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WRIGHT-PATTERSON AIR FORCE BASE PCB INVENTORY, ASSESSMENT, AND CLEANUP PROJECT SUMMARY[a]

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Wright-Patterson Air Force Base (WPAFB), of the United States Air Force (USAF) Air Force Logistics Command, requested Department of Energy, Idaho Operations Office (DOE-ID) assistance through the Idaho National Engineering Laboratory (INEL) in characterizing and remediating polychlorinated biphenyl (PCB) spill sites at the base. In addition, WPAFB requested assistance in identifying PCB-filled and PCB-contaminated equipment at WPAFB in Dayton, Ohio. This paper presents a summary of the work completed to date on this project.

The objective of the project was to provide the technical management, manpower, and services required to: characterize and clean up select PCB spill sites; identify, sample, and label oil-filled equipment (typically electrical and hydraulic); and prioritize for removal, retrofill, or chemical detoxification the PCB-filled and PCB-contaminated transformers at WPAFB. The INEL team also provided environmental inspection services for the WP 92-8 (transformer replacement) project, which was conducted by another contractor at WPAFB; the environmental inspection task is beyond the scope of this paper.

The initial task of the project was to prepare a Scope of Work (SOW) and a Project Management Plan (PMP). The SOW was prepared and submitted to WPAFB for review and comment. The finalized SOW, details of the tasks and activities needed to successfully meet the objectives of the project, and detailed cost estimates were incorporated into the PMP. The PMP, following WPAFB review and approval, was the governing document for the project.

The next task of the project was to prepare the procurement specifications necessary to select subcontractors to perform the sampling activities required for characterizing PCB spill sites, perform remediation activities at PCB spill sites, sample oil-filled equipment, and analyze samples. Four subcontracts were established for the project: Primary laboratory subcontract, which analyzed the majority of the samples taken during the project; independent verification and validation laboratory

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subcontract, which analyzed approximately 10% of the samples as a quality assurance/quality control (QA/QC) function; condition analysis laboratory subcontract, which tested the oil from transformers and large oil-filled circuit breakers to determine the condition of the device based on oil characteristics; and survey, characterization, remediation, and sampling subcontract, which provided the manpower and equipment necessary for performing onsite tasks at WPAFB.

A Request for Proposal (RFP) was prepared and sent to prospective subcontractors. The RFP contained all project and subcontract specifications, including the INEL specifications requiring a general Health and Safety Plan, Quality Assurance Project Plan, and Spill Prevention, Control, and Countermeasures Plan to be included in the proposal. All proposals received were evaluated on technical capabilities and cost considerations, and the subcontractors were selected.

Onsite work began in September of 1989 with the arrival of the INEL project team on the base. A project office was established in Fairborn, Ohio, which is just outside WPAFB. Initial preparatory work included familiarizing project personnel with WPAFB layout and procedures, collecting existing background information, inspecting spill sites to be characterized and/or remediated, and developing sampling schemes for electrical and hydraulic oil-filled equipment to be surveyed.

The survey, characterization, and remediation subcontractor arrived onsite in January of 1990 and began work on sampling electrical devices and characterizing and/or remediating PCB spill sites. Following the completion of the characterization/remediation activities, which could be completed at this time (due to the pending removal of transformers for access to spill sites), the hydraulic device sampling was initiated. From this point forward, hydraulic sampling and characterization/remediation were conducted on an alternating basis using the same subcontract personnel. Two crews of subcontractor personnel were utilized for the project in order to allow work to be conducted on more than one project task at a time and thus shorten the overall length of time required for field work.

