loosely adhered contaminants and dirt from the debris. After the spray cycle, the drum pieces were removed and transferred to the wash tank, where the debris was immersed in a high-turbulence washing solution. Each batch of debris was cleaned for a period of 1 hour in the spray tank and 1 hour in the wash tank. During both the spray and wash cycles, a portion of the cleaning solution was cycled through a closed-loop system in which the contaminated cleaning solution was passed through an oil/water separator, and the aqueous solution was then recycled into the DWS. After the wash cycle, the debris was returned to the spray tank, where it was rinsed with fresh water. Figure 3 presents a schematic of the pilot-scale DWS.

Upon completion of the debris cleaning process, posttreatment wipe samples were obtained from each of the drum pieces to assess the residual levels of benzonitrile and Dicamba. In the case of the metallic debris sampled in this study, the posttreatment wipe sample was obtained from a location adjacent to the location of the pretreatment sample. This was necessary because wiping the surface removes the contamination, and if one were to wipe the same surface after cleaning, the results obtained would be biased low.

All field demonstration activities performed under the SITE program were governed by an EPA-approved, site-specific Health and Safety Plan.[3] Hydrogen cyanide was of particular concern at this site. In one instance during excavation, inadvertent mixing of drum contents resulted in a release of hydrogen cyanide.

