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PROJECT COMPLETION REPORT FOR SURFACE CONCRETE REMOVAL DEMONSTRATION IN THE PLANT 8 MUFFLE FURNACE AREA

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FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

U. S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

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1.0 PROJECT SUMMARY

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The U.S. Department of Energy (DOE) implemented and successfully completed the removal of at least the top inch of concrete on 91 percent of the first floor of the Muffle Furnace Area in Plant 8 at the Fernald Environmental Management Project (FEMP) several years ahead of the schedule for Plant 8 remediation. This activity was performed in accordance with the Focused Implementation Plan for Concrete Removal Demonstration in the Plant 8 Muffle Furnace Area (DOE 1998), which outlined the remedial design details consistent with the strategies outlined in the Operable Unit 3 (OU3) Integrated Remedial Design/Remedial Action (RD/RA) Work Plan (DOE 1997). The removal and off-site disposition of the top inch of concrete from the first floor of the Plant 8 Muffle Furnace Area was identified as a requirement, among several other areas in OU3 that contain the highest levels of technetium-99 (Tc-99) in debris, in the OU3 Record of Decision for Final Remedial Action (ROD) (DOE 1996).

The Plant 8 surface concrete removal demonstration was sponsored by the DOE Office of Science and Technology, Deactivation and Decommissioning Focus Area - Large Scale Demonstration & Deployment (LSDD) Project. The specific scope of work included the removal of the top inch of concrete in the first floor of the Muffle Furnace Area (Process Area 4) of Plant 8, an area having dimensions of approximately 31 feet x 55 feet. As defined in the Implementation Plan, the first floor of the Muffle Furnace Area includes an areal footprint of 1,705 square feet, 1,611 square feet of which had concrete that was subject to the removal requirement. The difference between the two areas was due to areas that do not have concrete flooring, namely those occupied by fixed pillars (28 square feet), steel floor drains (62 square feet), and raised piers supporting the legs of the Muffle Furnace (4 square feet). Due to the stand-off limitation of the scabbling machine around vertical obstructions (e.g., fixed columns) and floor anomalies (e.g., trench grating), the demonstration was limited to removing concrete at a depth of at least one inch from 1,464 square feet of the 1,611 square foot area. Removal of the top inch of concrete from the remaining 147 square feet of floor area will be performed in conjunction with the Decontamination and Dismantlement (D&D) subcontract associated with the Plant 8 Complex. The implementation plan for the D&D of the Plant 8 Complex will specify the requirement to remove all remaining surface concrete down to at least one inch for the remaining Muffle Furnace Area, including both first and second floors.

The concrete removal demonstration began on June 2, 1998 and was completed August 21. The original target completion date stated in the Implementation Plan (August 1), was extended to August 24 (per DOE letter dated August 4) due to equipment modifications required as a result of filter efficiency testing. The objectives achieved during the demonstration include: 1) testing of a technology new to the D&D arena; 2) removal of the top inch of concrete floor surface over an area greater than 1,400 square feet; and 3) the collection of data to assess the technology's production rate, cost and quantity of waste generated in an effort to compare this technology to other concrete removal technologies. The data has been submitted to the U.S. Army Corps of Engineers for preparation of a Cost Benefit Analysis (CBA). The results of the CBA will be published in an Innovative Technology Summary Report (ITSR) that will be available in hard copy as well as on the DOE web site located at: http://em-50.em.doe.gov/.

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2.0 PROJECT EXECUTION

2.1 Methods/Equipment

The demonstration began on June 2, 1998 with the mobilization of the subcontractor and equipment to the site. The subcontractor promptly initiated required site training and obtained medical clearance to work in Plant 8. The equipment was set up and calibrated within the old soil washing area of Plant 8 (a non-radiological contaminated area). After efficiency testing of the high efficiency particulate air (HEPA) filtration system, preliminary testing of the machine was performed on July 13, 1998. The preliminary testing provided an opportunity for the FEMP project team members and other interested individuals to view operation of the shot blasting system before initiating the work in the Plant 8 Muffle Furnace Area.

