U-006-105.8

168

APPENDICES A THROUGH H: STUDY AND EVALUATION OF K-65 SILOS FOR THE FMPC

1-1-90

BNI/DOE
DOE-ACO5-81OR20722
90
REPORT

R-008-104.2

0168

Bechtel National, Inc.

APPENDICES A THROUGH H STUDY AND EVALUATION OF K-65 SILOS FOR THE FEED MATERIALS PRODUCTION CENTER AT FERNALD, OHIO

DOE/OR/DE-AC05-81OR20722

4.29 1590.2

168

Appendices A through H
Study and Evaluation of K-65 Silos
for the
Feed Materials Production Center
at
Fernald, Ohio

JANUARY 1990

Prepared for
United States Department of Energy
Oak Ridge Operations Office
Under Contract No. DE-AC05-81OR20722

By

Bechtel National, Inc.
Oak Ridge, Tennessee

Bechtel Job No. 14501

2

APPENDIX A

CONCLUSIONS EXCERPTED FROM CAMARGO REPORTS

APPENDIX A

CONCLUSIONS EXCERPTED FROM CAMARGO REPORTS[4]

1.0 K-65 SILOS STUDY & EVALUATION REPORT

1.1 The base slab and walls at this time are structurally stable under the existing static loads being applied to them and should continue to be so for approximately 5 to 10 years.

1.2 If either the contents of the silos or the silo are removed, they must be removed, they must be removed simultaneously or failure of the walls or base slab could result.

1.3 The center 20 foot diameter portion of the dome top is structurally unsound for a load greater than the existing static dead load and no life expectancy can be assigned to it.

1.4 The application of a three foot thick earth fill load on the dome or the application of a tornado suction or pressure loads, would cause a structural failure of the dome.

1.5 The application of the "defined" synthetic earthquake would induce some additional cracking in the base slab and at the base of the silo wall, but the silo would still be in a serviceable condition. The dome would be unaffected, and should simply move with the ground motions.

1.6 If a cover is chosen to cover the center portion of each silo dome, the weight should be as light as possible and in no case should it be greater than that allowed by the buckling capacity of the dome (approximately 11,000 pounds).

---

[4] **Refs. 1-1 and 1-2.**

2.0 METAL OXIDE AND EMPTY SILO STUDY & EVALUATION REPORT

2.1 Static Results - Dome

Based on field investigation of Silos 3 and 4, the domes seem to be in good condition, exhibiting little distress or deterioration. Slight inconsistencies which do exist are judged to be the result of construction tolerances.

Silo 3 was modeled for finite element analysis using the existing contents load. The dome exhibits hoop stress ranging form 173 psi compression at the perimeter to 35 psi tension at the dome center.

Since Silo 4 has never been used for storage, the content load used for the finite element analysis was the original design content load. The dome exhibits compressive hoop stress over nearly all of its surface. At the dome center a slight tensile hoop stress of 4 psi exists. The maximum compressive hoop stress is 179 psi. This occurs near the dome perimeter.

2.2 Static Results - Wall

Non-destructive testing of both the silo walls indicates only minor concrete thinning has occurred. Also, vertical post-tensioning unit reinforcement steel bundles show no deterioration. However, the horizontal post-tensioning wires do indicate some reduction of area. This loss of area is most prevalent in regions where the silo walls have through cracking.

Silo 4 experiences a greater loss of horizontal post-tensioning wires than Silo 3. The fact that Silo 4 has never

been filled may have contributed to the amount of cracking exhibited in the walls. This would be due to the long term effects of creep on unloaded post-tensioned members causing additional deformation.

For the finite element analysis of Silo 4, the original design content load was used. The results showed net tension in hoop stress at some levels of the silo walls. The maximum tensile increase in the post-tensioning wires is 17,000 psi at approximately 8 feet above the silo floor. Since the objective of the post-tensioning is to keep the walls in compression, the allowable lateral load due to silo content should be reduced to 85% of original design values. If the walls go into tension, additional cracking could result since for tension the concrete can resist only approximately 100% of its design strength.

Additionally, in order to prevent water infiltrating through the cracks in the domes and prevent further corrosion of the post-tensioning wires a waterproofing coating should be applied to the silo exterior.

2.3 Base Slab

Field investigation revealed several through slab cracks in both Silos 3 and 4. The presence of these cracks would not adversely affect the structural behavior of the silos. However, the cracks would preclude storing a liquid type material in the silos as this would result in leakage through the cracks. Currently Silo 3 is filled with a dry material. Silo 4 has not yet been used but it does have a certain amount of water in the bottom. The existing water should be removed before using Silo 4 for storage.

2.4 Combined Static and Dynamic Results

The dynamic analysis of Silos 3 and 4 were similar to that performed on the two K-65 storage tanks and presented in "K-65 Silos Study and Evaluation." February 25, 1986 by Camargo Associates, Limited. The method of analysis was a time history finite element analysis using the ASHSD2 program. The analysis methods and results are described in detail in [Ref. 1-2] Appendix D.

All silo models assumed zero damping during the computer runs. This is slightly conservative because, unlike the K-65 silos, there is no earth berm built up around the silos. Therefore, the only damping present in the system is the natural damping of the silos themselves, which for a structure of this type is approximately only 3%. Under the induced 50 year earthquake, both silos proved to be very ductile structures. As the ground moved with the earthquake, the silos did not attempt to resist these movements. This produced rather large displacements with relatively low stresses.

Silos 3 and 4 (with design contents load) behave somewhat different than Silo 4 empty. The contents tend to add mass to the system without increasing the stiffness, thus intensifying the earthquake's effect on the silo over time. At the end of the earthquakes duration (10 seconds), stresses and displacements at the top of the wall and dome were still increasing due to resonance. Maximum stresses were still below allowable stresses at 9.9 seconds and decreased very rapidly once the earthquake ended. Since the earthquake modeled had the longest anticipated duration for the Fernald, Ohio Region, the encountered resonance should not be a problem.

The base slabs of Silo 3 and 4 filled, experienced very little displacement or stress. The silo wall incurred a maximum shear stress of 79.9 psi at 9.9 seconds with maximum displacements of 1.5 inches horizontally and 2.25 inches vertically. The walls will remain serviceable, but should experience some cracking due to the high displacements.

The dome experienced extremely low longitudinal stresses (1.5 psi max.) and hoop stresses (1 psi max.). In-plane stresses were larger, reaching 264 psi at 9.9 seconds near the dome center. Maximum displacements in the dome were 1.5 inches horizontally and 2.25 inches vertically near the dome edge. The dome, like the wall, should remain serviceable but experience some cracking.

Silo 4 empty incurred somewhat higher stressed than Silos 3 or 4 full but without resonance. Maximum stresses and displacements occurred at 8.7 seconds and decreased for the remainder of the earthquake.

The base slab experienced virtually no displacement and very little stress (only as high as 4 psi shear) throughout the earthquakes duration. Likewise the silo wall experienced small stresses. A maximum hoop stress of 19 psi occurred near the base of the wall at 6.3 seconds into the earthquake. Displacements were large, however, with maximum deflections of 1.6 in. radially and 2.0 in. vertically. The walls, while remaining serviceable, should experience some cracking due to these movements.

The dome also had large deflections, but unlike the wall, showed some large stresses as well. Shear stresses in particular were large, reaching a maximum 378 psi near the dome center. Longitudinal and hoop stresses remained very low (less than 1 psi), which were a result of the silos ductility.

A maximum combined static and dynamic stress of 424 psi shear occurred at the dome center of Silo 4 empty. While the stress is large, it is still below the modulus of rupture for the dome of 444 psi (7.5 (f'c), ACI 3/8/83 Sect. 9.5.2.3). Also, field investigation showed that the wire mesh reinforcement in both domes was in good condition. This further adds to the tensile capacity of both domes.

Both silos should remain serviceable with some microcracking occurring in the dome and wall.

2.5 Tornado Load

Tornado suction loading acts symmetrically on the exposed silos due to a pressure drop around the exterior of the exposed silos. This resulting load is 432 psf acting outward. This load is applied as a nodal load on the outside nodes of the dome and silo wall.

Under tornado suction the silo domes experience both radial and hoop compressive stresses in excess of 300 psi over the major portion of their span. The maximum tensile stress encountered in the domes is over 400 psi in both radial direction and hoop stress.

The silo walls experience significant tensile bending stress in their upper regions. Hoop stresses are not adversely affected in the wall of Silo 3. Hoop stress in the wall of Silo 4 is in tension when combined with full content load. The silo dome remains as the critical element under tornado suction loading.

APPENDIX B

DOCUMENTATION PROVIDED TO BECHTEL NATIONAL, INC. BY WESTINGHOUSE MATERIALS COMPANY OF OHIO

1. Camargo Associates, Limited. K-65 Silos Study & Evaluation Report, Cincinnati, Ohio, February 1986.

2. Camargo Associates, Limited. Metal Oxide and Empty Silo Study & Evaluation Report, Cincinnati, Ohio, May 1986.

3. U. S. Department of Energy. Factsheet K-65 Silos.

4. Catalytic Construction Co. Third Party Test Report On Material, TTM No. 13. Cincinnati, Ohio, September 11, 1951.

5. Catalytic Construction Co. Third Party Test Report On Material, TTM No. 13A. Cincinnati, Ohio, September 14, 1951.

6. Catalytic Construction Co. Third Party Test Report On Material, TTM No. 25. Cincinnati, Ohio, October 17, 1951.

7. Catalytic Construction Co. Third Party Test Report On Material, TTM No. 28. Cincinnati, Ohio, October 19, 1951.

8. Catalytic Construction Co. Third Party Test Report On Material, TTM No. 75. Cincinnati, Ohio, November 12, 1951.

9. Catalytic Construction Co. Third Party Test Report On Material, TTM No. 83. Cincinnati, Ohio, November 28, 1951.

10. Catalytic Construction Co. Third Party Test Report On Material, 3 TTM No. 124-125. Cincinnati, Ohio, March 28, 1952.

11. Drawing No. F.D. 3034-A-01-A, Dowell Details of Trench Tie-in. Catalytic Construction Co. Index Code 34X 1450-S-00072.