Characterization and/or remediation activities were conducted at 88 sites located throughout WPAFB. A variety of methods and equipment were used in the characterization and/or remediation activities conducted during the project. These included: solvent washing with Citrikleen (see Figure 1); selective soil and/or concrete removal using a corner cutter (see Figure 2), shotblaster (see Figure 3), bosch hammer (see Figure 4), and various hand tools; and gross removal of soils and concrete using a backhoe and/or jack hammer (see Figure 5). The sites that were characterized and/or remediated ranged in size and complexity from 3-inch diameter surface stains (see Figure 6) to spill response cleanup, which required pavement removal in a parking area (see Figure 7), selective concrete demolition, solvent washing, and excavation of an area 15 feet long, two feet wide, and eight feet deep (see Figure 8).

Sampling for characterization and sampling for verifying that remediation activities had been completed were conducted following guidelines contained in the Environmental Protection Agency (EPA) documents on sampling of PCB spill sites, specifically EPA-560/5-85-026, "Verification of PCB Spill Cleanup by Sampling and Analysis," and EPA-560/5-86-017, "Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup," and statistical methods, as detailed in EPA SW-846 Section One. Sampling for characterization and/or remediation activities consisted chiefly of wipe (see Figure 9) and soil (see Figure 10) samples, with a total of 757 samples taken.

Specific details of all the characterization and/or remediation activities conducted during this project will be contained in the project reports, which are being prepared. These reports will be available upon request from the authors of this paper.

The WPAFB device survey entailed identifying 1,378 hydraulic and 1,779 electrical devices. The hydraulic devices sampled (2,145 samples taken) included elevators, pumps, air compressors, lathes, drills, and other stationary hydraulic devices. Once the samples had been analyzed, less than one-half of one percent of the devices was found to contain greater than 50 parts per million (ppm) PCBs. WPAFB was notified of PCB-contaminated and PCB-filled devices as these were located, and appropriate actions were taken by the base. Because of the low number of PCB-contaminated and PCB-filled hydraulic devices, no risk analysis was performed on these devices.

The electrical devices sampled (2,080 samples taken) consisted primarily of transformers, oil circuit breakers, reactors, rectifiers, and capacitors. The analysis of samples from electrical devices showed approximately 10% of the devices to be PCB-contaminated or PCB-filled. Because of the vastness of the base, and its over 1200 facilities (not including family housing), the experience of WPAFB's exterior electricians and existing one-line diagrams were used to expedite locating the electrical devices. The one-line diagrams provided detail of WPAFB's power distribution system through its eight substations, and the subsequent facility transformers.

Access to the oil within an electrical device was obtained by one of three main methods. First, the top or side fill plugs were removed, if they were accessible. If no fill plugs were accessible, then the bottom drain valve was carefully used. As a last resort, a hole was made in the device by using either a Hilti gun or a drill. The Hilti gun employed a special punch manufactured for transformer use to provide a 1/4" hole in the device. When using the drill, a 1/4", high-tempered drill bit with a special stop attached was utilized. The stop prevented the bit from protruding into the bushings or windings of the transformer. Normally the Hilti gun was used to sample pole-mounted transformers and the drill was used to sample pad-mounted transformers.

Sampling of the oil was accomplished through using a tygon tube and plastic bellows. A 20-mL sample of oil was taken from each device. Once the sample was taken, if a hole had been made, a neoprene plug was inserted into the hole and tightened into place. If access was gained through an existing opening, the threaded caps of the drain or fill plug were coated with plumbers PVC tape and reinserted.

Outages were not a major obstacle for this project as the majority of the electrical devices were sampled while energized. Where access posed a safety problem, or the sampling crew did not feel safe in sampling an energized device, an outage was scheduled.

For pad-mounted transformers and large oil circuit breakers, an additional eight-ounce sample was taken and analyzed for a condition analysis of the oil. The condition analysis tests reported water in oil, dielectric strength, acid content, interfacial tension, color, specific gravity, sediment/sludge content, and a visual inspection. All of these tests indicate the condition of the transformer. Based upon the results of these tests, the transformer was then categorized into classifications of good, marginal, poor, bad, very bad, and extremely bad. These six classifications were used in the risk analysis report, which relates to the condition factor. The condition analysis reports were also used to report to the base which transformers required some type of maintenance (for example, an oil change or a thermal cleaning) to help increase the life of the non-PCB transformers.

