

**Remediation Assessment
130 Liberty Street Property**

**Technical Memorandum
*R3: Ductwork Remediation***

Report Date: May 2004

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Technical Memorandum

R3: Ductwork Remediation

Summary

As a result of the collapse of the World Trade towers ("WTC Event"), the building located at 130 Liberty Street, New York, NY (the "Building") was contaminated with WTC Dust and WTC Hazardous Substances.¹ WTC Dust and WTC Hazardous Substances penetrated the Building and permeated its systems, including the Heating Ventilation and Air Conditioning (HVAC) ductwork.² Three methods for remediating the HVAC ductwork were evaluated in this study: the method used by the Insurers' environmental contractors; a wet method using a mixture of chemicals targeted specifically at the analytes of concern; and a dry method as approved by the National Air Duct Cleaning Association ("NADCA"). All remediation methods studied failed to reduce concentrations of WTC Hazardous Substances below Appropriate Levels.³ This technical memorandum reports the findings of the experts.

Key Findings

- Remediation methods employed by the Insurers' contractors failed to reduce concentrations of WTC Hazardous Substances in the HVAC ductwork to at or below applicable Appropriate Levels.
- Wet remediation methods failed to reduce concentrations of WTC Hazardous Substances in the HVAC low or high pressure ductwork to at or below Appropriate Levels.
- The dry remediation method approved by NADCA⁴ failed to reduce concentrations of WTC Hazardous Substances in low-pressure ductwork to at or below Appropriate Levels.

¹ RJ Lee Group, All Contamination Reports, December, 2003.

² RJ Lee Group, "Supplement to CR01: Ductwork Interior," May, 2004.

³ Center for Toxicology and Environmental Health, "Determination of Appropriate Levels for Surfaces in the Building," December, 2003.

⁴ National Air Duct Cleaners Association (NADCA), "General Specifications for the Cleaning of Commercial Heating, Ventilating and Air Conditioning Systems," Washington D.C. 2002.

Conclusion

Ductwork is a key component in preserving the overall health of the Building because it circulates air throughout the Building connecting spaces and floors. Because of their function, failure to completely remediate the ducts would likely result in recontamination of the entire Building.

Three methods were tested: the method used by the Insurers' environmental contractors, a wet method using chemicals specifically targeted at the analytes of concern, and a dry method approved by the NADCA. The methods were not effective in reducing WTC Hazardous Substances to at or below Appropriate Levels.

Based upon studies to date, the number of remediation attempts required for effective remediation using any of the three methods tested was not able to be determined. If full scale remediation were employed using any of the three methods tested, portals would have to be cut into the ductwork every four to six feet in order to gain access for remediation and post remediation testing. Over the approximately 30 miles of ductwork in the Building, 26,000 to 40,000 holes would have to be cut with the resulting repairs adding additional significant cost.⁵

1.0 Purpose

Prior reports demonstrated that WTC Hazardous Substances are present in the HVAC ductwork in the Building above Appropriate Levels. Review of the literature and industry standards⁴ provided insufficient information on remediation methods for HVAC ductwork given the unique mixture of contaminants in the Building HVAC ductwork. Thus, the HVAC ductwork, which provides a circulating airflow throughout the Building, needed to be investigated to determine whether it was possible to remediate concentrations of WTC Hazardous Substances below Appropriate Levels.

⁵ Deloitte & Touche, "Damage Matrix: 130 Liberty Street," May, 2004.

2.0 Description of System

HVAC ductwork in the Building is identified according to certain characteristics: ductwork may be high pressure or low pressure, lined or unlined, and made flexible or rigid. High pressure ductwork delivers conditioned air to the perimeter induction units; low pressure ductwork delivers conditioned air to the interior of the Building. Unlined ductwork, as its name denotes, is absent any interior liner, and represents the majority of the ductwork in the Building. Unlined high and low pressure ductwork were investigated in this study.

Lined ductwork has a fiberglass insulating material lining its interior walls. Per NADCA,⁴ lined ductwork cannot be cleaned using wet methods because wet methods will result in damage to the lining rendering it unusable. Because of this lining, and because it only represents a fraction of the total ductwork in the Building, lined ductwork was not investigated in this study.

Flexible ductwork used to connect to air terminals (either perimeter induction units or diffusers) was not investigated because it represents a small portion of the total Building ductwork and it would likely be damaged by any remediation attempt.

