Dual Advanced Remedial Technologies (ISCO & ERH) for Chlorinated Solvent Remediation

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Joseph D. Diener, E.E., Surendra B. Joshi, P.E., and Victor Owens, P.E.
Aeronautical Systems Center, U.S. Air Force, Agile Combat Support Directorate, Acquisition Environmental & Industrial Facilities Division (ASC/WNV)

ABSTRACT

Two advanced remedial technologies for the interim corrective measure (ICM) of chlorinated solvents in one aircraft hangar were driven by complex site infrastructure, tight underlying clay soils, and an extremely aggressive renovation schedule. The B-84 hangar defense aircraft manufacturing facility housed a classified aircraft program. A release of tetrachloroethene (PCE), trichloroethene (TCE), and 1,1,1-trichloroethane (111TCA) was identified at a former parts cleaning area containing a sump pit. There were extensive soil and groundwater investigations, delineation, and treatability studies. Soil removal and soil vapor extraction were not viable remedies. The hangar was divided into two source areas: the parts cleaning sump pit and the hangar door area. Lockheed consultation occurred with the Air Force (AF), the state regulatory agency, and outside engineers for the unique dual advanced remedial technologies. The remediation six-month window of opportunity required extensive hangar renovations. In-situ chemical oxidation (ISCO) with potassium permanganate through direct soil blending was selected for the hangar door area. Electrical resistance heating (ERH), six phase thermal treatment system was selected for the sump pit/parts cleaning area with structural and utility constraints. Design and implementation encompassed a team of Air Force Compliance/Restoration, Lockheed Facilities Engineering, and Environmental Remediation. Through active planning, assertive oversight, and early buy-in from state regulators, ICM was implemented safely, in compliance with regulatory requirements and on schedule. Approximately 1,756 cubic yards of impacted soil, depth 15 feet, was treated with potassium permanganate and resulted in 99% reduction of chlorinated solvents (pre-treatment average concentration of 3,561 ppb to post-treatment average concentration of 41 ppb). Approximately 3,163 cubic yards of impacted soil, depth 20 feet, was treated with ERH, resulting in 99% (pre-treatment concentration of 848,000 ppb to post-treatment concentration of <500 ppb). Cost: $2.5M. Soil Volume: 4,919 cubic yards, depth 20 feet. Schedule: Remediation (6 months), Renovation (8 to 12 months).

INTRODUCTION

The project was completed at Air Force Plant 6 (AFP 6), in a government-owned (Air Force) contractor-operated (Lockheed Martin Aeronautics Company in Marietta, Georgia) defense facility at building B-84. The remediation of volatile organic compounds (VOCs)-contaminated soil was preceded by the 2007-08 investigation and remediation study. The project was implemented to comply with the environmental requirement, which had the site listed as a Solid Waste Management Unit (SWMU 37) on the Resource Conservation and Recovery Act Part B

Permit of the Hazardous Waste Facility Permit. Development of these plans for corrective action is required under the permit. Remediation corrective action is to comply with applicable local and national codes, the Environmental Protection Agency, and requirements of the Georgia Environmental Protection Division.

The parts cleaning operation in building B-84 was taken out of service in 1986. The spill release was believed to have occurred post-1984 (1985-86). There were soil and groundwater investigations of the SWMU performed in 2003, 2004, 2005, and 2006. The extent of VOC soil contamination was approximately 70 feet by 40 feet and 20 feet thick. The extent of VOC groundwater contamination resulting from the soil contamination was a plume approximately 475 feet long, 300 feet wide, and the average saturated aquifer thickness was 30 feet. The groundwater plume was currently contained. Additional investigation (sampling and delineation) was required from the FY06 study. After AFP 6 lease renewal, ASC/WNV requested that Lockheed submit an FY09 proposal for B-84 Investigation and Remediation. A Corrective Measures Study (CMS) and Corrective Action Plan (CAP), CMS/CAP, was conducted to determine the best method of remediation given the site conditions and site soils. Due to the tight soils and building structure, thermal treatment was recommended for corrective action in and outside B-84 to a depth near groundwater (Figure 1). In 2010, aircraft production