All of the data (see Figures 11 and 12) obtained from the survey will be compiled in a data base written in Dbase IV. The device information can be added, edited, or deleted from the data base. The data base also contains a reports section through which reports can be generated. The user has the choice of several standard reports or creating custom reports. The custom reports can be constructed in any manner the user chooses.

The risk analysis model used was originally developed by the Naval Energy and Environmental Support Activity (NEESA) and was modified for use in this project. Of the sixteen (16) factors required by this modified model, five are essentially quantitative in nature. Four of these factors were determined from nameplate data; one will be determined from the analytical results. Ten factors were determined as a result of the inspection of the device while being labeled (see Figure 13). The last factor was determined from the condition analysis testing done on the oil as discussed above.

In addition to these sixteen factors, each transformer will be evaluated with respect to proper primary and secondary fusing. Due to the lack of manpower at the base, certain maintenance procedures are overlooked. In addition, certain supply items are not readily available during an emergency situation or even in normal situations. Thus, improper fusing has occurred over the years. In the event of an overload, improper fusing may not disrupt the circuit as intended, which could result in possible explosion of the transformer. As previously mentioned, each transformer will show its proper primary and secondary fuse sizes in accordance with the National Electric Code (NEC). It will be left up to the base to verify each of these fuse ratings.

Once all the data are compiled, the PCB-contaminated and PCB-filled devices will be prioritized in the risk analysis report. Recommendations of retrofit, retrofill, or leave-in-place with special monitoring devices installed will be given to the base.

Based on the results of a study conducted by INEL on retrofilling PCB transformers, it is our recommendation that retrofill not be considered. During the above study, sixteen PCB-filled transformers were designated for retrofill. Two companies were awarded retrofill contracts, with each company receiving eight transformers. To date, after 49 months, only one transformer has been successfully reclassified.

The PCB-filled transformers remaining at WPAFB will be removed from service. As for the PCB-contaminated transformers, our recommendation is to leave them in place, with equipment installed to monitor for internal arcing via acoustic emission methods. Acoustic emission equipment is currently on the market that can detect a partial discharge. This equipment can be used in conjunction with a Supervisory Control And Data Acquisition (SCADA) system. Once a partial discharge is detected, an alarm can be sounded and the appropriate circuit breaker deenergized to remove the transformer or other oil-filled device from the circuit. In addition to equipment for detecting a partial discharge, an ultrasonic, oil level monitoring device could also be installed. If the oil level drops below a preprogrammed level, an alarm could be sounded and the appropriate response measures can be initiated.

Specific details of all the survey and risk assessment activities conducted during this project will be contained in the project reports, which are presently being prepared. These reports will be available upon request from the authors of this paper.

In summary, the Wright-Patterson Air Force Base PCB Inventory, Assessment, and Cleanup Project identified, sampled, analyzed, labeled, and conducted risk assessment of 1,779 electrical and 1,378 hydraulic devices. In addition, the Project characterized and/or remediated 88 PCB spill sites at WPAFB in Dayton, Ohio. If you would like further information regarding this project, please contact the authors.