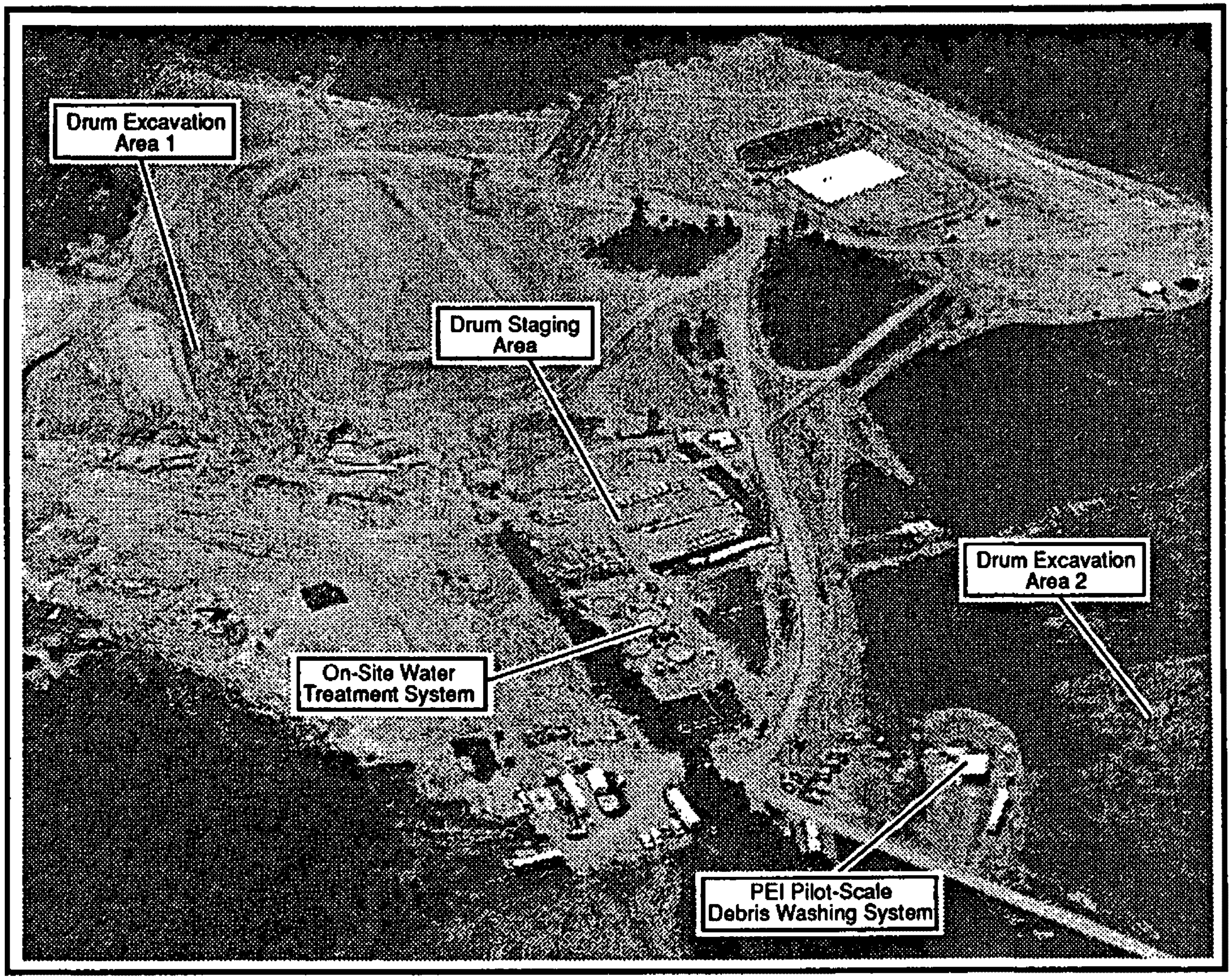

Figure 1. Aerial photograph of Shaver's Farm site.