The equipment used for the demonstration included two different sizes of centrifugal shot blasting machines manufactured by Georg Fischer Disa Goff, Inc. The Model 420E had a sealed 40 horsepower electric motor, directly driving a 15-inch blast wheel. The tip speed of the 420E blast wheel exceeded 150 miles per hour and propelled approximately 100 pounds of hardened steel shot pellets per minute. The Model 13E had a sealed 15 horsepower electric motor rotating a 9-inch blast wheel at approximately 90 miles per hour and propelled approximately 50 pounds of hardened steel shot pellets per minute. The dust collection system was manufactured by Farr Company and consisted of a multiple cartridge type pre-filter with a gravity fed drumming station. The entire system operated under negative pressure and included a nuclear grade (Type B) HEPA filter.

2.2 Demonstration Results

The results of the demonstration for this report are viewed from the perspectives of technology performance and the OU3 ROD requirement for removal of at least one inch of surface concrete from the demonstration area.

<u>Technology Performance</u>
Before use of the Model 420E, the small shot-blasting machine (Model 13E) was used along the base of the walls and other vertical surfaces due to increased mobility and closer standoff distance from vertical obstacles. The Model 13E scabbled a 13-inch outline around all vertical obstacles, leaving approximately two inches of surface concrete in place around concrete support footers and approximately three inches along walls. The exception to the two to three inch standoff distances was along a section of the north wall where a guard rail prevented machine access out to approximately 22 inches. The remaining scabbling was performed by the Model 420E. The outlining by the Model 13E included building support column footers and footers of the legs of the Muffle Furnace. After the outlining phase was complete, the large shot blasting machine was then attached to the dust collection system. The Model 420E was more aggressive in terms of concrete removal by providing a wider coverage and an increased volume of concrete removed on a pass-per-pass basis than the Model 13E.

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The preliminary production rate observed for the larger machine, Model 420E, was found to have a path width of 20 inches and the depth per pass varied between 1/8 - 3/8 inch. The smaller machine, Model 13E, removed concrete in the same manner, but had a path width of approximately 13 inches and an had a depth per pass removal rate of approximately 1/8 inch. The actual depth and volume of concrete removed by centrifugal shot blasting was dependent on several variables. It was apparent that one variable — concrete properties — impacted the production rate greater than the others. For example, it was observed that concrete which had a greater surface hardness, and/or increased resistance to fragmentation, exhibited a lower shot blasting removal rate. As preliminary production data indicate, the concrete removal rate during the demonstration at the FEMP was lower than the removal rate obtained during the initial assessment held at Florida International University in June 1996. The lower production rate is attributed to a relatively large size of aggregate stone within Fernald's 40+ year-old concrete. The stone aggregate in this area was creek gravel from 1 - 2 inches in diameter. The aggregate stone may be viewed in Photo No. 3 in Attachment 1. The matrix surrounding the aggregate stone was more conducive to being removed via centrifugal shot blasting, but the aggregate stone tends to remain until the surrounding matrix releases the aggregate stone. Significantly greater quantities of aggregate stones were encountered as the depth approached one inch. These aggregate stones were much stronger than the surrounding matrix and their removal was mostly as a result of erosion of the surrounding concrete matrix by steel shot than fragmentation of the stone itself.

Due to the rough (uneven) surface left after removing more than ½ inch of concrete, the Model 420E had difficulty maneuvering across the exposed aggregate subsurface. As a result, the Model 420E eventually suffered mechanical problems with the hydraulic drive system. This problem would be atypical in future deployments where the success criteria is less than one full inch deep of concrete removal. Based on the results of the demonstration at the FEMP, Centrifugal Shot Blasting is recommended for applications requiring less than one inch of concrete to be removed from floor surfaces with relatively large sizes of aggregate stone. The ideal removal depth would be between ⅛ and ¼ inches deep. Applications with an aggregate stone located deeper than the removal criteria will maximize the effectiveness of the centrifugal shot blasting technology.