Figure 1 – Site Plan

B-84 Hangar Door Area

B-84 Interior ISCO Area

Door open with soil exposed

schedules were reviewed and changed. As a result, LM Aero identified a narrow window of opportunity to implement source area soil remediation beneath floors and foundations in B-84. This also would include facility building renovation at B-84 concerning roof replacement and expansion area for hangar doors, a new fire suppressant system, and restroom and lighting upgrades. Prior to the shift in aircraft production schedules at B-84, access to the building for soil contamination corrective action was on a limited basis. The Air Force and Lockheed integrated team set in motion an aggressive approach to the window of opportunity by emphasizing the importance of the project. A narrow window of time was available to do the Interim Corrective Measure (ICM) as a result of the building use going from the F-22 aircraft program to the long-term usage of the C-130 retrofitting program. With the compliance/remediation project already on contract, and a direct access window of opportunity opening up, the team began to consider the most efficient and effective way to do the ICM in the time allotted. As a result, with the newly established parameters, it was determined that a second technology (ISCO) could be added, which would be less costly than using one method.

ICM, consisting of ISCO with soil blending combined with ERH, was performed in accordance with the Soil Interim Corrective Measures Plan dated January 3, 2011, with revisions dated February 21, 2011. The corrective action goal for the ICM was to reduce chlorinated compound contamination to the extent possible in source area soil in order to remove a potential continuing cause of groundwater contamination. The ICM Soil Screening Level (SSL) for both PCE and TCE was 500 μg/kg.

BACKGROUND

Building B-84 is located at Air Force Plant 6 and comprises an aircraft modification hangar that was constructed in 1964 of sheet metal and girder superstructure over concrete slab-on-grade. The B-84 Parts Cleaner Sump was located inside the building at the smaller section of the building. A prior use parts cleaning room was constructed as a separate room measuring approximately 15 feet by 30 feet and had grated floor drains within a bermed area of the floor that collected waste fluids (oils and solvents). The former cleaning room was used for cleaning and degreasing of used aircraft parts. Chlorinated solvents (degreasing agents) were used in this room. The chlorinated solvent release occurred because of a leak related to the parts cleaner sump within the former cleaning room. B-84 was converted from servicing existing aircraft to production support for the F-22 Raptor aircraft in 2002. The building interior was remodeled and the interior parts cleaning room was dismantled. When B-84 was involved with production of the F-22, access to the interior of the building was restricted. The F-22 Raptor manufacturing program reached completion in 2011, and the B-84 building is currently designated for use in the C-130J manufacturing program.

Several phases of RCRA Facility Investigation (RFI) at SWMU 37 were performed between 2002 and 2010. In 2010, during preparation for the potential source area soil remediation at building B-84, AEM conducted two phases of additional soil sampling within the building. In early 2011, a RCRA Soil Corrective Measures Study for SWMU 37 was prepared that utilized the available data to delineate two separate areas of proposed ICM soil treatment at the B-84 building.