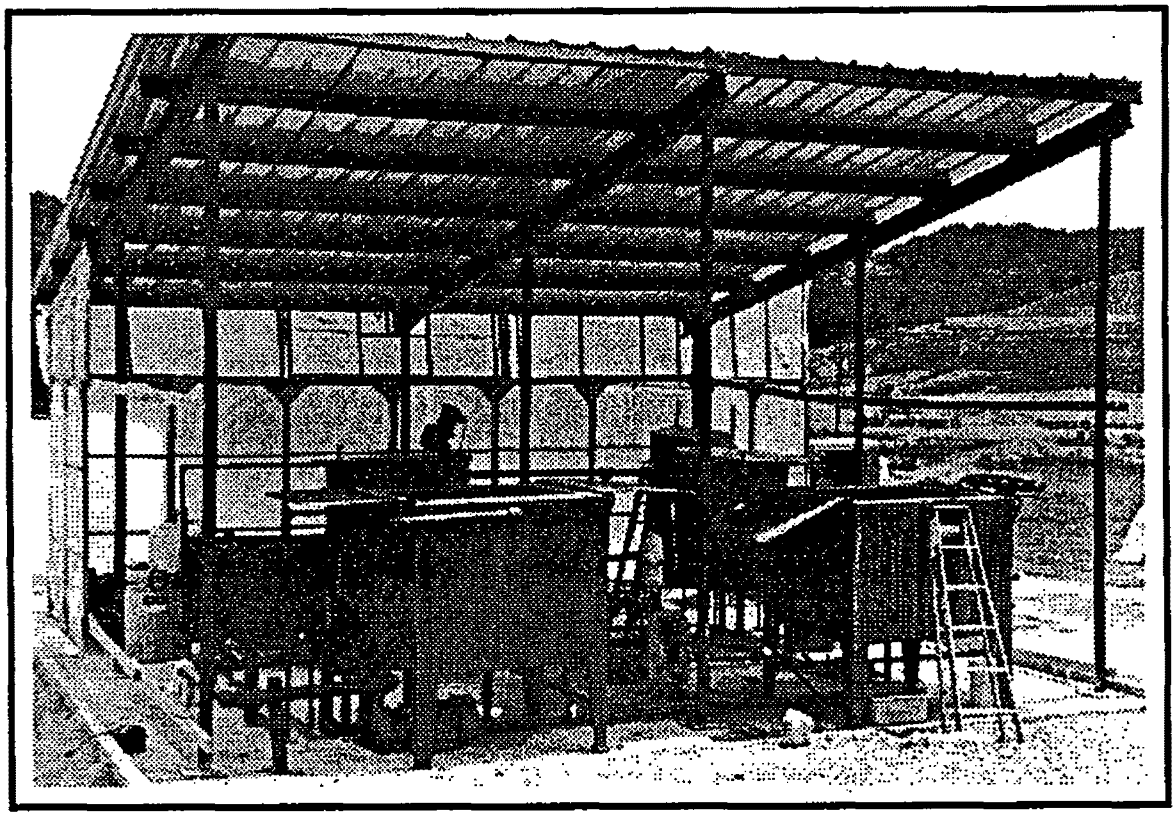

Figure 2. The temporary enclosure and assembled pilot-scale DWS at Shaver's Farm site.