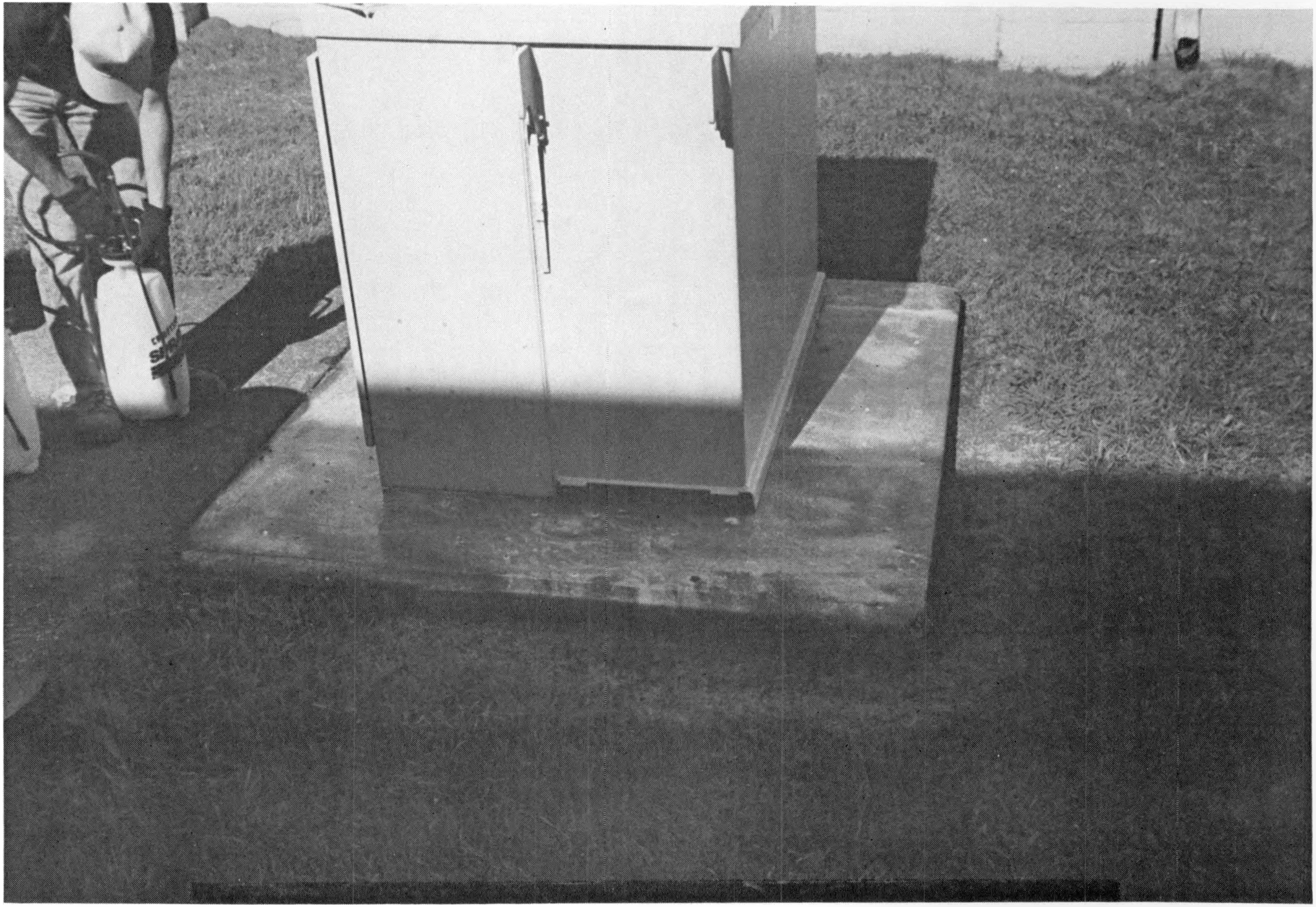

Figure 1. Solvent washing concrete pad with Citrikleen.

Figure 2. Concrete scarification using corner cutter.

Figure 3. Concrete scarification using shotblaster.

Figure 4. Concrete removal using bosch hammer.

Figure 5. Concrete removal using jack hammer.

Figure 6. Small concrete remedial site (3-inch diameter spill).

Figure 7. Pavement removal in parking area for spill cleanup.