12. Drawing No. 3034-H-53-A, Rev. 3, General Layout K-65 Storage Area. Catalytic Construction Co. Index Code 34X 1450-P-00023.

13. Drawing No. 3034-H-55-A, Rev. 3, Trench Piping Plan, Catalytic Construction Co. Index Code 34X 1450-P-00026.

14. Drawing No. 3034-H-56-A, Rev. 3, Trench Piping Sections. Catalytic Construction Co. Index Code 34X 1450-P-00027.

15. Drawing No. 51T29-4, Rev. 1, Vertical Prestressing Unit. Standard Detail. Type 1A. Two 125,000 C.F. silos, Fernald, Ohio. Preload Enterprises, Inc. Index Code 34X 1450-M-00093.

16. Drawing No. 51T20-6, Rev. 1, Two 125,000 C.F. Slurry Storage silos - Type K-65, Atomic Energy Commission, Fernald, Ohio. Preload Enterprises, Inc. Index Code 34X 1450-M-00089.

17. Drawing No. 34-4013, Rev. 0, K-65 Storage, Earth Embankment at K-65 silos. National Lead Company of Ohio. Index Code 34X 5000-M-00066.

18. Drawing No. 34-4015, Rev. 0, K-65 Storage, Earth Embankment at K-65 silos, Electrical. National Lead Company of Ohio. Index Code 34X 5000-M-00068.

19. Drawing No. 34-4018, Rev. 0, K-65 Storage, Drainage Facilities at K-65 silos. National Lead Company of Ohio. Index Code 34X 5000-G-00070.

20. Drawing No. 34X 5500-G-00082, Rev. 1, K-65 Storage, Repair of K-65 silo Embankment, Embankment Layout. National Lead Company of Ohio.

21. Drawing No. 34X 5500-G-00084, Rev. 1, K-65 Storage, K-65 silo Embankment Stabilization General Layout. National Lead Company of Ohio.

22. Drawing No. 34X 5500-G-00085, Rev. 0, K-65 Storage, K-65 silo Embankment Stabilization Sections & Details. National Lead Company of Ohio.

APPENDIX C

LETTER, DONALD E. GRAHAM TO R. B. BARBER, BECHTEL NATIONAL, INC. "JOB # 14501, FUSRAP PROJECT FERNALD K-65 SILOS - SILO # 4 EVALUATION OF CONCRETE," CCN , NOVEMBER 27, 1989.

DONALD E. GRAHAM
CONSULTING MATERIALS ENGINEER
2239 COLONIAL CT.
WALNUT CREEK, CA 94598
(415) 932-0509

November 27, 1989

Mr. R. B. Barber, Project Manager
Bechtel National Inc.
P. O. Box 350
Oak Ridge, Tenn. 37831 - 0350

Re: Job #14501, FUSRAP Project Fernald K-65
Silos - Silo #4 Evaluation of Concrete

Dear Mr. Barber:

I have reviewed the original design documents, concrete core sampling technics, concrete core compressive and tensile strengths and the petrographic analysis of cores for the subject K-65 silo #4 and my findings are as follows:

SILO #4 CONSTRUCTION

A 2500 psi f'c, 5.5 sack, 3/4" maximum size aggregate concrete was specified for the 4" silo foundation. This mix was placed with a 5" to 6" slump and weighed approximately at 152# ft^3. Actual seven day average compressive strengths were 3025 psi with an average 28 day compressive strength of 3671 psi.

The 6" thick wall and the dome concrete (4" thick at the outer periphery of the structure reducing to approximately a 2½" to 3" thick section in the center of the dome) was specified to be a 4500 psi f'c, 7 sack, 3/4" maximum size aggregate concrete. This mix was placed with a 6" slump and weighed approximately 156# ft^3. The average compressive strength of this mix was 3289 psi at 7 days and 5205 psi at 28 days.

Type I cement was used in the concrete judging from the compressive strength gain from 7 to 28 days. No air entrainment was used in the concrete for durability to protect against freezing and thawing conditions and no pozzolan was used to prevent reactivity between the alkalies of the cement and reactive rock constituents.

Reinforcing steel was used in all concrete members except for the center of the dome where a wire mesh was used in the reduced thickness of the dome.

An asphalt coating was placed on the outside walls of silos #1 and #2 in 1964 to prevent internal corrosion and natural deterioration. An earthen embankment was then placed around the two silos to prevent further concrete weathering.

November 27, 1989

A protective covering was placed over the centers of Silo #1 and #2 in 1986. In 1987, a foam insulation was applied to the domes of Silo #1 and Silo #2 to further protect the concrete from weathering, temperature changes and radon gas emissions.

BECHTEL CONCRETE TESTING

Concrete core samples were obtained from Silo #4 by Geoteck Engineering Company of Oak Ridge, Tennessee using a 3" outside diameter core barrel which produced a 2 3/4" diameter core.

During the core drilling, the crew informed Bechtel that it was impossible to obtain a complete core without cracks, stating that some cores were so badly fragmented that additional cores had to be obtained.

I received a 4 piece fragmented core from Silo #4 wall at approximately 320° azimuth for observation on November 4, 1989. The sample was visually examined with a hand lens and the specimen had reaction rims around the perimeter of some of the aggregate particles and alkali silica gel or calcium carbonate in cracks and voids which is generally associated with alkali aggregate reaction.

Of the five samples taken from the dome, one was fragmented and not suitable for testing. Of the eight cores taken from the wall, four were fragmented and not suitable for testing. Intact cores, three dome, four wall and one foundation core was tested for compressive strength and one wall core was tested for tensile strength. Results are as follows:

Compressive Strength Cores	Location	PSI
B91C02D	Dome	2062
B91C93D	Dome	1306
B91C04D	Dome	2475
B91C08W	Wall	2531
B91C09W	Wall	1463
B91C09W	Wall	2501
B91C12W	Wall	1614
B91C18F	Foundation	3214

November 27, 1989

Tensile Strength Core

B91C13W	Wall	463

The Silo #4 wall and dome concrete had a compressive strength of 5205 psi at 28 days after the concrete was placed. The dome concrete cores had an average compressive strength after 37 years of 1948 psi or a loss of 63% of its strength. If the lowest compressive strength core, 1306 psi strength is used for the dome, the concrete has lost 75% of its strength since the structure was completed.

The wall concrete cores has an average compressive strength after 37 years of 2027 psi remaining strength or a loss of 61%. If the 1463 psi lower core strength is used for the wall concrete, it has lost 72% of its compressive strength.

The tensile strength cores from the wall was tested and had a splitting tensile strength of 463 psi, which is excellent if true. Generally, tensile strength runs from 8% to 10% of the the compressive strength of concrete. Since some of the wall concrete had a 1463 psi compressive strength, it is more realistic that the tensile strength was in the approximate range of a 100 to 150 psi.

Petrographic Analysis of Cores

Twin City Testing Corporation of St. Paul, Minnesota performed the petrographic analysis on core samples #B9-1Co1D, #B91C05D, #B91C07W and B91C19 Grout. Their report dated 11-17-89 conclusions were as follows:

1. The overall quality of the concrete was poor. All three cores were extensively cracked throughout. The cores show the concrete to be placed with a high slump producing a more porous and less durable concrete. The higher porosity of the concrete appeared to allow water to migrate through the concrete removing cement as calcium carbonate in liquid form. Upon oxidizing it formed a white calcium carbonate effloresence along fractures in the concrete and on out side faces of the concrete structure.

In addition, secondary deposits of ettringite with reaction rims around coarse aggregate particles appear to indicate minor alkali aggregate reaction.

November 27, 1989

2. The overall quality of the grout sample (gunite) was good. No evidence of micro-cracking or alkali aggregate was noted.

Twin City Testing results stated the overall quality of the concrete cores were poor based on the following factors:

1. 3/4" maximum size gravel was well graded and uniform.
2. Fly ash pozzolan was not used.
3. Paste color was tan to buff with slump estimate to be between 4" to 6".
4. Paste was judged to be medium to hard with bond to aggregate fair to good.
5. Carbonation was negligible to 1/16" indicating medium porosity.
6. Micro-cracking was observed throughout all cores.
7. Water/cement ratio of the cores was estimated to be 0.50 to 0.55 with 3% unhydrated cement.

CONCLUSIONS

- Data obtained from constructions records during our visit to the Fernald K-65 Silos on September 12, 1989 showed no air-entrainment or pozzolan was used in the concrete silos. This was verified byTwin City Testing Corporations petrograhic analysis.

Air entrainment would have provided durability to the concrete against freeze/thaw action.

- The pozzalan would have protected the concrete against alkali aggregatge reaction which produced some micro-cracking of the concrete due to expansion of the concrete. This expansion is the result of swelling of sodium silica gel produced by reaction between the alkalies of the cement (Na_2O) and (K_2O) and the reactive minerals in the aggregates,producing osmotic pressures over 300 psi tensile strength and concurrently micro-cracking in the concrete. If a pozzolan had been used, it would have absorbed and combined the alkalies forming sodic and potassic compounds which are incapable of swelling as they do not absorb water and concurrently makes the alkalies unavailable for reaction with the reactive rock constituents at a later date. This alkali aggregate reaction takes place while the concrete is still in a plastic state and as long as water soluble alkalies are released, dimensional stability is assured at an early age, generally from 60 to 90 days.