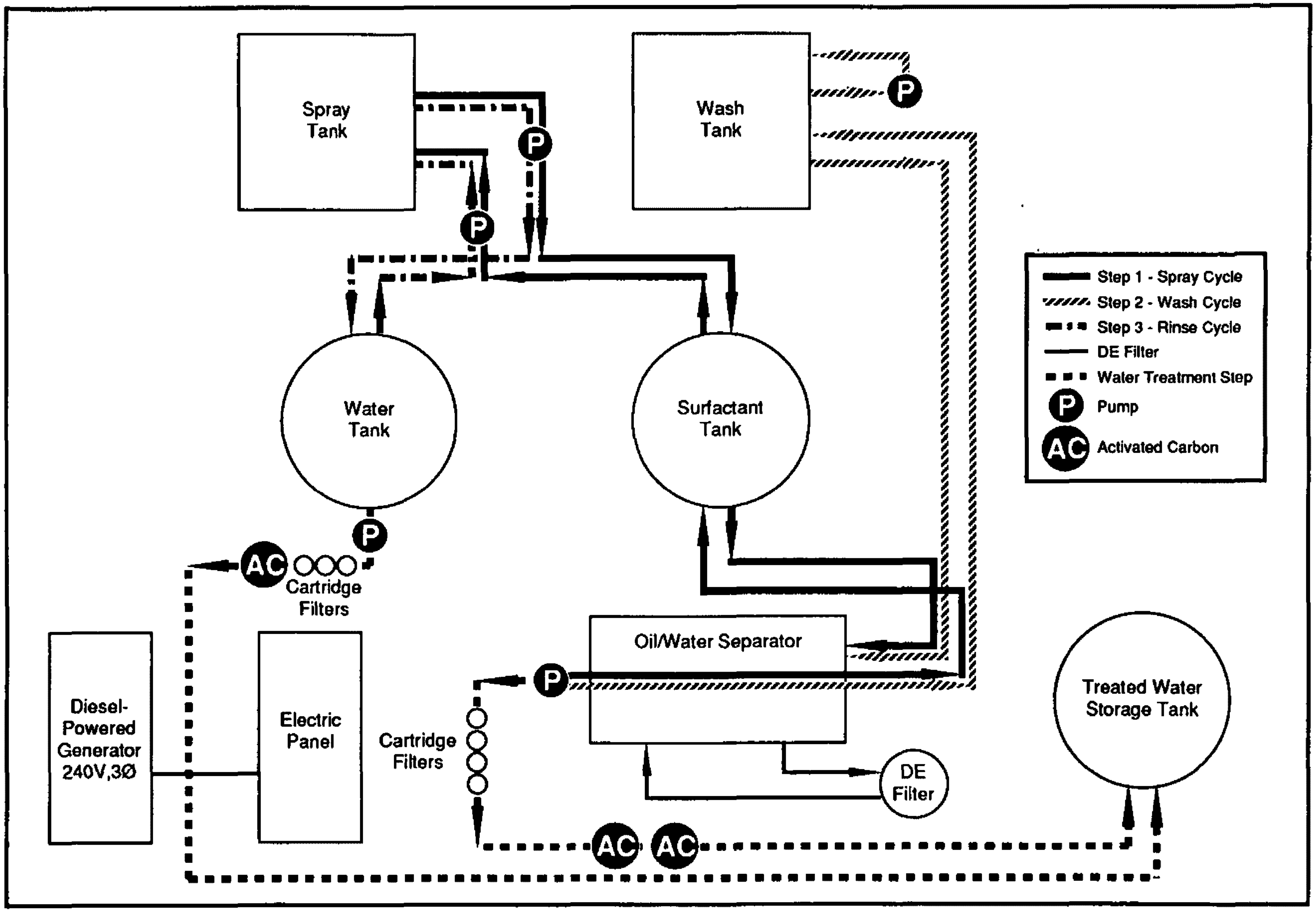

Figure 3. Schematic of pilot-scale Debris Washing System.

However, no airborne hydrogen cyanide was detected during operation of the DWS (Draeger Tubes were used to assess airborne cyanide concentrations). Personnel donned Level C protective gear while working near the contaminated drums.

As stated above, surface wipes were obtained using the same method as described for assessing PCB contamination. The Dicamba and benzonitrile in the surface wipes were quantitated using SW 846 analytical methods. Dicamba was extracted from the gauze wipes using Method 3540 and quantitated using Method 8150. Benzonitrile was extracted using Method 3540 and concentrations in the extracts were measured using SW 846 Method 8270.

RESULTS

The results obtained during this demonstration are summarized in Tables 1 and 2. The data provide an indication of the effectiveness of the DWS technology for removing a pesticides and a related contaminant (benzonitrile) from the internal surfaces of excavated drums. Pretreatment concentrations of benzonitrile in surface-wipe samples ranged from 8 to 47,000 µg/100 cm^2 and averaged 4556 µg/100 cm^2. Posttreatment levels of benzonitrile ranged from below detection limit to 117 µg/100 cm^2 and averaged 10 µg/100 cm^2. Pretreatment Dicamba values ranged from below detection limit to 180 µg/100 cm^2 and averaged 23 µg/100 cm^2, whereas posttreatment concentrations ranged from below detection limit to 5.2 µg/100 cm^2 and averaged 1 µg/100 cm^2.

Upon completion of the treatment, the spent surfactant solution and rinse water were treated in the water treatment system, where they were passed through a series of particulate filters, and then through activated-carbon drums. The treated water was temporarily stored in a 1000-gallon polyethylene tank pending analysis. The before- and after-treatment water samples were collected and analyzed for benzonitrile and Dicamba. The concentration of benzonitrile in the pretreatment water samples was 250 and 400 µg/L (analyzed in duplicate), and the posttreatment concentration was below the detection limit of 5 µg/L. The concentration of Dicamba in the pretreatment samples was 6800 and 6500 µg/L (analyzed in duplicate), and the posttreatment concentration was estimated to be 630 µg/L (value estimated due to matrix interferences).

Because the concentration of Dicamba in the posttreated water sample was 630 µ/L, the treated water stored in the polyethylene holding tank was pumped into an onsite water-treatment system for further treatment before its discharge into a nearby creek. Although the concentration of Dicamba in posttreatment water was an estimated value, it was decided to send the water to the onsite water-treatment system prior to discharge as a precautionary measure.

The test equipment was decontaminated with a high-pressure wash. The wash water generated during this decontamination was collected and pumped into the onsite water-treatment system. The system and the enclosure were disassembled and transported back to Cincinnati in a semitrailer.

Batch Number	Sample Number	Benzonitrile	
		Pretreatment	Posttreatment
1	1	180[a] (50)[b]	ND[c]
	2	130[a] (50)	ND
2	1	125	117
	2	90	7.8[a] (5)
3	1	43	ND
	2	28	ND
4	1	4400	ND
	2	2700	ND
5	1	47000	10[a] (5)
	2	22000	7.9[a] (5)
6	1	10[a] (5)	ND
	2	8[a] (5)	ND
7	1	200	ND
	2	320	10[a] (5)
8	1	1400	28
9	1	3000	ND
	2	3500	7[a] (5)
10	1	22[a] (5)	ND
	2	1400	ND

a Estimated result less than 5 times detection limit.

b Numbers in parentheses indicate the minimum detectable concentration of the analyte.

c None detected in excess of the minimum detectable concentration of 5 µg/100cm² unless otherwise specified.