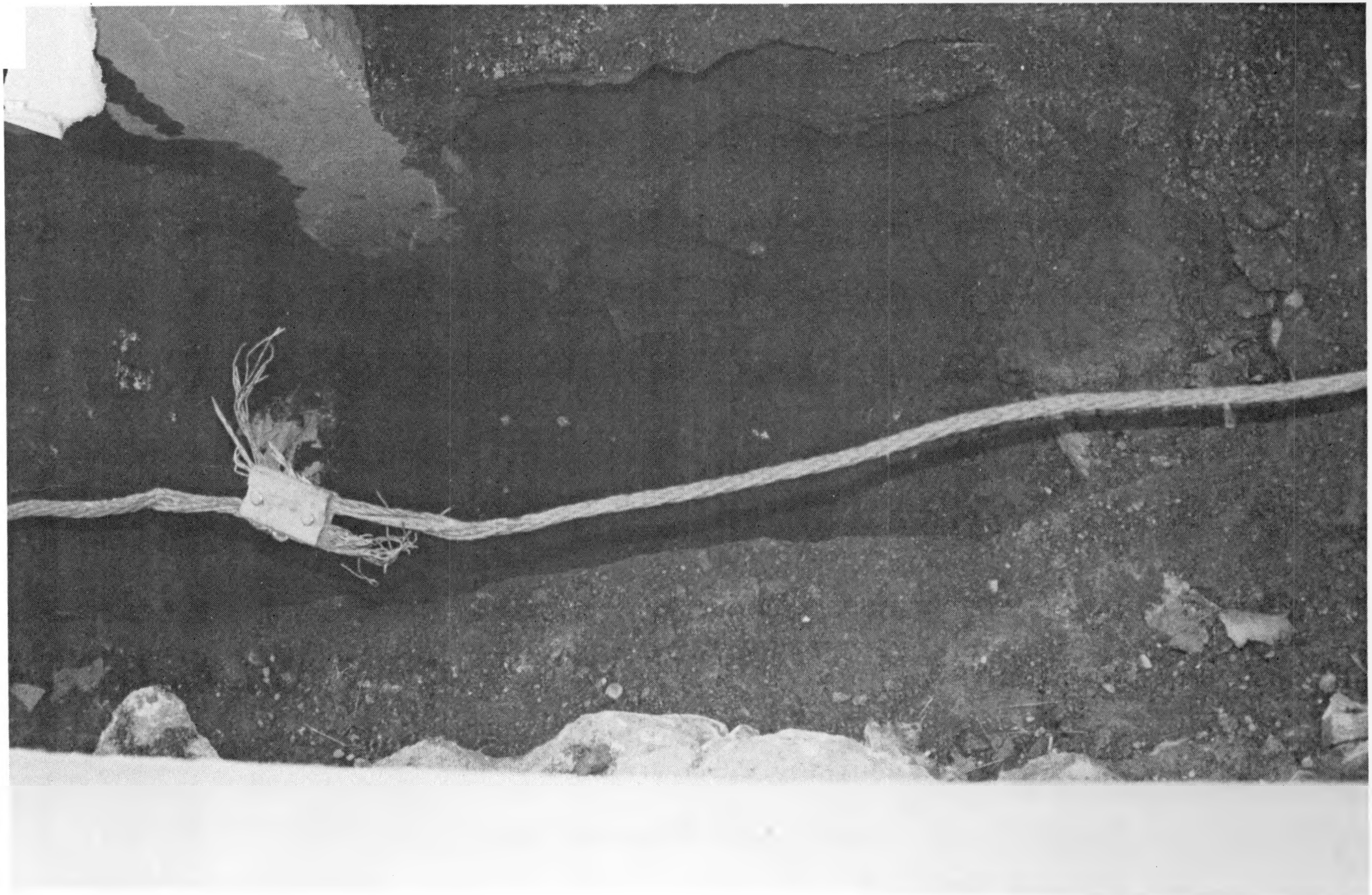

Figure 8. Excavated area for spill cleanup.