November 27, 1989

- K-65 silo construction records also show the slump of the concrete when placed was 6" which is high. This was verified by the petrographic analysis performed by Twin City Testing.

This high slump would produce a more porous concrete due to water in the mix migrating up after placement and settling under the coarse aggregate particles producing small voids.

- The internal micro-cracking and pattern cracking I contribute to the alkali aggregate reaction reported by the Twin City Testing Laboratories Petrographic analysis. This took place approximately 60 to 90 days after concrete placement and allowed rain water in inclement weather to migrate into the micro fractures. This migration of water during freezing and thawing cycles could through time expand the cracks and oxidize reinforcing and post tension steel in the concrete. This oxidation of steel could contribute to expansion of the concrete and fracture the post tension gunite protective covering .

- Silos #1 and #2 were not protected from the elements until 1964 when they placed a coating of asphalt on the walls and an earthen embankment was placed around both silos. This was done 12 years after the silos were constructed and by photographs taken at that time, the wall gunite grout had cracked in many areas around the periphery of all silos.

In 1968 a protective cover was applied to the center of the domes of Silos#1 and #2 and a foam insulation was applied to reduce weathering, extreme temperature changes and radon gas emissions. These coverings were placed over the domes of the 37 year old silos 34 years after construction and the concrete could be in the same condition as the Silo #4 dome concrete which was constructed at the same time and exposed to the elements only 3 years longer.

The protective cover has helped the concrete from the elements. There is no guarantee that rebar oxidation may still occur from moisture condensation inside the silos migrating through cracks reacting and expanding the concrete resulting in further concrete deterioration.

<u>OVERALL ASSESSMENT</u>

- The material of the silo concrete is in such a degraded condition that the life expectancy of the structure is questionable.

November 27, 1989

° I recommend the lower values for core compressive strength of the walls and dome be used for analysis and the tensile strength be computed using 8% to 10% of the above lower compressive strength values.

If I can be of further assistance, kindly advise.

Very truly yours,

Donald E. Graham

Donald E. Graham, P. E.

CF K. M. S. Mark
Roger Land
P. K. Wadia
O. K. Kiciman

APPENDIX D

INSTRUCTION GUIDE WORK PLAN FOR THE SILO 4 SAMPLING AT THE FEED MATERIALS PRODUCTION CENTER, FERNALD, OHIO, 191-IG-010, REVISION 1.

169

INSTRUCTION GUIDE

WORK PLAN

FOR THE

SILO 4 SAMPLING

AT THE

DEPARTMENT OF ENERGY

FEED MATERIALS PRODUCTION CENTER

FERNALD, OHIO

NO.	DATE	REVISIONS	BY	CHK'D	SUPV.	PE/EHS	PM
△							
△							
△							
△	12/28/89	Issued "As-built"	RL				
△	10/13/89	Issued for Use	RL				

ORIGIN AT		INSTUCTION GUIDE COVERING: Work Plan for Silo 4 Sampling	JOB NO. 14501	REV.
			191-IG-010	1
			SHEET 1 OF 11	

21

CONTENTS

1.0	SCOPE	3
2.0	FACILITY AREA	3
3.0	MATERIAL CHARACTERISTICS	3
4.0	PROCEDURE	3
4.1	Method	3
4.2	Operation/Application Consideration	4
4.3	Equipment Configuration	4
4.4	Supplies and Materials	4
4.5	Personnel	6
4.6	Process Application/Operation	7
4.7	Contingency	8
4.8	Evaluation of Risk	10
4.9	Decontamination Methods	10
5.0	HEALTH AND SAFETY	10
6.0	CONTAMINATION DETERMINATION	10
7.0	TRANSPORTATION AND DISPOSAL	10
8.0	QUALITY ASSURANCE	10
9.0	PERMITS/AGREEMENTS	11
10.0	CERTIFICATION AND DOCUMENTATION	11
10.1	Inspector's Daily Report	11
10.2	Revisions to Work Plan	11
10.3	Photographic Record	11
11.0	APPENDICES	11

1.0 SCOPE

The Department of Energy (DOE) Feed Material Production Center (Fernald Site) is located approximately 9 miles NW of Cincinnati, Ohio.

The purpose of this instruction guide is to delineate the methods and procedures which will be utilized to obtain concrete core samples from the dome, wall, and floor slab of Silo 4. The cores will be used to perform compressive and tensile tests and petrographic analyses. A petrographic analysis will also be performed on a sample of the gunite obtained from the outside of the silo wall.

2.0 FACILITY AREA

Silo 4, located on the west side of the Fernald site, was constructed in 1955. The silo is of cylindrical concrete construction, 80 feet in diameter and the walls are approximately 27 feet high. The silo dome rises an additional 10 feet above the walls.

There are exterior ladders on the silo and access to the interior of the silo may be made through nine 20-inch diameter manways located in the dome. There is no interior ladder. 1

3.0 MATERIAL CHARACTERISTICS

The walls of Silo 4 are 8 inches thick and are post-tensioned vertically and horizontally. The vertical prestressed anchor cables are internal to the wall structure and the horizontal prestressed cables are wrapped around the outside surface of the walls. A 2 inch coating of gunite covers the post-tensioned walls.

Reinforcing steel was used in all concrete members except for the center of the dome where a wire mesh was used in the reduced thickness.

Silo 4 is empty, has never been used for storage and is therefore not contaminated.

4.0 PROCEDURE

4.1 Method

The methods used to obtain the silo samples are normal construction techniques.

Core samples of the dome, wall, and floor slab of Silo 4 will be obtained using heavy duty diamond drilling

equipment. Equipment selection is limited because the narrow (20-inch diameter) manway access to the silo limits the size of the tools which may be inserted into it.

The cores of the dome will be taken from the exterior of the silo, and the cores of the walls and the bottom will be taken from its interior.

The core holes will be repaired using a fast setting concrete repair compound.

4.2 Operation/Application Consideration

This instruction guide is based in part on the following assumptions:

a) Five manways of Silo 4 will be opened and its internal atmosphere analyzed by Westinghouse Materials Co. of Ohio (WMCO) and Bechtel National, Inc. (BNI) personnel. 1

b) Water in Silo 4 will be removed, as required, by WMCO personnel.

c) Work will be performed inside of Silo 4 without the use of supplied air or self-contained breathing apparatus. An emergency breathing system will be available.

d) Process water (non-potable) is available, as a supply of cooling water for the core drill, on site. 1

e) Uncontrolled waste will be disposed of by WMCO.

4.3 Equipment Configuration

Not applicable.

4.4 Supplies and Materials

The following lists of equipment, supplies, and material are as comprehensive as may be determined prior to the initiation of actual field activities. The equipment will be supplied by Bechtel. The Bechtel supervisor may select other equipment or material for use at his discretion.

<u>a. Supplies and Materials</u>

1 ea	portable fire extinguisher, dry chemical or CO_2, 10-20 lb capacity
1 lot	packaging materials for 15 uncontaminated core samples (3" dia. x 6" max.) for tensile and compressive strength analysis

30 ea	expansion anchors, 1/2 inch diameter x 2 1/4 inch embedment, Hilti Kwik bolt KB-12-234 C or Bechtel approved equal
1 ea	emergency rescue system, 350 lbs. capacity, complete with tripod, 50 foot retracting lifeline, built-in winch, carabineer hook, and full body harness, meeting OSHA 1926.104 and ANSI A10.14 standards
100 LF	rope, general purpose, polypropylene, 1/2 inch dia., 700 lbs. working load limit
2 ea	2-inch wide, 10-feet long web slings, 4,000 lb choker load limit (minimum)
3 ea	emergency escape breathing apparatus, self-contained, NIOSH/MSHA approved.
1 ea	rope ladder, nylon rope, hardwood or aluminum rungs, loop ends, 40 ft long
2 ea	50 lb bag concrete repair compound, non-shrink, fast setting, Sonneborn Sonopatch or Bechtel approved equal.
2 ea	diamond masonry core bit, 3-in nominal size.
1 ea	tank, water 3 gal. capacity(cooling water supply to core drill bit)
3 ea	radio, hand held, rechargeable with charger
2 ea	electrical extension cord, 50 ft long
2 ea	electrical extension cord, 100 ft long
1 ea	tool box with wrenches, pliers, hammer, saw, screw drivers, tape measure, etc.
1 ea	tool bucket, canvas or nylon, 12 inch diameter x 17 inch length
1 ea	shop vacuum, wet-dry, with liquid recovery floor tool
1 ea	fish net (to catch dome core samples)

1 lot Miscellaneous material:

plastic sheeting, saw horses (2), 2" x 4" lumber, pen point trowels, marking pens (sample identification), buckets, rags, paint brush

b. Rental Equipment

The following equipment will be locally rented and will be used in areas of little or no surface contamination. All rental equipment will be surveyed and decontaminated, as required prior to release from the site.

1 ea. cargo van

1 ea. personnel and equipment lift, hydraulically operated boom or scissors lift, 40 ft lift height, 500 lbs capacity.

1 ea. portable electric generator, 25 KW capacity, with 6 ea. 115 VAC, 3-prong grounded outlets, 15 amp, and 1 3-prong outlet 30 amp, equipped with a ground-fault interrupter circuit.