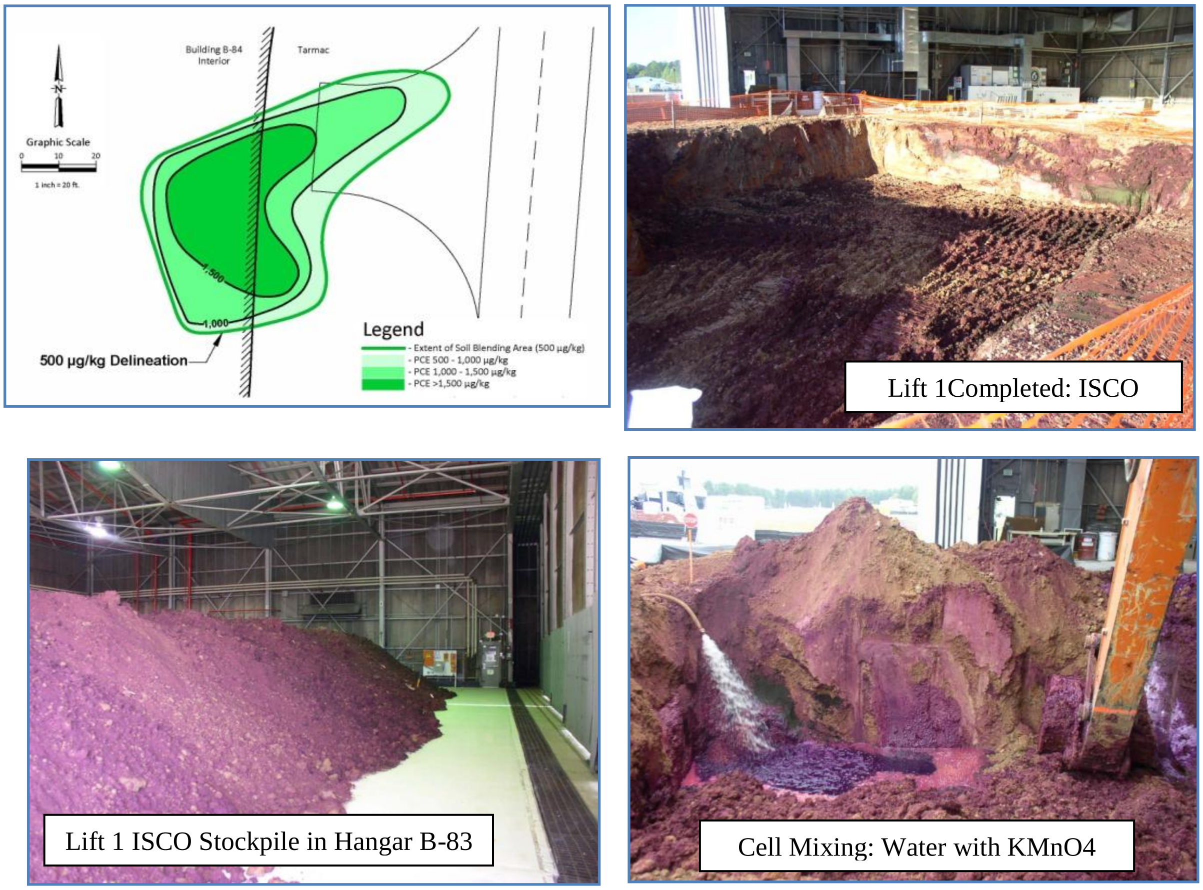
Electrical resistance heating (ERH) was the preferred treatment technology for the soil underlying building structures in the western interior part of building B-84 (orange outline area on Figure 2). This technology was selected because it would avoid potential destabilization of building foundations and it would not adversely impact the load-bearing capacity of the soil

Figure 2 – ERH Treatment Area with Pre-Treatment Soil Sample Results

within the target treatment area. Additionally, the ERH technology was uniquely designed to allow building renovations to continue with worker access, while soil treatment continued below the building slab. ERH Treatment Area with Pre-Treatment Soil Sample results are shown within the 500 µg/kg (micrograms per kilogram) delineation area (Figure 2).

In-situ chemical oxidation (ISCO) with soil blending, chemical drying, and cement re-stabilization was the chosen treatment technology for the eastern part of the building (green outline area on Figure 3). This technology was faster and more cost-effective than ERH. ISCO was feasible because the target treatment area extended inside and outside through the hangar door area. In this area of B-84 the foundation destabilization of the building was not a factor. ISCO Treatment Area with Pre-Treatment Soil Sample results are shown within the 500 µg/kg delineation area (Figure 3).