High Pressure Ductwork. High pressure ductwork investigated in this study is manufactured as a long, continuous cylinder with a spiral seam and is used for high pressure HVAC ductwork systems, shown in Figure 1. Only straight, unlined sections were investigated because these sections were deemed easiest to clean by the contractors.



Figure 1. High pressure ductwork.

Low Pressure Ductwork. Low pressure ductwork used in this study consisted of rectangular fabricated metal ductwork that is manufactured in sections and assembled on site using a system of metal fasteners to connect the sections together (Figure 2). Only straight, unlined sections were investigated because these sections were deemed easiest to clean by the contractors.



Figure 2. Low pressure ductwork.

3.0 Procedure

Three methods were investigated in this study: the Insurers' contractors' method; a wet remediation method using chemicals specifically targeted at the analytes of concern; and a dry remediation method approved by the NADCA. In this report, ductwork remediation tests will be referred to as the "Insurers' method"; the "wet method"; and the "dry method".

Insurers' Method. The Insurers' contractors attempted to remediate unlined, low pressure HVAC ductwork on floors 7 and 26 of the Building. The Bank's contractors did not participate in the Insurers' remediation tests; however, they observed the Insurers' remediation methods and sampled the ductwork at the completion of the Insurers' tests. The Insurers' remediation methods were observed to consist of the following practices:

- Cutting a series of holes in the bottom of the ductwork to access the ductwork interior.
- HEPA vacuuming the interior ductwork surface.
- Wet wiping the interior ductwork surface.
- Visually inspecting the ductwork to determine if further remediation was required.

Wet Remediation Method. Two wet remediation tests were conducted by the Bank's contractors. One test was conducted using an existing test cell with a 20-foot straight section of high pressure ductwork and another test was conducted using a 20-foot straight section of low pressure ductwork in the same cell. The cell was located on the 14th floor of the Building. The lengths of ductwork chosen provided sufficient area to permit a series of remediation passes followed by sampling. A remediation pass is one complete cycle of the remediation sequence described later in this section.

Holes were cut into the sides of the ductwork (Figure 3) every four feet to gain access to the interior surfaces (Figure 5).

A pre-mixed, commercially available, water-based chemical cleaning formulation was used for the wet-remediation method. This formulation consisted of the following products:

- HgCS-102⁶
- HMCS-101⁷
- Pipe X-Metal X⁸

This formulation was chosen based on the chemical properties that aid in the removal of heavy metals, particularly mercury, and organic contaminants such as dioxins. The wet procedure additionally helped to control the release of dust.



Figure 3. Access to interior surfaces of high pressure ductwork.

All remediation activities were conducted within a controlled test cell. As a further precaution to prevent contamination from other areas of the Building, the HVAC ductwork was maintained at a positive pressure relative to the test cell during the remediation activities.

Each remediation attempt using the wet method included the following steps:

- Spray chemical solution to thoroughly wet all test surfaces

⁶ Hg Cleaning Solution-102 or HgCS-102, (Catalog #RP-103), Chemical Solution International Corporation, Houston TX.

⁷ HCMS-101, (Catalog #RP-104), Chemical Solution International Corporation, Houston TX.

⁸ Pipe X-Metal X, (Catalog #RP-102), Chemical Solution International Corporation, Houston TX.

- Surfaces remain wet for 15 minutes
- Hand-wipe surface
- HEPA vacuum to dry surface
- Spray rinse with potable water to thoroughly wet all test surfaces
- HEPA vacuum and wipe dry

The remediation attempt was repeated four times on the same section of ductwork for both high and low pressure.

There were 5 sampling events: *Pre-Remediation* and *Post-Remediation 1, 2, 3, and 4* corresponding to its respective remediation attempt.

Dry Remediation Method. A dry remediation test consisted of disassembling low pressure ductwork from floor 38 of the Building, collecting pre-test samples and reassembling the ductwork in an existing remediated test enclosure on floor 26. A 40-foot section of ductwork was placed on scaffolding at a level of approximately five feet from the floor in order to allow for easy access and remediation.