1 ea. portable ventilation blower, 8500 CFM (minimum) at the outlet of 100 ft of duct, gasoline powered, with 100 LF of flexible duct (18 inch dia. max.) and duct carriers

2 ea. flood light, 120 VAC, 15 amp plug

2 ea. spotlight, 120 VAC, 15 amp plug

2 ea. telescoping stands, 12 ft high, must be capable of passing through a 20 inch dia. manway

1 ea core drill, electric, with stand, feed control, and leveling screws

1 ea. rebar detector

1 ea core drill, hand held

1.5 Personnel

The personnel performing the task described herein consist of:

1 BNI site supervisor

1 BNI site health and safety officer

2 BNI worker/technicians

4.6 Process Application/Operation

4.6.1 Deleted

4.6.2 Sampling Activities

BNI field activities will commence upon receipt of an approved FMPC Work Permit for the task described herein.

The first day's activities included 4-hour site specific training for the BNI personnel, obtaining passes for camera, radios and computer and a pre-construction meeting with WMCO required prior to issuance of work permit.

The second day's activities will include set up and check out of the air blower, core drill, portable generator, lights, emergency rescue system, and water supply. Air hoses and power lines will be connected to their supply units and rigged to the silo dome.

The equipment and supplies, which will be utilized to obtain the dome and interior samples, will be transferred to the silo dome and the sample of the gunite from Silo 4 will be obtained, surveyed, labeled, and packaged for shipment.

The silo dome sample locations will be identified using a rebar locator and the dome core samples will be obtained, surveyed, labeled and packaged for shipment. The dome coring cavities will be dry packed with Sonneborn Sonopatch or equal prior to entry into the silo.

There are 4 manways on Silo 4 and all will be used during sampling activities. Two flood lights will be suspended from manways located on opposite sides of the silo to provide general silo interior lighting. The rope ladder and emergency rescue system will be deployed from a third manway and its use will be exclusively for personnel access. The portable ventilation system hose, cooling water hose, and tools will be inserted into the silo from the fourth manway.

The blower will be energized prior to any personnel entering the silo. The site safety and health officer (SSHO) will don the emergency rescue system harness and an emergency escape breathing apparatus for the initial entry into the silo. The breathing apparatus will not be employed unless conditions require its use. The SSHO will perform a survey of the silo atmosphere prior to entry and continuously during work in the silo by the worker/technicians (workers).

The SSHO will doff the emergency rescue system lifeline for use by the workers while entering the silo. The workers will don emergency system harnesses and escape breathing apparatus and enter and exit the silo. The emergency rescue system lifeline will remain deployed at the bottom of the manway whenever individuals are in the silo and the lifeline is not in use.

A spot light was lowered into the silo and secured with rope to illuminate the locations from which a silo interior samples will be obtained. The core drill, drill bits, tool bag, and cooling water hose will be lowered into the silo.

A rebar detector will be used to locate an area from which a sample may be taken which will not contain rebar. The silo interior core samples will be hoisted to the dome for surveying, labeling, and packaging for shipment as they are obtained.

The wall core sample will be limited to a maximum depth of penetration of 7 inches. Grouting of the wall core cavities will take place prior to obtaining the floor core samples.

The silo floor cores will be the last obtained. The core sample cavities will be dry packed with Sonneborn Sonopatch or equal and all equipment and tools removed from the silo with the exception of the ventilation hose, suspended flood lights, rope ladder and the emergency escape apparatus.

The coring locations and silo interior will be inspected by the BNI site superintendent prior to removal of the ventilation hose, rope ladder, emergency escape apparatus, and suspended flood lights.

The manways will be closed and a final inspection of the area made by the BNI site superintendent after removal of all equipment from the silo dome.

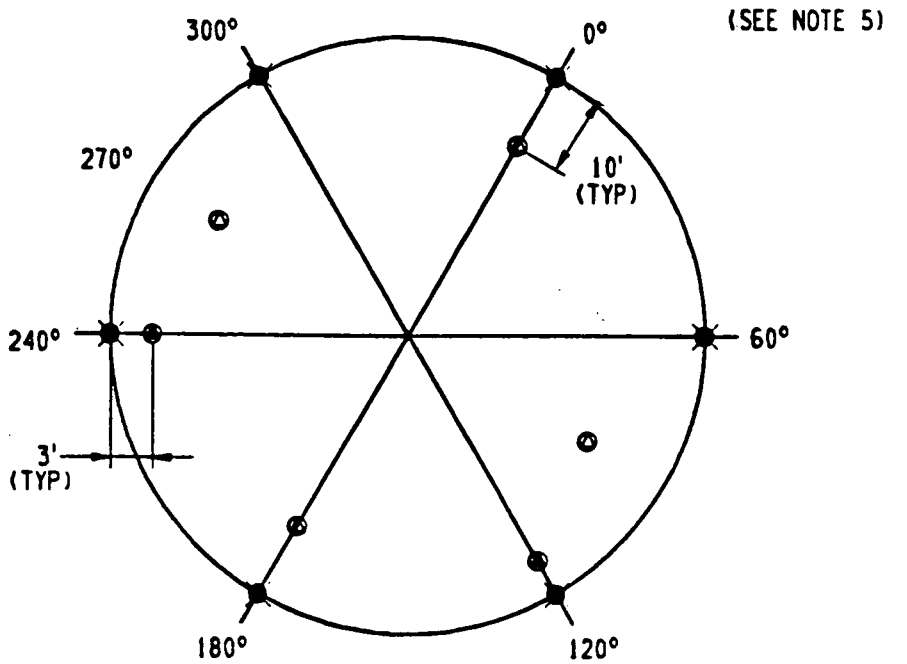
All equipment and material will be surveyed for radioactive contamination prior to removal from controlled areas.

4.6.3 Sample Locations

Core sample locations are shown on Figure 1.

4.7 Contingency

N/A



NOTES

1. CORE SAMPLES OF THE INTERIOR WALL CONCRETE WERE TAKEN AT AN ELEVATION OF 4FT. ±1FT. ABOVE THE FLOOR AT THE LOCATION SHOWN.
2. CORE SAMPLES OF THE DOME CONCRETE WERE TAKEN FROM THE THICKENED AREA AROUND THE ACCESS OPENINGS.
3. THE GUNITE COVERING SAMPLE WAS TAKEN FROM THE EXTERIOR WALL.
4. ALL SAMPLE LOCATIONS WERE DRY PACKED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
5. 0° SAMPLE POINT WAS ORIENTED WITH THE PERSONNEL ACCESS MANWAYS.

- INTERIOR WALL CORE SAMPLE 3" DIAMETER
- FLOOR CORE SAMPLE 3" DIAMETER
- 20" ACCESS OPENING (SEE NOTE 2)

FERNFIG1.DGN

FIGURE 1 CORE SAMPLES TANK 4

4.8 Evaluation of Risk

A Quality Assurance Assessment evaluating the consequences of failure has been performed and is attached to this IG (Appendix A).

4.9 Decontamination Methods

All equipment and material used to obtain the silo samples will be decontaminated, as required, using manual decontamination procedures.

5.0 HEALTH AND SAFETY

The work defined in this IG will be performed in accordance with the site specific safety and health plan (Appendix B). The plan includes specific safety and health procedures to be followed at various phases of the work activity (Appendix C).

6.0 CONTAMINATION DETERMINATION

WMCO will provide a radiation technician to monitor silo work activities and survey personnel, equipment, and material prior to removal from the controlled area.

7.0 TRANSPORTATION AND DISPOSAL

Wastes generated by the sampling procedures described herein are expected to be neither radioactively nor chemically contaminated and will therefore be disposed as uncontrolled waste. The waste will be disposed by WMCO.

8.0 QUALITY ASSURANCE

The work described herein shall be performed in accordance with the Formerly Utilized Sites Remedial Action Program, Quality Assurance Program Plan (approved by DOE-ORO) and implementing procedures and instructions. Specifically the following will be accomplished.

- The core samples will be taken from the locations indicated in section 4.6.3.
- Each core sample will be uniquely identified such that each will be traceable to the location indicated in section 4.6.3.
- Each core sample will have its unique identification number marked on it using a permanent marker.

- Core samples shall be obtained per ASTM C 42, "Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete."
- Cores will be suitably protected for transfer to the testing laboratory.
- A chain of custody form will be used for transmitting the cores to the testing laboratory.

9.0 PERMITS/AGREEMENTS

A confined space entry permit, waste area entry permit, and radiological work permit, meeting the requirements of Appendix C, were issued by WMCO prior to personnel entry into Silo 4. The permits are attached as Appendic C. 1

A camera pass, computer pass, and radio permit were provided by WMCO.

10.0 CERTIFICATION AND DOCUMENTATION

10.1 Inspector's Daily Report

Completed Inspector's Daily Report (IDR) forms are attached as Appendix D, to this "as built" instruction guide.

10.2 Revisions to Work Plan

Any revisions to the work plan will be approved by the BNI project manager, or his representative, prior to their implementation.

An "as built" revision of this instruction guide will be written upon completion of the work and will include any changes made to this procedure.

10.3 Photographic Record

A photographic record of the sampling of Silo 4 will be maintained by BNI.

11.0 APPENDICES

Appendix A, QAA 191G-01, Rev. 0

Appendix B, Safety and Health Plan for the K-65 Silo Evaluation

Appendix C, FUSRAP PI 24.161, Hazardous Work Permits (HWPs)

Appendix D, Inspector's Daily Reports (IDR's) 1

APPENDIX A

QAA 191G-01, REVISION 0

DEPARTMENT OF ENERGY
FORMERLY UTILIZED SITES
REMEDIAL ACTION PROGRAM
BECHTEL JOB 14501 (FUSRAP)

QUALITY ASSURANCE ASSESSMENT

SITE IDENTIFICATION Feed Materials Production Center, Fernald, Ohio QAA # 191G-01

SUMMARY DESCRIPTION

This assessment is for the concrete core and gunite sampling activities of Silo 4 at the Feed Materials Production Center, Fernald, Ohio. The work will be performed, monitored, and documented by Bechtel National, Inc.