Table 1. Results obtained in analyzing surface wipe samples for Benzonitrile (µg/100 cm^2).

Batch Number	Sample Number	Dicamba	
		Pretreatment	Posttreatment
4	1	1.9	0.63[a] (0.27)[b]
	2	3.4	ND
5	1	ND[c]	ND
	2	ND	2.6
6	1	ND (2.7)	ND
	2	ND (2.7)	ND (2.7)
7	1	7.3[a] (2.7)	1.8
	2	15	2.3
8	1	55	5.7[a] (2.7)
	2	13	0.62[a] (0.27)
9	1	1.7	0.63[a] (0.27)
	2	ND (2.7)	ND
10	1	41	0.30[a] (0.27)
	2	180	0.34[a] (0.27)

a Estimated result less than 5 times detection limit.
b Numbers in parentheses indicate the minimum detectable concentration of the analyte.
c None detected in excess of the minimum detectable concentration of Dicamba at 0.27 unless otherwise specified.

Table 2. Results obtained in analyzing surface wipe samples for Dicamba ($\mu g/100\ cm^2$).

FULL-SCALE DEBRIS WASHING SYSTEM: CONCEPTUAL DESIGN

This section describes the conceptual design of a full-scale version of the DWS, which is based upon results obtained during bench- and pilot-scale work. The lessons learned from these latter development stages are incorporated into the full-scale design, and the elements that worked well have been retained. Figure 4 presents a schematic block diagram of the full-scale DWS.

The debris will be loaded in a cylindrical basket, lifted by a crane, and lowered into the wash/spray/rinse tank, in which the basket will rotate. The debris will then be washed and sprayed with hot surfactant solution and finally rinsed with clean water. A small bleed stream will be sent to the water treatment system to recondition the surfactant solution while the process is in progress.

The full-scale system will be about 3 1/2 times (1000-gallon) the capacity of the pilot-scale DWS and will be permanently mounted on two 48-ft flat-bed trailers. The system will be semiautomatic and will be capable of cleaning 3 to 5 tons of debris per 8-hour day.

CONCLUSIONS

Field-test results reported in this paper and previously obtained using the pilot-scale transportable DWS showed the unit to be highly reliable and rugged. Extreme high ambient temperatures had little effect on the operation of the equipment. The system was successfully previously used to remove PCBs from transformer casing surfaces and in this present demonstration was shown to be efficacious for removing certain pesticide and herbicide residues from drum surfaces. Although the system has not been proven effective for removal of all types of organic contaminants from the surfaces of debris, results obtained to date are considered promising.

The cleaning solution was recovered, reconditioned, and reused during the actual debris-cleaning process, which minimized the quantity of process water required for the decontamination procedure. The water treatment system was effective in reducing contaminant concentrations to below the detection limit.

The planned progression of this U.S. EPA-developed technology is continuing with design, development, and demonstration of a full-scale, transportable version of the DWS unit.