Figure 3 – ISCO Treatment Area with Pre-Treatment Soil Sample Results



Both the ISCO and ERH technologies could be installed relatively quickly, meeting project scheduling constraints while also providing cost-effective interim remediation of soil.

Simultaneously, with implementation of the ICM, improvements to the B-84 building facility included expansion eastward to accommodate larger aircraft, as well as improvements to the building interior. The available schedule for implementation of the construction phase of the ICM was a window of approximately nine weeks, commencing the first quarter of 2011. During that nine-week time period, the ISCO blending activities were completed and the ERH system equipment was installed, tested, and started. Once B-84 was turned over for renovations, the ERH system continued to operate from outside the construction zone, and construction activities continued on schedule. In accordance with the ICM schedule and to accommodate construction, the ERH was terminated in November 2011 and the aboveground portion of equipment was removed after approximately six months of continuous ERH operation.

Technology Methods

The ICM utilized two remedial technologies that were selected in accordance with the RCRA Soil Corrective Measures Study (CMS) for the specific physical and schedule constraints imposed at B-84. A brief overview of the selected technologies is provided in the following:

ISCO Process

ISCO using a specialized, chemically resistant blending tool attached to an excavator arm was used for mixing oxidant, soil, and water to a depth of 15 feet below surface in the door area and runway apron of the hangar in the east part of the B-84 building. There are no building foundations in this area of the hangar that would interfere with excavation or blending. Blending was selected for this area because it is faster and is lower in cost than ERH.

Potassium permanganate ($KMnO_4$) in granule form was the oxidant used, with a dosage rate of at least 10 grams of $KMnO_4$ per kilogram (kg) of target soil. $KMnO_4$ was selected because it has favorable shipping and handling properties and it is very effective at destroying chlorinated solvents when thoroughly mixed with water and contaminated soil. The blending process results in a thoroughly homogenized and liquefied soil, which then is stabilized using Portland cement and/or quicklime (calcium oxide) before it is suitable as a structural foundation.

ERH Process

ERH was applied to the most highly contaminated soil in the western area of B-84, where other potential contaminant removal methods would result in building structural damage. ERH overcomes natural soil impermeability for vapor removal by transmitting an electrical charge through the soil mass, and it is able to heat a targeted volume of soil without relying solely on heat conduction or convective heat transfer. Heating occurs in much the same manner as an electrical resistant heating element. Recycled water is applied, and electrical power is applied through electrodes until the soil temperature reaches the boiling point of the solvent/water mixture that is trapped in the soil pores and on the particle surfaces. Once the soil pore water reaches boiling temperature, both the water and the solvent slowly vaporize with little propensity to re-adhere to or coalesce on the heated soil. The volatile contaminants are continuously steamed out of the soil and removed by vacuum extraction points installed in the hot zone.

Implementation Sequence

LM Aero contracted with TRS Group, Inc. (TRS), Redox Tech, LLC (Redox Tech), Swofford Construction, Inc (Swofford), and Atlanta Environmental Management, Inc. (AEM). TRS and Redox Tech are specialty remediation contractors. TRS was contracted to install and operate the ERH remediation system. Redox Tech was contracted to perform the ISCO blending operation. Swofford provided general construction support services such as concrete removal and clean soil disposal, and AEM provided implementation oversight and reporting.

On March 14, 2011, Swofford saw-cut and removed the concrete flooring and pavement from the ICM treatment area. At that time the trench drains and associated piping from the former parts cleaning room in the nose cone area were removed. The removed materials were disposed off site.

TRS began installation of the ERH system on March 24, 2011, and completed the installation and performed start-up testing between May 3 and May 9, 2011. Continuous operation of the ERH system started on May 9, 2011. Redox Tech mobilized to the site on March 28, 2011, and demobilized on April 13, 2011. After Redox Tech and TRS finished work in the ICM treatment area, the area sub-grade was prepared for new pavement outside and a replacement floor within building B-84. On April 23, 2011, Swofford poured and finished the new concrete floor within B-84, and the ICM construction/implementation phase within the B-84 building was completed. After this time, LM Aero proceeded with the overall building renovation.