The work may include:

- Obtaining core samples from the concrete dome, inside walls, and floor of Silo 4
- Obtaining a sample of the exterior gunite wall coating
- Packaging and transfer of samples to testing labs

A meeting was held on September 29, 1989.

ASSESSMENT RECOMMENDATIONS (see attachment(s))

yes no
☐ ☒ A Quality Action Plan (QAP) is required. If yes, by _____
☐ ☒ A Revised QAP is required. If yes, by _____

REV#	COGN ENG	PROJECT ENG	EH&S	F. CONST	PQAS	PROJECT MANAGER	DEP. PROG MANAGER	PROGRAM MANAGER	DATE
0	[illegible]	HJD	[illegible]	[illegible]	[illegible] 10/13	RRL for EBB	HJD for RRH	HJD for GKH	10.13.89

IF DESIGN IS LESS THAN 100%, ENTER % COMPLETE

QUALITY ASSURANCE ASSESSMENT WORKSHEET

SITE DESCRIPTION: FEED MATERIALS PRODUCTION CENTER, FERNALD, OHIO

ISSUE DATE: 9/29/89
QAA NO.: 1916:01

ITEM NAME AND NUMBER	FAILURE MODE	FAILURE EFFECT	CONSEQ	PROBAB	RATTLE	ASSESS	POSSIBLE CAUSES	COMMENTS
1. General	• Encountering unsafe atmosphere	• Asphixiation, physical harm, poor public relations	S	L	E,F,G	R		• Site will be ventilated. A site Health and Safety technician will be present and ongoing testing of the atmosphere will be performed.
	• Unauthorized entry into work areas	• Personnel injury, poor public relations	S	L	F,G	R		• Work activities are performed in controlled areas. Site specific training will identify restricted areas.
	• Improper use of equipment	• Personnel injury, poor public relations	S	L	E,F	R		
2. Obtaining Samples	• Unsafe Work practices	• Personnel injury from uncontrolled equipment or dropped material	S	L	E,F,G	R		• Personnel will be instructed not to override equipment safety features.
	• Falls	• Personnel falling off or into silo 4	S	L	E,F			

C2210-1001.1

064253

34

68

QUALITY ASSURANCE ASSESSMENT WORKSHEET

REV. NO.: 0
ISSUE DATE: 9/29/89
QAA NO.: 1916:01

SITE/WORK DESCRIPTION: FEED MATERIALS PRODUCTION CENTER, FERNALD, OHIO

ITEM NAME AND NUMBER	FAILURE MODE	FAILURE EFFECT	CONSEQ	PROBAB	RATING	ASSESS	POSSIBLE CAUSES	COMMENTS
3. Access Agreement (Entry Permits)	• Failure to obtain entry permit for Site 4	• Cancellation or postponement of on site activities, cost and schedule impacts; poor public relations	S	L	G	R		• Site operator is participating in review of planned activities and their concerns will be addressed prior to start of field activities.
4. Scheduling	• Failure to complete work by required date.	• Increased cost	S	L	F	R		

C2SQ.1001.1

064259

- **CONSEQ - CONSEQUENCES OF FAILURE** [1,2]

  I - Insignificant
  S - Significant
  U - Unknown
  X - Unacceptable

- **PROBAB - PROBABILITY OF FAILURE**

  L - Low
  H - High
  U - Unknown

- **RATNLE - RATIONALE FOR ASSESSING PROBABILITY OF FAILURE** [3]

INSIGNIFICANT CONSEQUENCES OF FAILURE

1. Contamination should be local and can be cleaned up.
2. Entrance of small amount of water to waste will not cause spread of contamination.
3. Amount of radioactive material would be small.
4. Backup system provided to prevent or minimize release radioactive material.
5. Other - (Identify in comments).

LOW PROBABILITY OF FAILURE

A. History of low failure frequency in similar application.
B. Standard off-the-shelf hardware of proven application.
C. Redundance or backup system is provided to maintain plant performance in event of failure.
D. Design, test and operational experience will establish mature, reliable design.
E. Normal use of proven and established standard practices (test, inspection, procedures, etc.) will assure adequate quality.
F. Training program and standard operating procedures will provide adequate human reliability.
G. Other (Identify in comments).

- **ASSESS - ASSESSMENT CLASSIFICATION** [4]

  R - Routine
  S - Special

FOOTNOTES

1. Consider: Personnel and public health and safety, environmental impact, program objectives, monetary loss, public reaction per pp. 1308, section 4.3.
2. If consequences of failure are "Insignificant" or "Unacceptable" go directly to Assessment Classification.
3. Provide rationale for elements having "Insignificant" consequences of failure or "Low" probability of failure occurrence. See rationale codes for "Routine" classification.
4. See pp. 1308, section 4.3 for guidance on basis for classification.

APPENDIX B

SAFETY AND HEALTH PLAN FOR THE K-65 SILO EVALUATION

SAFETY AND HEALTH PLAN

FOR THE

K-65 SILO EVALUATION

October 1989

BECHTEL

SAFETY AND HEALTH PLAN

FOR THE K-65

SILO EVALUATION

CINCINNATI, OH

Prepared by:	Safety and Health Coordinator	10/13/89 Date
Approved by:	Benny S. Howard Safety and Health Supervisor	10/13/89 Date
Approved by:	Edward M. McNurnee for WLB Environmental, Health and Safety Supervisor	10/13/89 Date
Approved by:	R. T. Hamilton Quality Assurance	10/13/89 Date
Approved by:	L. W. Daly for G.K. Honey Program Manager	10/13/89 Date
Approved by:	L. H. Dickson Safety and Health Services Manager	10/13/89 Date

EMERGENCY ASSISTANCE SERVICES
WMCO CONTACTS

WMCO MEDICAL DEPARTMENT.....513-738-6217

WMCO EMERGENCY.....513-738-6511

HAMILTON COUNTY EMERGENCY.....513-825-2260

BUTLER COUNTY EMERGENCY.....513-867-5700

Manager of Health Physics
Stuart Hinnefeld, WMCO.....513-738-6215

Contractor Health & Safety Coordinator
Gregg Johnson, WMCO.....513-738-6897

Utilities Engineer.....513-738-6295

BECHTEL CONTACTS

Management Switchboard.....615-576-1699

Project Manager.....615-481-2203

Deputy Program Manager.....615-576-3997

Environmental, Health and Safety Supervisor.....615-576-5031

Safety and Health Supervisor.....615-576-1842

Operations Supervisor.....615-576-0415

TABLE OF CONTENTS

		Page
1.0	Introduction	1
	1.1 Site History	1
	1.2 Project Organization	1
2.0	Hazard Analysis	2
3.0	Medical Surveillance	3
	3.1 General	3
	3.2 Baseline and Annual Health Assessment	3
	3.3 Termination Examination	4
	3.4 Supplemental Examination	4
4.0	Bioassay Program	5
5.0	Personal Protective Apparel and Equipment	6
6.0	Training	7
	6.1 General	7
	6.2 Site-Specific Training	7
7.0	Emergency Response and Notification	8
	7.1 General	8
	7.2 Occupational Injuries	8
	7.3 Fire	8
	7.4 Evacuation	8
8.0	On-Site Communication	10
9.0	Confined Space Permits	11
10.0	Administrative/Engineering Controls	12
11.0	Safety and Health Monitoring	13
	11.1 Monitoring Rationale	13
	11.2 Oxygen Deficiency Monitoring	13
	11.3 Noise Monitoring	13
	11.4 Total Organic Vapor Monitoring	13
	11.5 Lower Explosive Conditions	13
	11.6 Total Dust/Free Silica Monitoring	14

168

1.0 INTRODUCTION

The Safety and Health Plan (SHP) has been developed to provide the practical framework for safety and health during the Fernald Tank Reanalysis. The SHP provides the basic direction for all safety and health activities and will be referenced throughout this document.

The intent of the Fernald Site (SHP) is to provide the site-specific information required to implement an effective safety and health program. This will enable site-specific information to be readily available to site employees, increasing the effectiveness of the site safety and health program.

1.1 SITE HISTORY

The Feed Materials Production Center (FMPC) was constructed in 1951 and was in full production in 1953 under the Atomic Energy Commission. National Lead of Ohio (NLO) was the contractor from 1951 to 1985, and Westinghouse Materials Company of Ohio (WMCO) has been providing contract services in January of 1986. The Department of Energy became the government agency responsible of the site in 1977, succeeding the Energy Research and Development Association which replaced the AEC.

The FMPC consists of nine plants, each responsible for specific steps in manufacturing uranium metal products. The area were the SILO investigation will be performed is located on the west side of the site where other SILO's containing K-65 residues are stored.

The work will involve an investigation of SILO 4 which has never been used for storage and is currently empty. The instruction guide details the SILO specifications.

1.2 PROJECT ORGANIZATION

The Bechtel Safety and Health Group (S&H) of the Environmental, Health, and Safety (EH&S) Department is responsible for the development and implementation of all safety and health criteria. The S&H Supervisor, or designee, will assign individuals to fill the site safety and health positions for the Fernald Silo Evaluation. A written list of personnel assigned to the project will be maintained at the site.

168

2.0 HAZARD ANALYSIS

The hazardous materials known or suspected during the work activity are listed below:

Methane*
Silica
Cristobalite
Quartz
Uranium*
Thorium*
Radium*
Oxygen deficiency atmosphere
Radon

*Remote possibility

Consequences from exposures to the above chemicals or radioactive materials may cause blood abnormalities, central nervous system damage, kidney damage, liver damage, edema, chemical asphyxiation, cancer, and death. Pathways into the body include inhalation, skin absorption, and ingestion. Material Safety Data Sheets (MSDSs) and other technical data for each identified chemical shall be on-site and used in training as required by the Hazards Communication Standard.