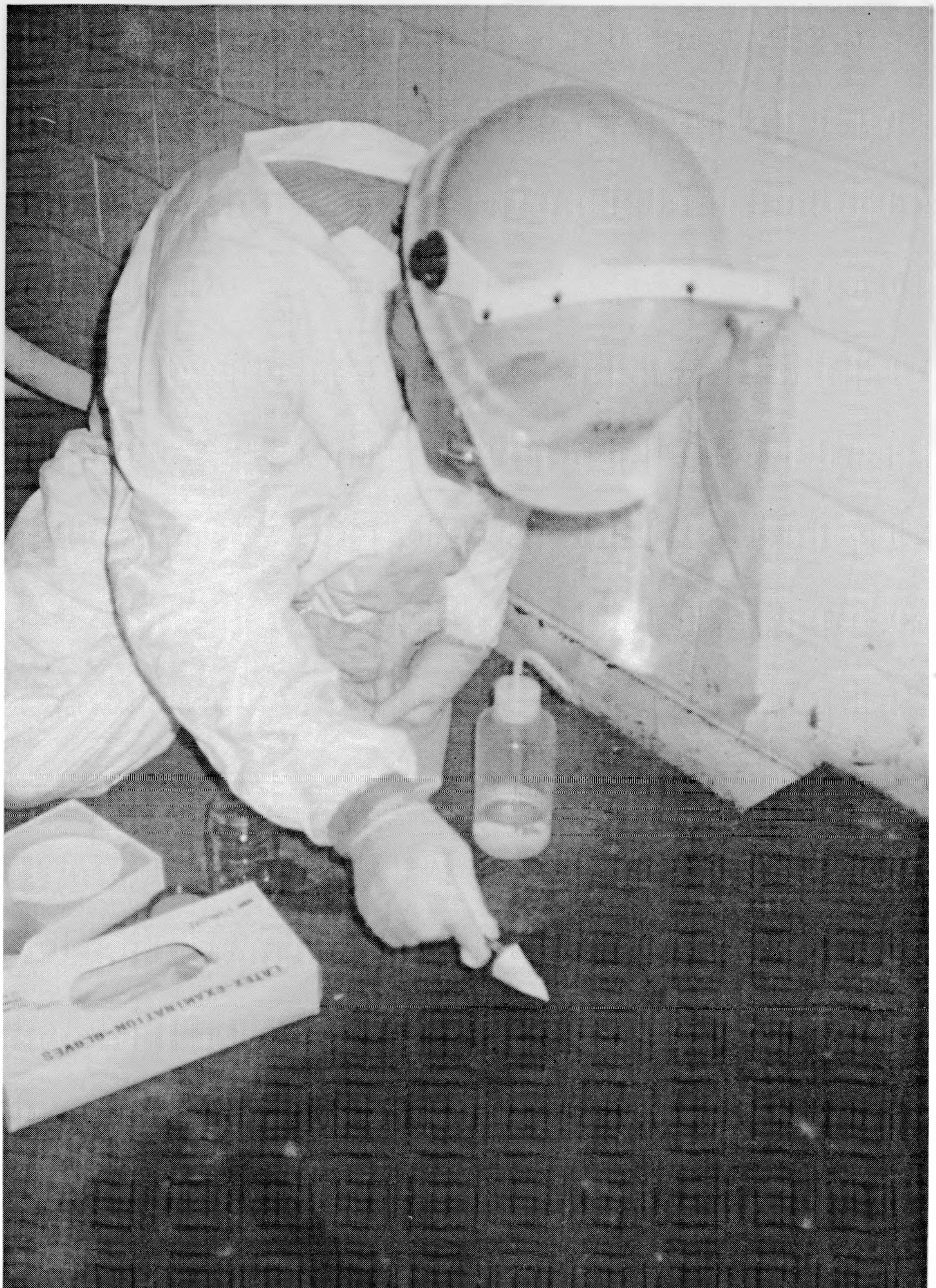

Figure 9. Wipe sampling.