The compressed schedule to accomplish the ICM required a work sequence that would allow both ERH and ISCO to proceed simultaneously with close proximity to each other and avoid work interferences.

ISCO Treatment

ISCO treatment with soil blending was performed on the approximately 3,160-square-foot treatment area (see Figures 1 and 2) to a depth of 15 feet below surface. To achieve proper treatment quality, blending was conducted in two layers. This process allowed for proper vertical mixing of oxidant and the complete treatment of the target zone to the total depth of 15 feet. However, it also required that the top treatment layer be treated, dried, and then removed and temporarily stockpiled at another location in order to gain access to the lower layer. The upper 7-foot soil level was first treated and tested (see Table 1, ISCO Treated Soil Characterization Sample Results) to verify contaminant removal and to document that the soil was non-hazardous. Treated and dried soil was moved and stockpiled in the adjacent building B-83 to allow access and treatment of the lower 8-foot soil level. After completion of the ISCO treatment, the stockpiled soil was returned to the lower 8-foot soil level. After completion of the ISCO treatment, the stockpiled soil was returned as backfill, then wetted and hardened to a nominal 500 psi compressive strength with Portland cement directly in the treatment excavation to return the excavation to proper grade. The remaining stockpiled treated soil was then properly disposed off site.

Potassium permanganate ($KMnO_4$) was mechanically blended with soil and added water, including recovered rainwater, in order to form the treatment slurry within individual treatment cells. The upper treatment level (surface to 7 feet below surface) was divided into five treatment cells and each was treated in turn with $KMnO_4$. After all upper cells were treated, the upper-level soil was temporarily moved (to Building B-83) to provide access to the level below. The lower treatment level (7 to 15 feet below surface) was also divided into five cells for treatment. After completion of the lower level treatment, treated soil from the upper level was then returned to fill the remainder of the excavation.

Table 1 - ISCO Treated Soil Characterization Sample Results

Sample Name:	Lockheed B-84			
Sample Date:	3/31/2011			
	TCLP Analysis		VOC Analysis	
Tetrachloroethene	<0.050	mg/L	<4.6	µg/kg
Trichloroethene	<0.050	mg/L	<4.6	µg/kg
1,1-Dichloroethene	<0.050	mg/L	<4.6	µg/kg
1,2-Dichloroethane	<0.050	mg/L	**3.5**	µg/kg
2-Butanone	<0.050	mg/L	**93**	µg/kg
Benzene	<0.050	mg/L	<4.6	µg/kg
Carbon tetrachloride	<0.050	mg/L	<4.6	µg/kg
Chlorobenzene	<0.050	mg/L	<4.6	µg/kg
Chloroform	<0.050	mg/L	**0.88**	µg/kg
Vinyl chloride	<0.020	mg/L	<4.6	µg/kg

< - Constituent was not detected. The numerical value = the practical quantitation limit (PQL).
J - Constituent was positively identified below the PQL and above the method detection limit (MDL).

An initial grab sample of ISCO treated soil (sample "Lockheed B-84") was collected in order to characterize the soil prior to transport and temporary storage in B-83. The sample was analyzed for hazardous waste characterization, for Toxicity Characteristic Leaching Procedure (TCLP) volatile organic compounds (VOCs) (in mg/L), and for total VOCs (in µg/kg). The analysis results documented that the soil was non-hazardous.

The target ISCO treatment volume of approximately 1,750 cubic yards was treated with 52,000 lbs. of $KMnO_4$. Approximately 60,000 gallons of potentially contaminated rainwater recovered from the treatment excavation was stored and was then used in the treatment process. Additional tap water was used as needed. Stabilization of the treated soil was provided by 46,000 lbs. of quicklime and 334,400 lbs. of Portland.