The degree of risk to personnel from each of the contaminants depends upon the amount of material encountered and the way in which it is contacted.

Engineering and/or administrative controls, along with personal protective equipment, will be used to minimize exposure to radioactive materials and toxic chemicals. Section 10 specifies the appropriate engineering controls to be used to minimize exposure to toxic substances whenever practicable. Section 5.0 identifies administrative controls and specifies personal protective apparel and/or equipment to be provided and used when engineering controls cannot reduce airborne contaminants to below permissible limits or when the potential for exposure to contamination exists.

168

3.0 MEDICAL SURVEILLANCE

3.1 GENERAL

Medical surveillance shall be conducted for personnel required to work in the restricted work area. The restricted work area will consist of the interior of SILO 4 and the exterior dome surface. These personnel shall undergo a baseline medical evaluation before participating in on-site operations. All medical surveillance records will be made available to individual employees upon request.

The project shall procure the services of a physician who is qualified to perform occupational health examinations. The physician may perform evaluations of the medical examination results to determine a pass or fail for each worker examined. The need for subsequent medical examinations will be determined by the Site Safety and Health Officer (SSHO) and the consulting physician.

The purposes of the medical surveillance program are to (1) assess the individual's health prior to work with hazardous materials, (2) determine suitability for work assignments requiring the use of personal protective clothing and equipment, and (3) monitor for evidence of changes in medical indicators that could be related to the work.

This assessment will investigate existing conditions that would predispose the employee to illness upon exposure to hazardous substances or from the physical demands exhibited while using personal protective equipment, such as respirators and protective clothing.

A physician's statement, certifying that the employee is physically fit to work in the restricted area, shall be received by the SSHO before the employee begins to work. The SSHO will ensure that all personnel participating in the K-65 Tank investigation activities have physicians statements on file.

3.2 BASELINE AND ANNUAL HEALTH ASSESSMENT

The baseline and annual health assessment shall include a complete medical, family and occupational history; physical examination; selected biological sampling; laboratory studies including a complete blood count (CBC); urinalysis; chemistry panel (SMAC); pulmonary function testing (FEV_1 and FVC); audiometry; and vision screening. Optional tests shall include a chest X-ray (PA); and electrocardiogram. Other tests deemed appropriate by the examining or consulting physician may be performed after consultation with Bechtel.

No special blood and urine test will be conducted with the exception to the radiological bioassay requirements specified in Section 4.0.

Ongoing medical consultation and post-project testing will be provided on a case-by-case basis.

3.3 TERMINATION EXAMINATION

A termination examination will not be required (unless specified by the SSHO) because of the duration of the work activity and the hazards involved.

3.4 SUPPLEMENTAL EXAMINATION

Any worker exposed to potentially harmful levels of contaminants shall undergo a supplemental examination, if deemed appropriate by the examining or consulting physician.

4.0 BIOASSAY PROGRAM

Routine bioassay samples shall be collected from all employees prior to starting work in the designated restricted work area and upon termination of the job. Urinary analyses will include total uranium, thorium-230, and radium-226. Individuals suspected of having an intake of radioactive contaminations will have special samples collected. These special samples will be taken at the direction of the S&H Supervisor.

Exposure to heavy metals should not occur during the K-65 SILO Evaluation and will not require bioassay analysis at this time.

5.0 PERSONAL PROTECTIVE APPAREL AND EQUIPMENT

Personal protective apparel and equipment requirements and practices for protection against airborne contamination, skin absorption, skin contact, or impact hazards.

The level of protection that will be used while entering int SILO 4 will be modified Level D protection. This level of protection is contingent upon the monitoring of hazardous materials identified in section 2.0 of this plan.

- Hard hats
- Safety glasses
- Rubber boots
- Cotton gloves
- Safety harness
- Ear protection
- Supplied air respirator with emergency escape pack (carried by personnel)

If oxygen deficient conditions fall below acceptable levels (< 19.5% oxygen) specified by 29 CFR 1926.21 and 29 CFR 1910.252, personnel will donn the supplied air respirator with the 5 minute emergency escape pack and evacuate the area.

During the drilling operation (section 4.1 of the instruction guide) water will be applied to the area of contact to reduce the ambient dust level. Negative pressure respirators with GMC-H cartridges will be worn while performing the work if deemed necessary by the SSHO.

In the event that site conditions change, the required levels of protection may change based on the current conditions. Any change in the level of protection will be made by the assigned SSHO.

168

6.0 TRAINING

6.1 GENERAL

Training requirements will follow the criteria established in the Occupational Safety and Health Administration (OSHA) Standards 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" and 29 CFR 1910.1200, "Hazard Communications"

6.2 SITE-SPECIFIC TRAINING

WMCO will provide site-specific worker radiation safety training to all personnel. In addition, BNI site-specific training will be conducted prior to the start up of work. Subjects will include types and levels of contamination, specific safety and health concerns, the emergency response plan, and site safety procedures. Arrangements will be made by the SHSO and Site Superintendent to provide a training location with a minimum of distractions.

Training in the use of respiratory protective equipment will be provided by WMCO. Each employee shall receive respiratory protection training if they are required to enter in SILO 4.

Each individual who must wear a respirator will be required to be clear shaven in the sealing areas of the respirator face piece. Each respirator user will be respirator fit-tested by qualified WMCO personnel and will be so documented in the WMCO database and Bechtel National, Inc. safety and health database

168

7.0 EMERGENCY RESPONSE AND NOTIFICATION

7.1 GENERAL

The SHSO shall ensure that all personnel are familiar with the procedures for communicating with local and project emergency services in the event that someone other than the SHSO or a designated representative is called upon to handle an emergency.

In responding to emergency situations at the work site, personnel will follow emergency services provided by WMCO. Emergency telephone numbers established for the site are listed in front of this HSP. Site personnel will transport severely injured persons to the hospital only as a last resort when professional service is not available.

A detailed investigation of emergency conditions and their causes will be conducted jointly by the senior BNI representative on-site, SSHO and the WMCO Health and Safety Coordinator. The senior BNI representative will notify the Project Office in Oak Ridge, Tennessee, as soon as the emergency condition is secure.

7.2 OCCUPATIONAL INJURIES

In compliance with 29 CFR 1926.50, a person with a valid certification in first aid training from the U.S. Bureau of Mines, the American Red Cross, or equivalent training that can be verified by documentary evidence, shall be available at the worksites to render first aid.

The WMCO medical facility will be utilized for all injuries.

7.3 FIRE

It is not expected that explosive conditions will be present during the SILO investigation. In the event however of a small fire, an attempt by trained personnel shall be made to extinguish the fire with portable fire extinguishers. If a fire cannot be extinguished with portable extinguishers, personnel shall immediately evacuate the area.

The senior BNI representative or designee will interact with the WMLO fire service as it arrives on the scene and will provide all pertinent information including potential hazards, missing personnel, their last known work locations, and fire location and size.

7.4 EVACUATION

Personnel may be required to evacuate from the work area if in the event of a fire, oxygen different environment (below 19.5 % oxygen) unacceptable radiological or chemical airborne concentrations, flammable or explosive atmospheres, or any other abnormal conditions.

168

Personnel shall be lifted by safety lines attached to the safety harness through a designated man hole opening. Personnel will be informed of the opening to be used during the sites specific training. Personnel shall be lifted using a manual man-lift.

No personnel shall reenter the SILO unless a rescue is to be attempted by training personnel. No workers shall reenter an evaluated area until the emergency conditions have been corrected. The SHSO and Site Superintendent will determine when the area is safe for reentry.

168

8.0 ON-SITE COMMUNICATION

A two-way radio communication shall be maintained with personnel working in SILO 4 and personnel outside.

168

9.0 CONFINING SPACE PERMITS

Employees required to enter SILO 4 shall be instructed during the site specific training on the nature of hazards involved.

A confined space permit must be issued by the Site Superintendent prior to each shift.

The SSHO will ensure monitoring for oxygen deficiency, explosive or toxic gases are conducted daily with the appropriate instrumentation (Section 11.2). These data will be documented as an attachment to the hazardous work permit form and checked as a confined space entry. (Attachment 3).

168

10.0 ENGINEERING/ADMINISTRATIVE CONTROL

The following engineering controls will take:

- Ventilation of SILO 4 with a minimum 4 air exchanges per hour
- Orange cones will be placed around each opened man-hole to identify open hole hazards
- Water will be applied to the diamond-bit core drilling equipment to reduce dust
- A man-operated lift will be in place for the emergency use lowering and raising personnel out of the SILO
- A rope latter will be in place to assist in entering and exiting
- A watchman will be located outside the silo at all times monitoring the operation
- The use of pneumatic drilling equipment to preclude the potential of shock (If available)
- Water in the SILO will be pumped out to provide dry conditions for the worker

168

11.0 SAFETY AND HEALTH MONITORING

11.1 MONITORING RATIONALE

Personnel and area monitoring strategies have been devised to ensure adequate identification of the SILO's works activities for which engineering controls and/or respiratory protection are required.

11.2 OXYGEN DEFICIENCY MONITORING

Oxygen levels shall be monitored before personnel are allowed to enter SILO 4. Whenever concentrations of oxygen are less than 19.5 percent, each individual in the area shall wear a full-face supplied air respirators with a 5-minute escape unit.

Monitoring will be conducted prior to each entry and continuously while personnel remain in the SILO.

11.3 NOISE MONITORING

Ambient noise monitoring will be conducted whenever the SSHO feels the noise levels exceed 80 dB(A) 8-hour-Time Weighted Average (TWA). Instrumentation that comply with the requirements defined in 20 CFR 1910.95 shall be used.