<u>OU3 ROD Requirement for Concrete Removal</u>

From the perspective of meeting the OU3 ROD requirement to remove the top inch of concrete from the Muffle Furnace Area, this technology demonstration set out to remove the greatest surface area of concrete practicable from the first floor of the Muffle Furnace Area. As noted in the Project Summary, the demonstration removed approximately 91 percent of the concrete at a depth of at least one inch several years ahead of schedule for Plant 8 D&D. Consequently, approximately 147 square feet of concrete remain to be removed in future D&D activities within the first floor of the Plant 8A former Muffle Furnace Process Area. This Report will be evaluated during the remedial design for the D&D of the Plant 8 Complex, along with other component background history to ensure that the concrete removal commitment is met.

3.0 WASTE MANAGEMENT

The net weight of waste generated during the demonstration equaled 15,362 pounds (7.68 tons), amounting to 35 55-gallon drums (note: the 35 drums equals the quantity estimated in the Implementation Plan). The amount of steel shot used during the demonstration, most of which became entrained in the pulverized concrete, is estimated at 750 pounds. Less than one drum of personal protective equipment (PPE) waste was generated during the demonstration, consisting of cotton liner gloves, blue nitrile gloves, respirator cartridges, and disposable boot covers. The drummed wastes are currently being staged in Plant 8 until characterization of wastes is complete. It is anticipated that the wastes will meet the waste acceptance criteria for disposal at the DOE Nevada Test Site, whereupon the drums would be moved to the Plant 1 Storage Pad for storage until off-site shipment. Currently, however, the analysis of samples from four representative drums is on hold pending the start-up of the newly relocated sample line at the FEMP. The sample line is expected to restart in mid-October. After sampling and analysis are initiated, it will take approximately 60 days for the completion of the analyses.

4.0 AIR MONITORING

Occupational air monitoring was performed during the concrete scabbling demonstration to determine effectiveness of engineering controls. Work area monitoring was performed using a 60 liter per minute (lpm) General Area Air Sampler. All sample durations were sufficiently long to both bracket the work activities and collect the procedurally-required minimum sample volumes of 10,000 liters. The samples were analyzed by the Air Sample Counting Group with a Tennelec alpha/beta gas flow proportional counter.

The Derived Air Concentration (DAC) values reported for the air samples taken during scabbling and related support activities are for U-238. U-238 was targeted for sampling because it is the isotope of concern in the Muffle Furnace Area of Plant 8. The decision to sample for U-238 is a conservative approach since the DAC for U-238 at the site (i.e., 2E-11 uCi/ml) is much lower than the most restrictive DAC for Technetium-99 (3E-07 uCi/ml).

The effectiveness of the scabbling unit and HEPA filtration system in maintaining air quality is demonstrated by the air sampling results, which showed that scabbling activities emitted less than 10 percent of DAC, except for one sample taken on August 14, 1998, which was 16.09 percent of DAC. Greater than 10 percent DAC is the action level at the FEMP for requiring respiratory protection. This result did not constitute an occupational health concern since all personnel in the work area were already wearing Powered Air-Purifying Respirators, which have a protection factor of 1000. An assessment of the activities conducted on August 14 indicated that the most likely cause of the increased U-238 in the work area was the release of U-238 contaminated dusts from overhead equipment due to vibrations caused by scabbling directly beneath the Muffle Furnace with the Model 13E.

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5.0 QUALITY ASSURANCE

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The area to be scabbled was delineated by the Fernald Environmental Management Project's surveying group to the dimensions of 31 feet from north to south and 55 feet from west to east. The area to be scabbled was indicated on CAD Drawing 08X-5500-X-03726, Rev. 0, (Attachment 1 in the Implementation Plan). The surveyors established 5-foot by 5-foot grid intervals over the demonstration area to enable before and after measurements and to verify that the one-inch concrete removal criterion was met. Before the operations began the surveyors determined pre-scabbling elevations of the floor surface at each grid interval. Individual pre-scabbling gridpoint elevations were recorded in the surveyors filed log. A Topcon level was used with a standard range pole modified with level graduations of one hundredth (0.01) of an inch. Upon completion of scabbling, the individual gridpoints were re-surveyed and elevations determined. The difference between the pre- and post-scabbling elevations were translated into inches and are represented in parenthesis on the CAD drawing attachment.