The ISCO treatment, soil blending, and treated soil stabilization was conducted by Redox Tech. Their work was performed between March 28, 2011, and April 13, 2011.

ERH Treatment

TRS installed twenty vertical ERH electrodes and four vertical temperature monitoring points (TMPs). TRS contracted with GeoLab of Winder, Georgia, to provide drilling and labor services for the electrodes and TMP installation.

The ERH electrodes were installed in 12-inch-diameter hollow-stem auger (HSA) borings at a horizontal spacing of approximately 20 feet. The conductive portion of each electrode extended from 3 to 21 feet below grade surface, to treat the desired interval from beneath the building floor to the water table. The TMPs were also installed in HSA borings and consisted of an array of four thermistors spaced vertically at five-foot intervals within each TMP boring. Electrodes and TMPs were connected to the control and process equipment located outside the building, via insulated conductors within a network of shallow trenches.

Also located within the shallow trenches was piping for vapor recovery (VR) and water return lines. A five-foot-long VR screen was placed horizontally over the top of each electrode, bedded in granular backfill, and connected to a vacuum blower outside the building. During ERH operation, vapor produced by heating the subsurface was removed and processed by the VR system while water was drip-metered back into the electrode borings to replace natural soil moisture that had been lost to vaporization.

After subsurface equipment was installed, the borings and shallow connecting trench network were backfilled with granular material up to the original soil grade to form a flat surface within the B-84 ERH treatment area. Then a grounding mat composed of light-gauge galvanized steel poultry mesh was laid, and a single-piece, heavy-gauge vinyl vapor barrier was cut and placed over the grounding mat and treatment area. The purpose of the grounding mat and vapor barrier was to contain stray ERH current and steam below the floor slab, where they would not be a hazard to personnel or equipment.

The ERH control and process equipment was composed of several mobile, modular components located outside the B-84 building on the pavement and the ground surface. The primary component systems included the ERH power control unit (PCU), the vapor recovery and processing system, and the electrode wetting system.

The PCU provided electrical current to the electrodes and provided control and performance monitoring equipment for the overall ERH system. The VR system was composed of a vacuum blower connected to the subsurface VR piping, a vapor condensing unit and condensate storage tank, granular activated carbon (GAC) off-gas treatment, and a discharge stack. The electrode wetting system provided replacement soil moisture at each electrode in order to maintain appropriate electrical conductivity/resistance and maximize effectiveness of the system. Condensate recovered from the VR system was used to supply the wetting system, with additional tap water used as needed.

TRS installed the subsurface portion of the ERH system (electrodes, TMPs, vapor recovery, and electrode wetting system) within building B-84 starting on March 24, 2011, and finishing that portion of the installation prior to the hangar floor replacement on April 23, 2011. TRS then proceeded to assemble the aboveground controls and processing components outside the rear portion of the building. After startup of the ERH system on May 9, 2011, TRS continually monitored and maintained the system until shutdown on November 7, 2011.

Soil Disposal

After removal of the concrete and trench drains from the solvent wash rack area, a portion of sub-grade soil in the western “nose cone” area was found to be unsuitable for future structural reasons and was subsequently cut out and replaced with approximately two feet of compacted crushed stone backfill. Excavation and backfilling were performed during the week of March 21, 2011. This removed soil was disposed under an existing SWMU 37 non-hazardous soil disposal profile and was then transported to the Waste Management, Inc., Pine Bluff Landfill in Ballground, Georgia, for disposal. A total of 75.41 tons of non-hazardous special waste soil from the nose cone area was disposed off site on March 30, 2011.

Additionally, in order to prepare proper sub-grade support for floor and pavement replacement, one to two feet of remaining untreated exposed sub-grade soil was removed from the area outside the ERH treatment zone and was replaced with structural backfill. This removed soil (572 tons) was disposed under an existing SWMU 37 non-hazardous soil disposal between April 15, 2011, and April 22, 2011. A total of 647 tons of non-hazardous special waste soil was transported off site for disposal.