The primary means of reducing noise levels is the use of engineering controls. However, when engineering controls are not feasible or cannot reduce levels to within the permissible limit, hearing protectors shall be worn. The SSHO will ensure the proper selection and usage of hearing protective devices based on the noise levels measured and the noise reduction rating (NRR) of the devices.

11.4 TOTAL ORGANIC VAPOR MONITORING

Prior to entering the SILO internal ambient organic vapor conditions will be determined. Measurements will be taken periodically throughout the day to determine any changes in the conditions.

When unexpected ambient concentrations of an unidentified total organic vapors is greater than 1 part per million personnel will be evacuated.

11.5 LOWER EXPLOSIVE CONDITIONS

Combustible gas concentration condition of SILO 4 will be determined prior to entering the SILO and conducted periodically throughout the day.

When concentration greater than 20 percent of the lower explosive limit (LEL) in the SILO, the work area shall require shutdown of the operation and personnel evacuated.

168

11.6 TOTAL DUST/FREE SILICA MONITORING

During the core drilling operation specified in the instruction guide, air surveillance shall be performed.

Biased air sampling techniques shall be utilized based on worst case exposure situation for ceiling or short-term time-weighted average measurements compared to existing or recommended standard with short-term limits as specified by OSHA 29 CFR 1910.1000 Subpart Z and the American Conference of Governmental Industrial Hygienists (ACGIH).

11.7 RADON MONITORING

Prior to entering the SILO interval ambient radon and radon daughter conditions will be determined. Measurements will be taken periodically throughout the day to determine any changes in the conditions.

168

APPENDIX C

FUSRAP PI 24.161
HAZARDOUS WORK PERMITS (HWPs)

56

TITLE: HAZARDOUS WORK PERMITS (HWPs)

DOCUMENT NUMBER: 24.061

REVISION NUMBER: 1

DATE: 6/19/89

PROJECT: FUSRAP
JOB NO. 14501

REVIEWED: R. T. Hamilton — Project Quality Assurance Supervisor — 6/2/89 Date

APPROVED: Wm. R. Beck — Environmental, Health, and Safety Supervisor — 6/16/89 Date

APPROVED: R B Haney — Program Manager — 6/19/89 Date

SUPERSEDES PI 24.061, REV. 0

1.0 PURPOSE

This instruction describes how hazardous work permits (HWPs) are used to identify and plan mitigation of radiological, chemical, biological, and physical hazards to work at FUSRAP sites. Potential exposures will be maintained in accordance with ALARA and will be so documented.

2.0 SCOPE

This instruction describes when HWPs are required; how HWPs are initiated; how radiological, industrial hygiene, and other safety hazard control conditions are specified; HWP review, approval, and termination; and HWP distribution and recordkeeping.

3.0 REFERENCES

(1) Project Instruction 24.108, "Work in Confined or Enclosed Areas."

(2) Project Instruction 24.021, "Restricted Work Areas."

(3) Occupational Safety & Health Guidance Manual for Hazardous Waste Site Activities, October 1985, DHHS (NIOSH) Pub. #85-115.

4.0 DEFINITIONS

4.1 Confined or enclosed space is any space having a limited means of egress, which may be subject to the accumulation of toxic or flammable contaminants or may have an oxygen deficient atmosphere (See PI: 24.108, Ref. 1).

4.2 Restricted work area is an area to which access is limited because of specific safety and health hazards which may occur as a result of entry into the area (See PI: 24.021, Ref. 2).

5.0 PROCEDURE

5.1 When HWPs are Required

An approved and currently active HWP shall be required prior to any work activity that could result in serious injury, illness, or death. These hazardous work activities could be the result of the following:

a. Chemical exposures

b. Oxygen deficiency

c. Exposure to ionizing and non-ionizing radiation

d. Electrical hazards

e. Fire and explosion

f. Physical hazards

g. Extreme temperatures

h. Excessive noise

i. Biological hazards

j. Other work determined to require an HWP by the site radiological support subcontractor (RSS) supervisor, site safety and health officer (SSHO), or site superintendent.

The only exceptions to the above are for:

- Surveys and sample collection in support of establishing and monitoring restricted work areas in accordance with PI: 24.021 (Ref. 2).
- Emergency responses when serious impacts could result if time were taken for HWP preparation and approval.

5.2 HWP Initiation

Anyone responsible for work that requires an HWP may initiate one. The initiator shall enter the request date, the work description, work location, estimated start date, and his/her name on the HWP form (a sample HWP form is included as Attachment 1), and forward the form to either the site RSS supervisor or the site safety and health officer (SSHO).

5.3 Specification of Radiological Control Conditions

The site RSS supervisor or SSHO shall include the following information on the HWP form:

- The next sequential HWP number (WBS/site number and sequence number)
- Radiological conditions and maximum doses expected at the work location
- Measures used to assure that occupational radiation exposures are maintained ALARA
- Recent radiological surveys and their results
- Additional radiological surveys, if needed
- Protective apparel and equipment required because of radiological conditions
- Special instructions required for radiological conditions, such as precautions to be taken when entering into a high radiation area
- Expiration date
- Potential industrial hygiene and industrial safety risks in the work area
- Names and signatures of workers involved in work activity covered by HWP (See Attachment 1)

5.4 Specification of Control Conditions for Non-radiological Hazards

If an HWP is required because of non-radiological conditions, such as toxic chemicals or asbestos, or industrial safety hazards involved in the planned work, the SSHO shall include the following information on the HWP form:

- Industrial Hygiene (IH) and safety conditions at the work location
- Recent IH surveys and their results
- Additional protective apparel and equipment required because of IH and safety considerations
- Special instructions required for IH and safety conditions

When the above information is complete, the site RSS supervisor and the SSHO shall sign the approval block and forward the HWP to the site superintendent.

When the site superintendent is acting as SSHO, he may consult with the safety and health supervisor, concerning appropriate requirements.

5.5 Site Superintendent Review and Approval

The site superintendent shall review the work description and location on each HWP and identify any additional personnel protection requirements. He shall confirm that the SSHO has approved HWPs for work that involves radiological, industrial hygiene or safety conditions. Then the site superintendent shall approve and sign the HWP.

The site superintendent shall ensure that supervision for appropriate subcontractors is cognizant of the HWP requirements and that the planned work is to be executed in accordance with the HWP.

The site superintendent shall send a completed copy of the HWP to the S&H supervisor in Oak Ridge.

5.6 HWP Changes

Minor changes to an approved HWP that provide stricter safety and health requirements, may be initiated by the site RSS supervisor or SSHO. The revised HWP shall be marked "Revised" and dated in the top margin of the form. Changes shall not obscure original entries. Each change shall be initialed and dated by the site RSS supervisor, the SSHO, and the site superintendent. After changes have been initialed, all copies of the original HWP shall be collected and replaced with copies of the revised HWP. Changes that would result in less conservative safety and health requirements shall require HWP termination and approval of a revised HWP.

Pertinent monitoring data collected during the work activities covered by the HWP shall be attached to the HWP.

5.7 HWP Termination

An HWP shall be terminated when <u>any</u> of the following occur:

- Completion of the work
- Attainment of the expiration date
- A substantial reduction in hazardous conditions in the work area
- A substantial reduction in the scope or method of executing the planned work
- It is superseded by a new approved HWP on the same topic

Upon termination, the site RSS supervisor or SSHO shall sign and date the HWP indicating termination.

5.8 HWP Distribution and Record Keeping

The site RSS supervisor or SSHO shall maintain a file of approved HWPs for the site WBS number. A copy of current approved HWPs shall be posted at the work area.

ATTACHMENTS:

1 Sample FUSRAP Hazardous Work Permit (HWP) ~~Form with Attachment~~

168

HAZARDOUS WORK PERMIT (HWP)

NO. ___ - ___
WBS NUMBER

WORK DESCRIPTION	WORK LOCATION
	EST. START DATE
	REQUESTED BY
	REQUEST DATE

HAZARDOUS CONDITIONS

SITE SURVEYS

TYPE	NUMBER	DATE	BY

REQUIRED PERSONNEL PROTECTIVE CLOTHING AND EQUIPMENT

HEAD/EYES	✓	FEET	✓	BODY	✓
SAFETY GLASSES	☐	RUBBER BOOTS	☐	COVERALLS COTTON	☐
GOGGLES	☐	PLASTIC BOOTS	☐	COVERALLS TYVEK (REGULAR)	☐
FACE SHIELD	☐	HIP WADERS	☐	COVERALLS TYVEK (SPECIAL-STATE TYPE)	☐
HARD HAT	☐	STEEL-TOE SHOES	☐	TYPE	
		DISPOSABLE SHOE COVERS	☐	RUBBER SUIT	☐
				ACID SUIT	☐
RESPIRATORY	✓	**HANDS**	✓	RAIN SUIT	☐
FULL-FACE (NEGATIVE PRESSURE) *	☐	COTTON GLOVES	☐	MOON SUIT	☐
HALF-FACE (NEGATIVE PRESSURE) *	☐	PLAYTEX GLOVES	☐		
POWERED AIR PURIFYING *	☐	RUBBER GLOVES	☐		
*SPECIFY CARTRIDGE-CANISTER TYPE BELOW		NEOPRENE GLOVES	☐	**MISCELLANEOUS**	
SUPPLIED-AIR HOOD	☐	SURGICAL GLOVES	☐	TAPE GLOVES AND BOOTS TO COVERALLS	☐
SUPPLIED-AIR FULL-FACE	☐	POLYVINYL ALCOHOL GLOVES	☐	LIFE LINE	☐
SANDBLAST HOOD	☐	LEATHER GLOVES	☐	SAFETY BELT	☐
SELF-CONTAINED (SCBA)	☐				

SPECIAL INSTRUCTIONS

- ☐ WATCHMAN
- ☐ ELECTRICAL LOCKOUT
- ☐ PRE-ENTRY MONITORING
- ☐ EMERGENCY EQUIPMENT.
- ☐ "BUDDY SYSTEM" IN EFFECT
- ☐ JOB COVERAGE BY SAFETY PROFESSIONAL
- ☐ SPECIAL TRAINING REQUIRED

DOSIMETRY	INCL	EXCL
TLD BADGE		
EXTREMITY TLD		
SRD 0-200 mR		
SRD (high)		
DIGITAL ALARMING DOSIMETER		

IN MONITORING	INCL	EXCL

EXPIRATION DATE

APPROVALS	DATES
SITE RSS SUPERVISOR	
SITE H&S OFFICER	
SITE SUPERINTENDENT	

TERMINATION	
SITE RSS SUPV SIGD	DATE
REASON	

63

168

FMPC WORK PERMIT

Work Permit Number: 00480

This work permit is to be completed in accordance with FMPC-516.