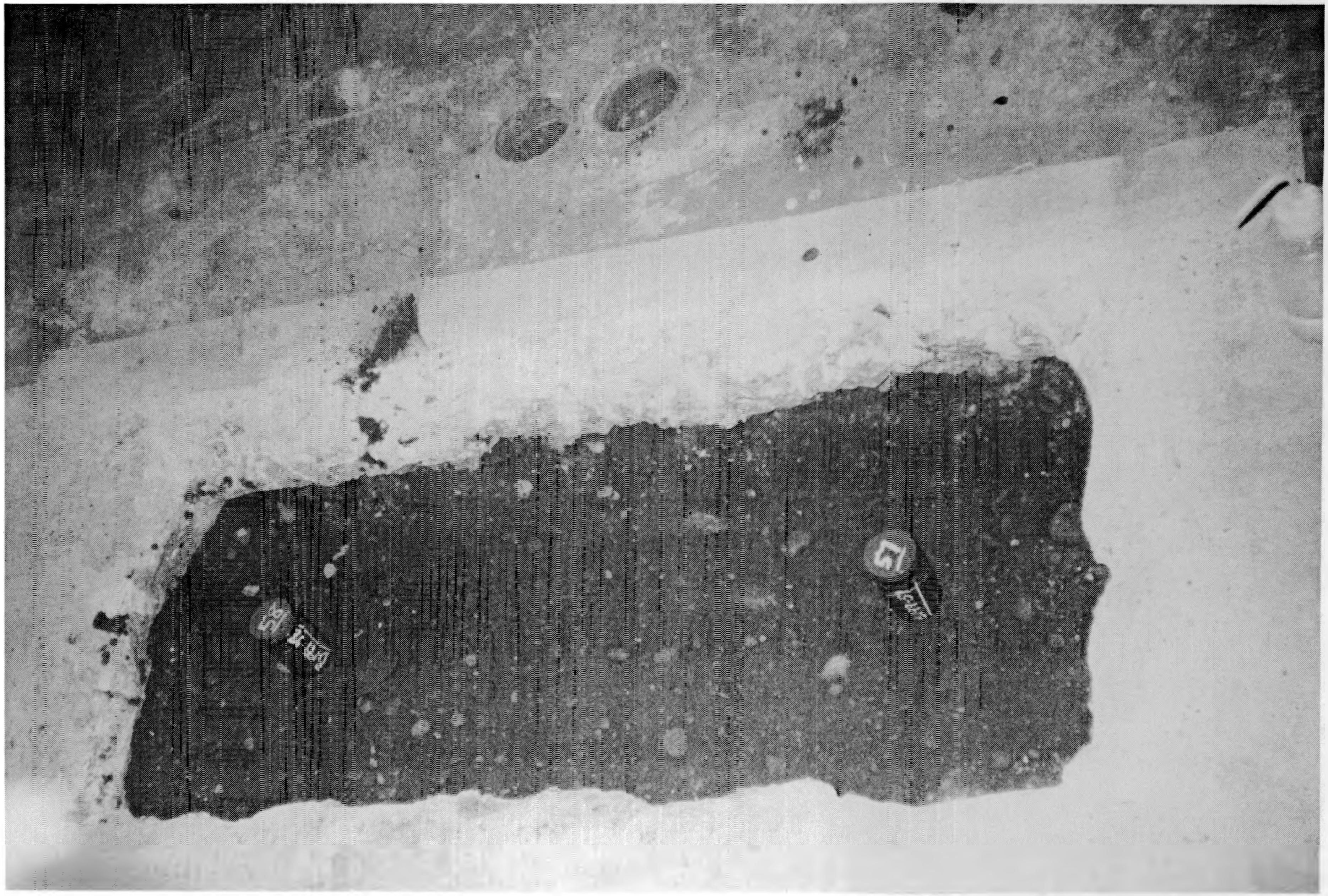

Figure 10. Soil sampling.