As per NADCA specification ACR 2002,⁴ the following remediation steps were performed:

1. The low pressure ductwork was placed under negative pressure in a test enclosure.
2. Remediation of the exterior ductwork occurred utilizing direct contact dry HEPA vacuum methods.
3. After the exterior was visibly clean by contact vacuuming, wipe and lift samples were collected. These samples are identified as Exterior Post-Remediation 1 in the applicable tables in the Results section of this report.
4. The exterior ductwork was then remediated again utilizing wet-wipe methods (using a household all-purpose cleaning solution).
5. Wipe and lift samples were collected again on the exterior ductwork. These samples are identified as Exterior Post-Remediation 2 in the applicable tables in the Results section of this report.

6. The interior ductwork was again placed under negative pressure.
7. Branch runs were removed and holes were sealed with poly and duct tape to ensure adequate negative pressure and airflow.
8. Additional access holes, approximately 6' apart were made for access (Figure 4).
9. Remediation of the interior ductwork occurred utilizing direct contact dry HEPA vacuuming methods.
10. Wipe and lift samples were collected on the interior ductwork. These samples are identified as Interior Post-Remediation 1 in the applicable tables in the Results section of this report.
11. The interior ductwork was remediated a second time utilizing direct contact dry HEPA vacuuming.
12. Wipe and lift samples were collected after the second HEPA vacuum on the interior ductwork. These samples are identified as Interior Post-Remediation 2 in the applicable tables in the Results section of this report.



Figure 4. An opening is cut to gain access to the interior surfaces of low pressure ductwork.

4.0 Results

Insurers' Remediation Method. Insurers' remediation method failed to reduce concentrations of WTC Hazardous Substances in the HVAC ductwork below Appropriate Levels as shown in Table 1.

Table 1. Analyte Concentrations after Employing Insurers' Contractors' Remediation Method.

Analyte	Sample Count	Concentration*		Appropriate Level (same units as row)	
		Average	Maximum	Average	Maximum
Asbestos (S/cm ²)	7	47,899	287,759	156	801
Cadmium (µg/ft ²)	6	3.4	13.6	0.15	0.94
Lead (µg/ft ²)	8	101	483	1.82	9.46
Mercury (µg/ft ²)	5	1.12	4.95	0.011	0.067
Dioxins TEQ (pg/100 cm ²)	9	18	159	0.25	1.83
PCBs (µg/100 cm ²)	11	0.013	0.14	0.001	0.01
PNA's (µg/100 cm ²)	11	0.111	1.18	0.035	0.29
Total Dust (g/m ²)	15	0.075	0.876	N/A	N/A

N/A: No Applicable Appropriate Levels for Total Dust

**For the purpose of comparison of values against Appropriate Levels, samples with a result of non detect which did not achieve the target detection limit of one-half the Appropriate Level were excluded from the computation of averages*

- Post-remediation asbestos levels exceed the Average and Maximum Appropriate Levels for asbestos by factors of 195 and 360, respectively.
- Post-remediation lead levels exceed the Average and Maximum Appropriate Levels for lead by factors of 37 and 51, respectively.
- Post-remediation mercury levels exceed the Average and Maximum Appropriate Levels for mercury by factors of 46 and 74, respectively.
- Post-remediation dioxins levels exceed the Average and Maximum Appropriate Levels for dioxins by factors of 72 and 360, respectively.

Wet Remediation Methods. Table 2 provides the analytical results for asbestos on high pressure and low pressure ductwork following each remediation attempt. High pressure and low pressure ductwork asbestos concentrations, following the second remediation attempt, were higher than those obtained following the first remediation attempt. This is attributed to a combination of variability in dust loading, remediation effectiveness and the release of asbestos from crevices and other surface characteristics which impact the remediation process.

Table 2. Asbestos Remediation Summary.

	Asbestos	Concentration* (S/cm ²)	Appropriate Level (S/cm ²)	
			Average	Maximum
High Pressure Ductwork	Pre-Remediation	382,700	156	801
	Post-Remediation 1	10,430	156	801
	Post-Remediation 2	173,900	156	801
	Post-Remediation 3	201,000	156	801
	Post-Remediation 4	47,100	156	801
Low Pressure Ductwork	Pre-Remediation	163,900	156	801
	Post-Remediation 1	14,580	156	801
	Post-Remediation 2	52,860	156	801
	Post-Remediation 3	2,500	156	801
	Post-Remediation 4	90	156	801

**For the purpose of comparison of values against Appropriate Levels, samples with a result of non detect which did not achieve the target detection limit of one-half the Appropriate Level were excluded from the computation of averages*

Note that after four remediation attempts, the high pressure ductwork surface contains asbestos that remains above Appropriate Levels.