The amount of concrete removed varied from 1.0 - 2.5 inches over the Muffle Furnace Area. An illustration of the surveyed concrete surface area following scabbling is provided in Figure 5-1, which shows final grid elevations and corresponding inches of concrete removed (in parenthesis). The amount of concrete removed was dependent on the amount, size, and depth of the aggregate in the matrix. Because the aggregate did not disintegrate from the shot blasting, but instead was loosened when the mortar mix was removed, the result was a pitted concrete surface as indicated in the profile sketch shown in Figure 5-2.

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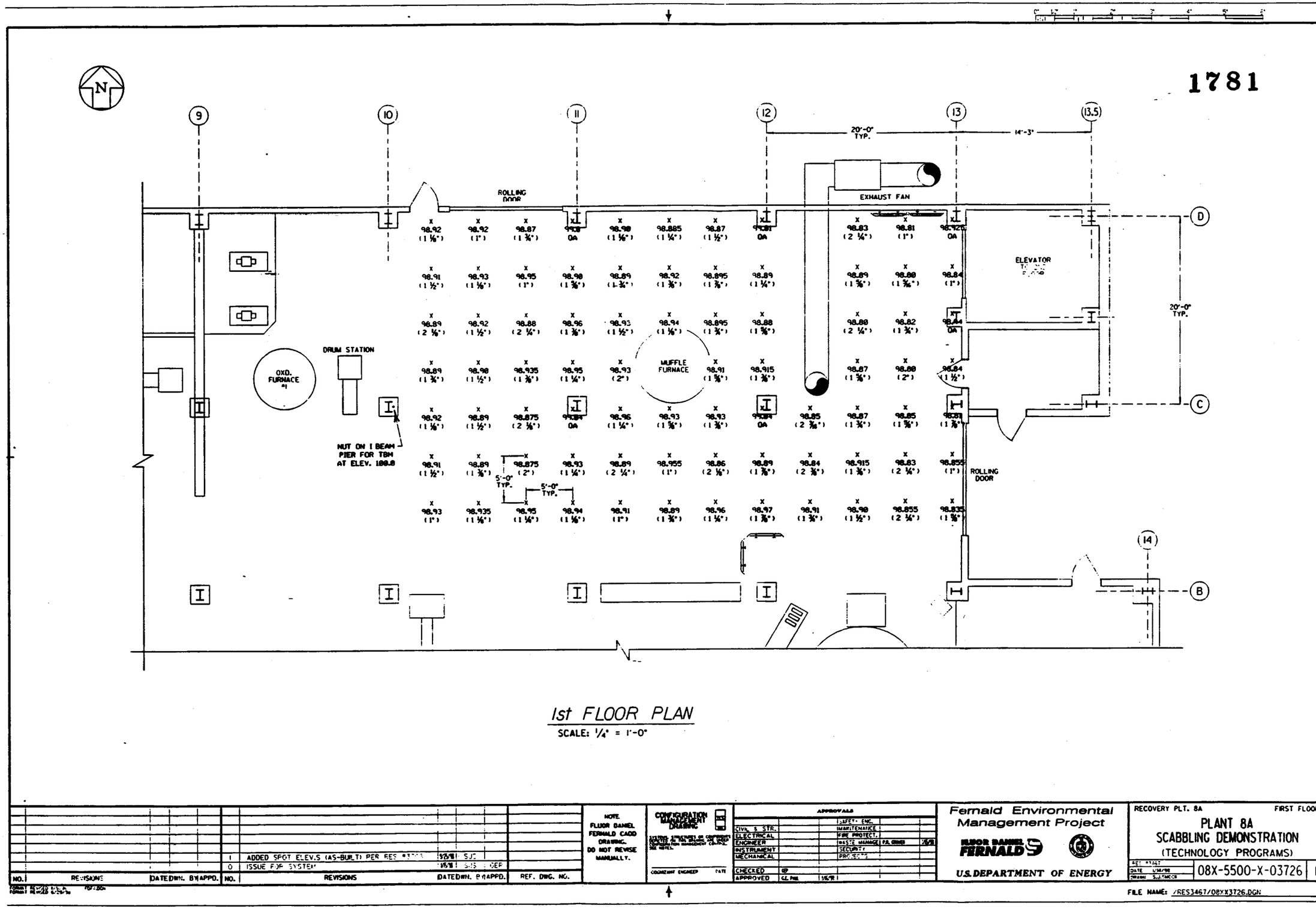