Hydraulic Device Data (WPAFB)

Device ID ____________________
Location ____________________

Device description ____

Mfg __________________________

Fluid type ________________ Fluid gals. ________________

Area____ (1) Inside
(2) Outside

Sample energized ____(1) Yes
(2) No

Service____ (1) Comm. (3) Resid.
(2) Indust.

Sample type____(1) Oil
(2) Wipe

Device leaking ____ (1) Yes
(2) No

Sample ID					
PPM					

Date sampled ____________________ Date Shipped ____________________

Final CRF PPM ____________________ Analysis received ____________________

Tag number ____________________ Project number ____________________

Date labeled ____________________ Tag placed ____ Yes or No

Comments

T91 0076

Figure 11. Hydraulic device survey data sheet.

Device Data (WPAFB)

Device ID ____________________
Location ____________________

Device type ____(1) XFMR (2) SW (3) REG (4) CAP (5) Other __________

Set-Up ____ (1) Pole (2) Pad

Mfg ______________________________ KVA ______________ Phases ____ (1 or 3)

Primary Voltage ____________________ Secondary Voltage ____________________

Configuration ____ (1) Delta - Delta (2) Delta - Y (3) Y - Y (4) Y - Delta (5) Other ____________________

Fluid gals. ____________________ Fluid type ____________________

Area ____ (1) Inside (2) Outside

Transformer type ____(1) Radial (10) Network

Service ____ (1) Comm. (3) Resid. (2) Indust.

Imp.______ % B. I. L. ________ KV

Device leaking ____(1) Yes (2) No

Sample energized ____(1) Yes (2) No

Sample ID					
PPM					

Date sampled ______________________ Date shipped ______________________

Final CRF PPM ____________________ Analysis received ____________________

Circuit number ____________________ Project number ______________________

Tag number ______________________ Tag placed ____ Yes or No

Date labeled ______________________

Comments

T91 0075

Figure 12. Electrical device survey data sheet.

Transformer Risk Assessment

Tag nunber ______________
Building number ______________

Spill consequence ______

(105) Contaminate pad, soil, gravel and other materials
(120) Contaminate occupied areas
(150) Contaminate bodies of water or cause contamination through migration
(300) Contaminate food or animal feed storage, preparation or serving area

Transformer location ______

(1) Outdoors on pad
(2) Outdoors on pole
(3) In stand-alone vault or electrical bldg.
(4) In basement of occupied bldg.
(25) On upper floor inside bldg. or on roof

Condition of Transformer ______

(1) Good
(10) Fair
(20) Poor

Condition of associated electrical equipment ______

(0) N/A
(1) Good
(10) Fair
(20) Poor

Possibility of overloading ______

(1) Low (<10%)
(10) Med (10-50%)
(20) High (> 50%)

Proximity to fire hazard ______

(0) >40'
(5) 21' - 40'
(10) 11' -20'
(20) 1' - 10'

Proximity to ductwork, windows, or doors ______

(0) N/A
(1) >200'
(10) 101' - 200'
(20) 1' - 100'

Proximity to ventilation equipment ______

(0) N/A
(1) >200'
(10) 101' -200'
(20) 1' - 100'

Number of bldg. occupants ______

(0) 0
(1) 1 - 10
(5) 11 - 100
(10) >100

Hours occupied per day ______

(0) 0
(1) 1 - 4
(2) 5 - 8
(5) 9 - 15
(10) 16 - 24

Mission impact if bldg. is out of use due to PCB fire ______

(0) No impact
(50) Moderate impact
(100) Severe impact

Replacement assessment ______

(1) No replacement constraints
(2) Minor constraints (Door/fence removal)
(3) Moderate construction required (Transformer disassembly, wall removal)
(4) Extensive construction cost in excess of transformer cost

T91 0077

Figure 13. Risk assessment data sheet.