Table 3 provides the analytical results for mercury on high pressure and low pressure ductwork following each remediation attempt. The concentrations measured following the third remediation attempt on the high pressure ductwork was 32 times higher than that obtained following the third remediation attempt in the low pressure ductwork.

Table 3. Mercury Remediation Summary.

	Mercury	Concentration ($\mu\text{g}/\text{ft}^2$)	Appropriate Level ($\mu\text{g}/\text{ft}^2$)	
			Average	Maximum
High Pressure Ductwork	Pre-Remediation	3.39	0.011	0.067
	Post-Remediation 1	0.63	0.011	0.067
	Post-Remediation 2	0.48	0.011	0.067
	Post-Remediation 3	0.32	0.011	0.067
	Post-Remediation 4	0.09	0.011	0.067
Low Pressure Ductwork	Pre-Remediation	0.4	0.011	0.067
	Post-Remediation 1	0.03	0.011	0.067
	Post-Remediation 2	*	0.011	0.067
	Post-Remediation 3	0.01	0.011	0.067
	Post-Remediation 4	*	0.011	0.067

**For the purpose of comparison of values against Appropriate Levels, samples with a result of non detect which did not achieve the target detection limit of one-half the Appropriate Level were excluded from the computation of averages*

Note that after four remediation attempts, one of two surfaces tested has mercury that remains above the Appropriate Level.

Table 4 provides the analytical results for cadmium on high pressure and low pressure ductwork following each remediation attempt. The concentrations measured following the third remediation attempt in high pressure ductwork was higher than that obtained following the second remediation attempt. This is attributed to a combination of variability in dust loading, remediation effectiveness and the release of asbestos from crevices and other surface characteristics which impact the remediation process.

Table 4. Cadmium Remediation Summary.

	Cadmium	Concentration ($\mu\text{g}/\text{ft}^2$)	Appropriate Level ($\mu\text{g}/\text{ft}^2$)	
			Average	Maximum
High Pressure Ductwork	Pre-Remediation	40	0.15	0.94
	Post-Remediation 1	8.7	0.15	0.94
	Post-Remediation 2	10.3	0.15	0.94
	Post-Remediation 3	23	0.15	0.94
	Post-Remediation 4	0.3	0.15	0.94
Low Pressure Ductwork	Pre-Remediation	14.1	0.15	0.94
	Post-Remediation 1	0.8	0.15	0.94
	Post-Remediation 2	0.3	0.15	0.94
	Post-Remediation 3	*	0.15	0.94
	Post-Remediation 4	0.1	0.15	0.94

**For the purpose of comparison of values against Appropriate Levels, samples with a result of non detect which did not achieve the target detection limit of one-half the Appropriate Level were excluded from the computation of averages*

Note that after four remediation attempts, one of two surfaces tested has cadmium that remains above the Appropriate Level.

Table 5 provides the analytical results for lead on high pressure and low pressure ductwork following each remediation attempt. The concentrations measured following the fourth remediation attempt in low pressure ductwork was higher than that obtained following the third remediation attempt. This is attributed to a combination of variability in dust loading, remediation effectiveness and the release of asbestos from crevices and other surface characteristics which impact the remediation process.

Table 5. Lead Remediation Summary.

	Lead	Concentration* ($\mu\text{g}/\text{ft}^2$)	Appropriate Level ($\mu\text{g}/\text{ft}^2$)	
			Average	Maximum
High Pressure Ductwork	Pre-Remediation	855	1.82	9.46
	Post-Remediation 1	109	1.82	9.46
	Post-Remediation 2	29.3	1.82	9.46
	Post-Remediation 3	25.4	1.82	9.46
	Post-Remediation 4	5.82	1.82	9.46
Low Pressure Ductwork	Pre-Remediation	334	1.82	9.46
	Post-Remediation 1	42.4	1.82	9.46
	Post-Remediation 2	14.7	1.82	9.46
	Post-Remediation 3	7.44	1.82	9.46
	Post-Remediation 4	10.3	1.82	9.46

**For the purpose of comparison of values against Appropriate Levels, samples with a result of non detect which did not achieve the target detection limit of one-half the Appropriate Level were excluded from the computation of averages*

Note that after four remediation attempts, two of two surfaces tested has lead that remains above the Appropriate Level.