The blending and subsequent stabilization of ISCO treated soil resulted in an expansion of the initial volume of soil, and thus not all treated soil could be replaced in the treatment excavation. This excess treated soil (61 dump truck loads) was disposed off site. The soil removal and disposal work was performed by Swofford.

Confirmatory Soil Sampling

During the ISCO treatment process, AEM collected nine confirmatory grab samples from representative portions of the ISCO treated soil. Sample "Lockheed B-84" was initially collected from an upper-level treatment cell in order to establish treatment effectiveness and to look at leaching characteristics. Four other grab samples were collected from various lower-level treatment cells. An additional four grab samples were collected from the treated soil pile at B-83, as representative of the soil replaced in the upper level of the treatment excavation.

AEM also collected confirmatory soil samples from representative soil boring locations in the ERH treatment area at two time periods. On August 24, 2011, after approximately 70% of the ERH schedule had elapsed, three soil samples were collected at five-foot intervals from each of three boring locations. Soil sampling was repeated on November 10, 2011, after the ERH schedule was complete. Again, three soil samples were collected at five-foot intervals from each of the six boring locations. All confirmatory soil samples were submitted to Xenco Laboratories for analysis of VOCs by EPA Method 8260.

SUMMARY

Prior to implementation of ISCO and ERH treatment, 75.41 tons of structurally weak soil was found and was removed from the upper two-foot zone of source surrounding the former trench drain in the nose cone portion B-84.

ISCO treatment was performed inside and through the hangar door into the adjacent tarmac area between March 28 and April 13, 2011. None of the ISCO area confirmation soil samples contained PCE or TCE at concentrations above the 500 μg/kg SSL.

Confirmation soil sample results of the chlorinated volatile organic compounds (CVOCs) at B-84 were compared with data collected prior to the ISCO treatment (Table 2). Prior to treatment, the average total CVOC concentrations at the 5-foot, 10-foot, and 15-foot depths in the treatment area were 689, 664, and 1,497 µg/kg, respectively. The 95% upper confidence limits (95% UCL) were 1,223, 840, and 2,311 µg/kg, respectively. After treatment, the average CVOC concentration (over all depths) was 10 µg/kg with a 95% UCL of 17 µg/kg. Using the 95% UCL values as the representative concentration, the percent reduction was 99%.

Table 2: ISCO Treatment Performance Summary

Original Concentrations Total concentration Chlorinated VOCs					Post Remediation Concentrations Total concentration Chlorinated	
	Depth bls					
Sample ID	5'	10'	15'	Total	Sample ID	
SWMU-37-SB-28		519	1921	2440	Lockheed B-84	3.5
SWMU-37-SB-30	1641	495	1040	3176	LMAB84-041011-1	8.2
SWMU-37-SB-43	1332	784	3561	5677	LMAB84-041111-1	8.4
SWMU-37-SB-44	676	905	1118	2699	LMAB84-041111-2	32
SWMU-37-SB-49	61	373	1887	2321	LMAB84-041111-3	<9.3
SWMU-37-SB-50	46	560	807	1413	LMAB84-041111-4	12
SWMU-37-SB-51	380	1013	146	1539	LMAB84-041111-5	5.8
					LMAB84-041111-6	7
					LMAB84-041111-7	5.8
	Average Total Concentration					
Interval:	5'	10'	15'	Combined		Combined
Average:	689	664	1497	963	Average:	10
95% UCL:	1223	840	2311	2023	95% UCL:	17
					Total % Reduction:	99.2

Note: All concentrations are µg/kg Dry Weight

The ERH treatment was performed between May 9 and November 7, 2011. One of the nine ERH area confirmation soil samples obtained at 70% of schedule duration contained PCE or TCE at a concentration above the 500 µg/kg SSL, while three of the eighteen final confirmation soil samples contained PCE or TCE at concentrations above the 500 µg/kg SSL.