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FIGURE 5-1 Survey of Scabbling Depths

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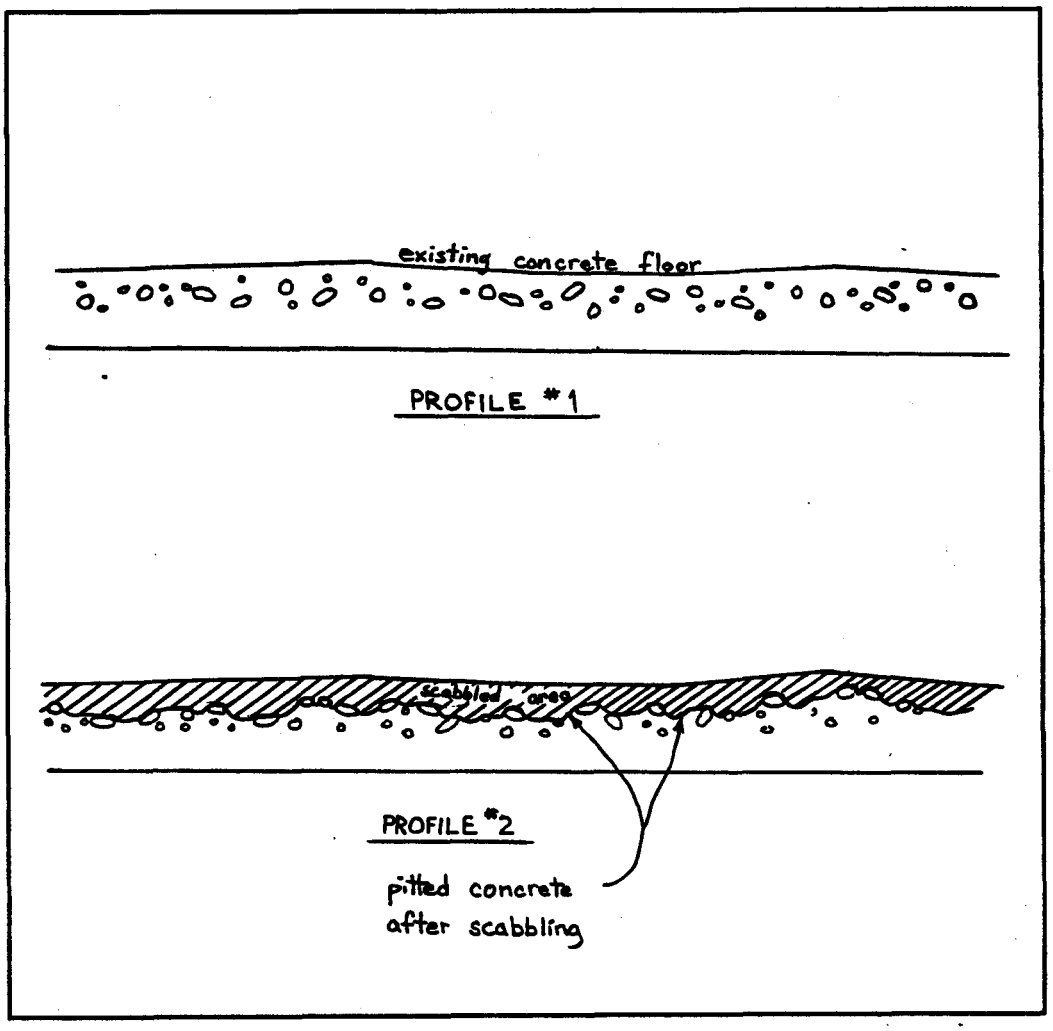