Table 6 provides the analytical results for dioxins/furans on high pressure and low pressure ductwork following each remediation attempt. The concentrations measured following the fourth remediation attempt in high pressure ductwork was higher than that obtained following the third remediation attempt. This is attributed to a combination of variability in dust loading, remediation effectiveness and the release of asbestos from crevices and other surface characteristics which impact the remediation process.

Table 6. Dioxins/Furans TEQ Remediation Summary

	Dioxins/Furans	Concentration (pg/100 cm ²)	Appropriate Level (pg/100 cm ²)	
			Average	Maximum
High Pressure Ductwork	Pre-Remediation	39.4	0.25	1.83
	Post-Remediation 1	1.3	0.25	1.83
	Post-Remediation 2	0.05	0.25	1.83
	Post-Remediation 3	0.22	0.25	1.83
	Post-Remediation 4	0.4	0.25	1.83
Low Pressure Ductwork	Pre-Remediation	63.3	0.25	1.83
	Post-Remediation 1	0.09	0.25	1.83
	Post-Remediation 2	0	0.25	1.83
	Post-Remediation 3	0	0.25	1.83
	Post-Remediation 4	0	0.25	1.83

Note that after four remediation attempts, one of two surfaces tested has dioxins/furans that remains above the Appropriate Level.

Additionally, sampling of a section of unlined, low pressure ductwork was performed by removing it from Floor 14 of the Building after remediation tests had been completed. The section was then shipped to RJ Lee Group for sampling of the ductwork joints. This portion of ductwork was remediated twice using the wet wipe procedure. The results of the analysis identified the presence of WTC Dust Markers, including asbestos, in the ductwork joints.

Dry Remediation Results. Dry remediation tests were conducted on low pressure ductwork from the 38th floor and witnessed by a certified NADCA member.⁹

Table 7 through Table 10 provide the analytical results for each analyte on ductwork interior and ductwork exterior following each remediation attempt. There were three locations for ductwork testing; the average of the three samples is reported.

Table 7 shows the average concentrations of asbestos on the ductwork interior and exterior surfaces following each remediation attempt. After two remediation attempts, both surfaces tested have asbestos levels that remain above the Appropriate Level.

Table 7. Asbestos Remediation Summary.

	Asbestos	Concentration* ($\$/\text{cm}^2$)	Appropriate Level ($\$/\text{cm}^2$)	
			Average	Maximum
Ductwork Interior	Pre-Remediation	7,727,000	156	801
	Post-Remediation 1	176,000	156	801
	Post-Remediation 2	15,100	156	801
Ductwork Exterior	Pre-Remediation	11,460,000	156	801
	Post-Remediation 1	59,600	156	801
	Post-Remediation 2	9,700	156	801

**For the purpose of comparison of values against Appropriate Levels, samples with a result of non detect which did not achieve the target detection limit of one-half the Appropriate Level were excluded from the computation of averages*

⁹ National Air Technologies USA, LLC, "Report on Results of Remediation Test RS-55 Performed at 130 Liberty Street NY, NY," Draft. March 24, 2004.

Table 8 provides the analytical results for mercury on the ductwork interior and exterior surfaces following each remediation attempt. After two remediation attempts, both surfaces tested have mercury levels that remain above the Appropriate Level.

Table 8. Mercury Remediation Summary.

	Mercury	Concentration* ($\mu\text{g}/\text{ft}^2$)	Appropriate Level ($\mu\text{g}/\text{ft}^2$)	
			Average	Maximum
Ductwork Interior	Pre-Remediation	5.88	0.011	0.067
	Post-Remediation 1	0.57	0.011	0.067
	Post-Remediation 2	0.29	0.011	0.067
Ductwork Exterior	Pre-Remediation	6.46	0.011	0.067
	Post-Remediation 1	0.34	0.011	0.067
	Post-Remediation 2	0.09	0.011	0.067

**For the purpose of comparison of values against Appropriate Levels, samples with a result of non detect which did not achieve the target detection limit of one-half the Appropriate Level were excluded from the computation of averages*

Table 9 provides the analytical results for lead on the ductwork interior and exterior surfaces following each remediation attempt. After two remediation attempts, both surfaces tested have lead levels that remain above the Appropriate Level.