Comparison of confirmation soil sample CVOC data with data collected prior to the ERH treatment (Table 3a and Table 3b) was conducted at B-84. Prior to treatment, the average total CVOC concentrations at the 5-foot, 10-foot, and 15-foot depths in the treatment area were 129,667 µg/kg, 11,111 µg/kg, and 3,440 µg/kg, respectively; the 95% UCLs were 279,744 µg/kg, 16,691 µg/kg, and 6,110 µg/kg, respectively. After ERH treatment, the respective CVOC concentrations at the same three depths were 2,439 µg/kg, 405 µg/kg, and 25 µg/kg; the respective UCLs were 4,850 µg/kg, 1,184 µg/kg, and 68 µg/kg.

Table 3a - ERH Treatment Performance Summary

Original Concentrations
Total concentration Chlorinated VOCs

	Depth bls			
	≤5'	>5' & <10'	>10'&≤15'	Total
B-84-SB-1	94710	939		95649
B-84-SB-2	28537	3529		32066
B-84-SB-3	39580	19012		58592
B-84-SB-4	15329	5576		20905
B-84-SB-5		27297		27297
B-84-SB-6		4930		4930
B-84-SB-7	834000	9264		843264
B-84-SB-8	652700	22300		675000
B-84-SB-9	2670	31840		34510
B-84-SB-10	4448	41920		
B-84-SB-13		4082	365	
B-84-SB-14		6783	4872	
B-84-SB-16		7113	2582	
SWMU-37-SB-31	1830	2315	3339	7484
SWMU-37-SB-32	3775	3659	780	8214
SWMU-37-SB-34	1183	2592	919	4694
SWMU-37-SB-35	5192	5720	12229	23141
SWMU-37-SB-41	1716	1120	2433	5269

	Average Total Concentration			
Interval:	≤5'	>5' & <10'	>10'&≤15'	Combined
	129667	11111	3440	47206
95% UCL	279744	16691	6110	188162

Note: All concentrations are µg/kg Dry Weight

Table 3b - ERH Treatment Performance Summary

Post Remediation Concentrations
Total concentration Chlorinated VOCs

	Depth bls			
	5'	10'	15'	Total
B-84-CSB-4	392	<5.4	<5.0	392
B-84-CSB-5	8,059	1,200	69	9,328
B-84-CSB-6	547	<4.7	<5.3	547
B-84-CSB-7	2,942	7	3	2,952
B-84-CSB-8	48	<5.2	<5.5	48
B-84-CSB-9	2,648	7	2	2,657
	Average Total Concentration			
Interval:	5'	10'	15'	Combined
	2,439	405	25	885
95% ULC	4,850	1,184	68	3,679
% Reduction	98.1	96.4	99.3	98.0

Note: All concentrations are μg/kg Dry Weight

The total CVOC average for the pre-ERH samples over depth was 47,206 with a 95% UCL of 188,162 μg/kg. The post-ERH CVOC average over depth was 885 with a 95% UCL of 3,679 μg/kg. Using the 95% UCL as the representative concentration, the percent reduction was 98%.

Further, TRS's final report notes that the project goal of reducing VOC concentrations in soil throughout the treatment volume by a minimum of 95% was achieved and that total average VOC reduction was 98.5%.

The ICM goal was achieved with Facilities renovation work completed and C-130 acquiring the building B-84 on March 1, 2012.

DISCLAIMER

Names of products and names of environmental consultants and/or contractors does not by any means constitute an endorsement by Lockheed or the Air Force.

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WA, Electrical Resistance Heating; Spur Environmental, Pine Bluff Landfill, Ball Ground, GA, Soil Disposal Manifests (Non-Hazardous Manifest); Xenco Laboratories, Florida Testing Services, LLC, Norcross, GA, Analytical Report 411648 for AEM, Inc., 1 April 2011) performed the project work.

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