FIGURE 5-2 Before/After Cross-Section Illustrations of Concrete

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ATTACHMENT 1

PHOTOGRAPHS

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1	6917-D0021	Muffle Furnace Area Before Scabbling
2	6917-53	Muffle Furnace Area After Scabbling
3	6917-50	Close-up View Showing Stand-off Distance

Photo 1 Muffle Furnace Area Before Scabbling

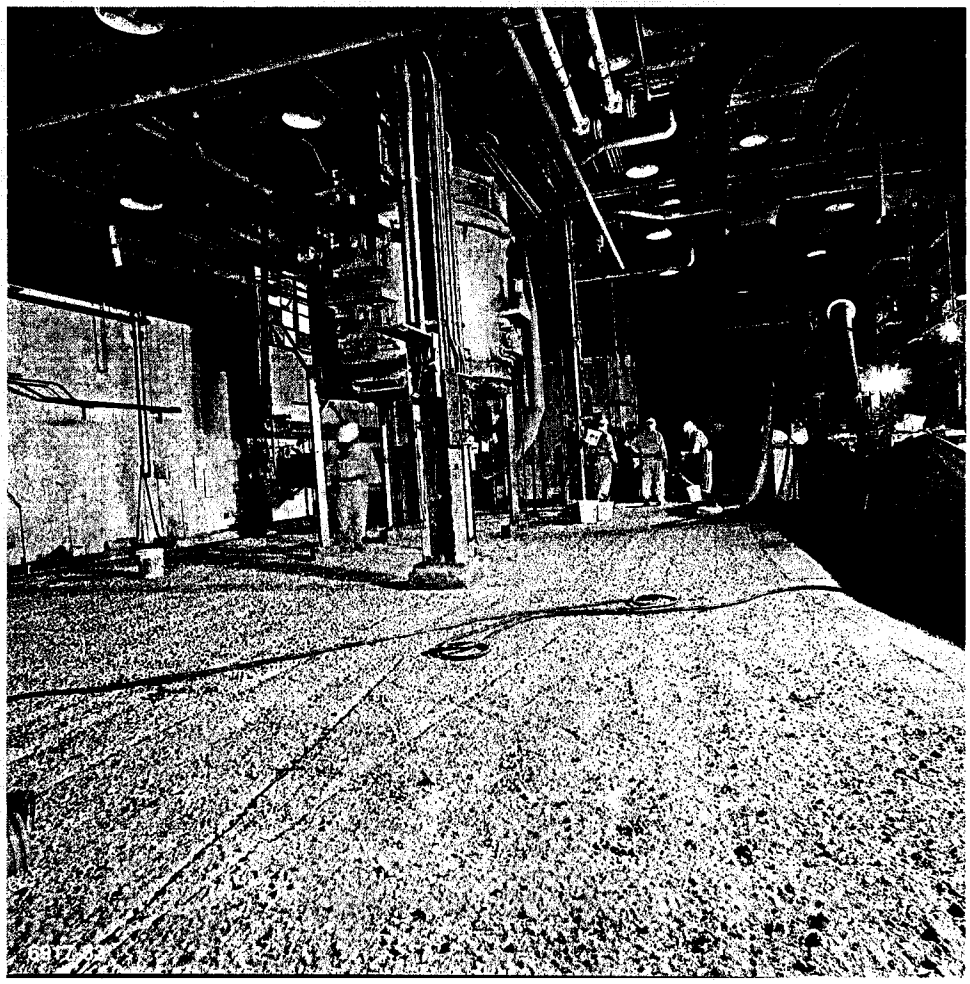

Photo 2 Muffle Furnace Area After Scabbling

Photo 3 Close-Up Showing Stand-Off Distance