Table 9. Lead Remediation Summary.

	Lead	Concentration* ($\mu\text{g}/\text{ft}^2$)	Appropriate Level ($\mu\text{g}/\text{ft}^2$)	
			Average	Maximum
Ductwork Interior	Pre-Remediation	2,170	1.82	9.46
	Post-Remediation 1	190	1.82	9.46
	Post-Remediation 2	70	1.82	9.46
Ductwork Exterior	Pre-Remediation	1,020	1.82	9.46
	Post-Remediation 1	100	1.82	9.46
	Post-Remediation 2	31	1.82	9.46

**For the purpose of comparison of values against Appropriate Levels, samples with a result of non detect which did not achieve the target detection limit of one-half the Appropriate Level were excluded from the computation of averages*

Table 10 provides the analytical results for cadmium on the ductwork interior and exterior surfaces following each remediation attempt. After two remediation attempts, both surfaces tested have cadmium levels that remain above the Appropriate Level.

Table 10. Cadmium Remediation Summary.

	Cadmium	Concentration* ($\mu\text{g}/\text{ft}^2$)	Appropriate Level ($\mu\text{g}/\text{ft}^2$)	
			Average	Maximum
Ductwork Interior	Pre-Remediation	134.7	0.15	0.94
	Post-Remediation 1	26.0	0.15	0.94
	Post-Remediation 2	13.0	0.15	0.94
Ductwork Exterior	Pre-Remediation	42.8	0.15	0.94
	Post-Remediation 1	1.3	0.15	0.94
	Post-Remediation 2	0.4	0.15	0.94

**For the purpose of comparison of values against Appropriate Levels, samples with a result of non detect which did not achieve the target detection limit of one-half the Appropriate Level were excluded from the computation of averages*

Table 11 provides the analytical results for the presence of WTC Hazardous Substances on the ductwork interior and exterior surfaces following each remediation attempt. After two remediation attempts, both surfaces test positive for WTC Dust.

Table 11. Dust Characterization, frequency of WTC Dust Positive.

Dust Characterization		WTC Dust Presence	Percentage WTC Positive
Ductwork Interior	Pre-Remediation	3 of 3	100
	Post-Remediation 1	3 of 3	100
	Post-Remediation 2	2 of 3	67
Ductwork Exterior	Pre-Remediation	3 of 3	100
	Post-Remediation 1	3 of 3	100
	Post-Remediation 2	1 of 3	33

5.0 Discussion

Ductwork presents certain challenges to remediation because of its construction. Joints and seams in both high and low pressure ductwork result in crevices that make the ductwork even more difficult to remediate. Bends and turns as well as transition sections and fittings result in hidden and hard to reach surfaces that present additional challenges to remediation. Unremediated duct work will act as a reservoir that will continue to recontaminate the Building over time.

The testing summarized within this report represents best-case conditions on surfaces far less complex than would typically be encountered in full-scale remediation. The test sections did not include transition pieces, angled or curved pieces, turning vanes, dampers, or reheat coils. The tests were also carried out in this study under controlled conditions with enclosure construction to ensure against cross-contamination. Therefore, the results are expected to be less favorable if full scale remediation attempts were employed.

An additional consideration is that the means employed of gaining access to the surfaces in this test would be impractical in a full remediation program. The time and cost required to provide openings in the ductwork for remediation and post-remediation testing as well as the follow-up costs of repairing the openings would likely exceed that of replacing the ductwork.⁵ The total linear feet of ductwork is estimated to be approximately 159,500 feet. Access portals every 4 to 6 feet would require that 26,000 to 40,000 openings would need to be created.

The Insurers' method on unlined ductwork failed to reduce WTC Hazardous Substances to below Appropriate Levels. Wet remediation methods were conducted on a limited amount of ductwork and only on flat surfaces. Further, the testing did not consider variability in surface dust loading throughout the Building.

Remediation reagents have the potential of leaving residual compounds in the ductwork system after remediation. These residual compounds left behind from reagents require further investigation prior to recommending any reagent for use in ductwork systems used to supplying conditioned air.

The results of dry remediation testing show that two remediation attempts conducted in a remediated test cell were not sufficient in reducing WTC Hazardous Substances below Appropriate Levels despite the fact that remediation was performed under NADCA guidelines.