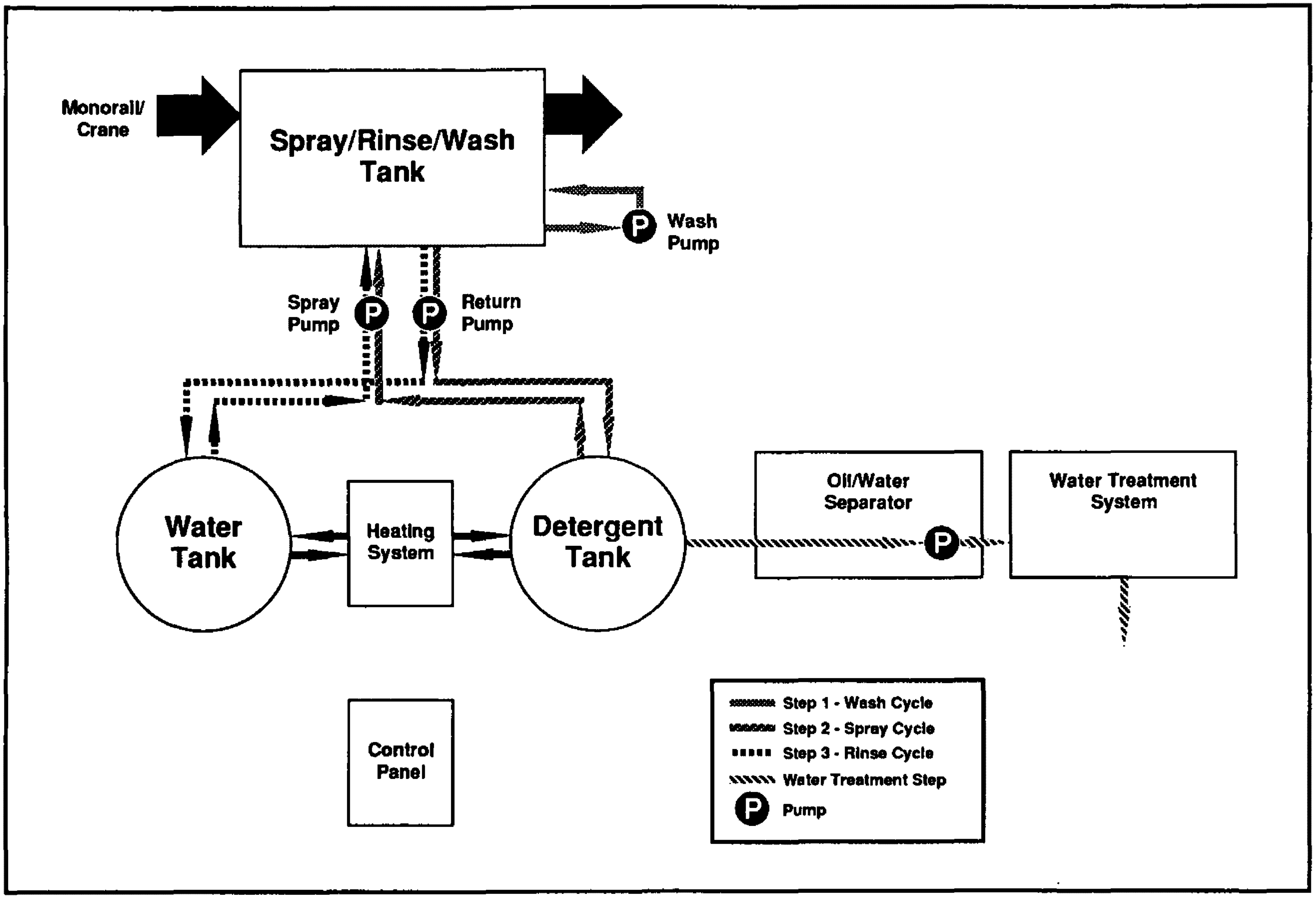

Figure 4. Schematic diagram of full-scale Debris Washing System.

REFERENCES

1) Taylor, M. L., Dosani, M.A., Wentz, J.A., et al. "Results of Field Demonstration of Debris Washing System," Presented at the 2nd Forum on Innovative Hazardous Waste Treatment Technologies: Domestic and International, Philadelphia, PA, May 1990.

2) Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup, U. S. Environmental Protection Agency, EPA 560/5-86/017, May 1986.

3) Standard Operating Safety Guides, Office of Emergency and Remedial Response, Hazardous Response Support Division, Edison, NJ, November 1984.

ACKNOWLEDGMENTS

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