SECTION A - BACKGROUND INFORMATION (To be completed by supervisor-in-charge)

A. MAINTENANCE REQUEST NO.: N/A

B. STARTING DATE & TIME: DATE: 10/26/89 TIME: 9:30 AM

C. EXPIRATION DATE & TIME: DATE: 11/26/89 TIME: 6:00 PM

D. PROJECT LOCATION: SILO 4

E. EQUIPMENT: ELECTRICAL DRILL, GENERATOR, BLOWER, LIFT, STAND

F. PROJECT DESCRIPTION OF WORK TO BE CONDUCTED: CORE SAMPLING OF SILO 4 DOME, WALL, AND FLOOR THE SAMPLES OF WALL AND FLOOR WILL BE TAKEN FROM INSIDE THE SILO. ALL CORE SAMPLES WILL BE TAKEN WITH A ELECTRICAL DRILL

G. EMPLOYEE(S) ASSIGNED TO JOB: BADGE NO.:
4 PERSONNEL FROM BECHTEL NATIONAL CORPORATION
61 Curtis Leidtuens / 63 G. Blust
[redacted] SR. Curry 64 D. ADAIR

H. SUPERVISOR(S)/WMCO PROJECT ENGINEER: P.A SHANKS x6531

SECTION B - TYPES OF PERMITS REQUIRED (Checked by supervisor-in-charge)

- [ ] ASBESTOS (Copy to be attached)
- [ ] RADIATION (Copy to be attached)
- [ ] CHEMICAL/HAZARDOUS MATERIAL
- [x] CONFINED SPACE ENTRY
- [ ] OPEN FLAME/WELDING

SECTION C - GENERAL PRECAUTIONS

ITEM	YES	NO
1. Equipment cleaned and purged	✓	
2. Nuclear Safety checks completed		✓
3. Lock & Tag Procedures required and followed	✓	
4. Water in space has been collected and sampled		✓
5. Complete isolation of process lines to space has been completed		✓
6. All mechanical equipment to the space have been tagged, disconnected and/or blocked		✓
7. Electrical isolation complete for Lock & Tag Procedure		✓
8. All lines within space have been cleaned and purged		✓

Equipment is safe and ready for work (FACILITY OWNER'S SIGNATURE): Robert C. Dasher

BADGE NO.: 551 DATE: 10/19/89 TIME: 1507

SECTION D - PERSONAL PROTECTIVE EQUIPMENT REQUIRED

EQUIPMENT	YES	NO	SPECIFY
Face Shield		X	
Hearing Protection		X	UNLESS >90dBA
Eye Protection	X		SAFETY GLASSES
Acid Splash Suit		X	
Gloves		X	SEE BELOW
Respiratory Protection (consult with IH rep.)		X	SEE BELOW
Flame Retardent Clothing		X	
Disposable Hood, Coveralls and Shoe Covers worn over Company-Issued Clothing		X	SEE BELOW

OTHER PROTECTION REQUIREMENTS: LETTER WMCO: QS(SAF): 89-444 SHOULD BE FOLLOWED BY SUBCONTRACTOR FOR HEALTH & SAFETY REQUIREMENTS

[redacted] BADGE NO.: 263 DATE: 10/24/89

SECTION E - CHEMICAL/HAZARDOUS MATERIAL PERMIT

TYPE OF MATERIAL: NAME OF MATERIAL(S):

PRECAUTION TAKEN	YES	NO	DNA
1. Equipment and/or lines have been drained, flushed, purged, or neutralized			✓
2. Valves have been closed and locked (when feasible) and danger tagged			✓
3. Area isolated			✓
4. Safety shower is operable close to worksite			✓
5. Special clothing or other protective equipment required			✓

Special precautions:

[redacted] BADGE NO.: 551 DATE: 10/19/89

NO.	DISTRIBUTION OF COPIES
1	POST AT JOB
2	SUPERVISOR-IN-CHARGE
3	IH&S (RECORD COPY)

SECTION F - CONFINED SPACE ENTRY PERMIT (Valid for no more than 12 hours)

ATMOSPHERIC GAS TESTING RESULTS

OXYGEN CONTENT TIME	OXYGEN CONTENT READINGS	COMBUSTIBLE GAS TIME	COMBUSTIBLE GAS READINGS	TOXICITY TIME	TOXICITY READINGS
1001	21.1%	1001	0%	1001	<0 ppm
				1001	<5 ppm

PRECAUTIONS TAKEN/NEEDED	YES	NO	DNA
1. Forced ventilation required	X		
2. Work requires staging or ladder	X		
3. Ground Fault Interupting protection required	X		
4. Adequate/proper illumination required	X		
5. Standby notified what action to take	X		
6. Safety line and harness required	X		
7. Nonsparking tools required	X		
8. Periodic gas testing required	X		

STANDBY-WORKER COMMUNICATION: Standby person with Radio

SPECIAL INSTRUCTIONS: Hardhat

TYPE OF CONFINED SPACE: [ ] CLASS A [ ] CLASS B [x] CLASS C

IH&S R[redacted] BADGE NO.: 173

PERMIT [redacted] 10-26-89 TIME: 1001

SECTION G - OPEN FLAME/WELDING PERMIT

PRECAUTIONS VERIFIED (within 35 feet of work)	YES	NO	DNA
1. Combustibles, magnesium and uranium have been removed, covered or shielded.			
2. Flammable liquids have been removed or isolated.			
3. Wall and floor openings are covered or protected.			
4. A flame retardent tarp has been suspended underneath work.			
5. A combustible gas check has been made.			
6. (work on walls/ceilings) All combustibles have been removed from opposite sides.			
7. A Fire Watch will be required and will remain posted during breaks and for 30 minutes after work is completed.			
8. Fire Watch is supplied with an extinguisher and know-how to activate the nearest fire alarm.			
9. Fire & Safety Inspector shall be present during the burning operation.			
10. Fire & Safety Inspector shall be present to monitor when the system is initially opened.			

COMBUSTIBLE GAS TESTING RESULTS:

EQUIPMENT/AREA CHECKED:

SPECIAL INSTRUCTIONS/PRECAUTIONS:

FIRE & SAFETY INSPECTOR SIGNATURE: BADGE NO.:

PERMIT ISSUED DATE: TIME:

SECTION H - WORK AUTHORIZATION REVIEWED AND FOUND ACCEPTABLE FOR USE

SUPERVISOR-IN-CHARGE SIGNATURE: BADGE NO.: DATE:

64

168

FMPC WORK PERMIT

This work permit is to be completed in accordance with FMPC-516.

Work Permit Number: 02672

SECTION A - BACKGROUND INFORMATION *(To be completed by supervisor-in-charge)*

A. MAINTENANCE REQUEST NO.: D.O.E. PROJECT

B. STARTING DATE & TIME: DATE: 10/27/89 TIME: 9:00 AM

C. EXPIRATION DATE & TIME: DATE: 10/27/89 TIME: 6:00 PM

D. EXACT LOCATION: SILO #4

E. EQUIPMENT:

F. EXACT DESCRIPTION OF WORK TO BE CONDUCTED: CORE SAMPLING OF SILO #4'S WALL, DOME, AND FLOOR. THE SAMPLES OF WALL AND FLOOR WILL BE TAKEN FROM INSIDE THE SILO. AN ELECTRICAL DRILL WILL BE USED.

G. EMPLOYEE(S) ASSIGNED TO JOB: Gerald Blust, Norman Adair, Stanley Cunningham > Bechtel

BADGE NO.:

H. SUPERVISOR(S)/WMCO PROJECT ENGINEER: P.A. SHANKS X 6531

SECTION B - TYPES OF PERMITS REQUIRED *(Checked by supervisor-in-charge)*

- [ ] ASBESTOS (Copy to be attched)
- [ ] RADIATION (Copy to be attached)
- [ ] CHEMICAL/HAZARDOUS MATERIAL
- [x] CONFINED SPACE ENTRY
- [ ] OPEN FLAME/WELDING

SECTION C - GENERAL PRECAUTIONS

ITEM	YES	NO
1. Equipment cleaned and purged	X	
2. Nuclear Safety checks completed		NA
3. Lock & Tag Procedures required and followed		NA
4. Water in space has been collected and sampled	X	
5. Complete isolation of process lines to space has been completed		NA
6. All mechanical equipment to the space have been tagged, disconnected and/or blocked		NA
7. Electrical isolation complete for Lock & Tag Procedure		NA
8. All lines within space have been cleaned and purged		NA

Equipment is safe and ready for work (FACILITY OWNER'S SIGNATURE): [signature]

BADGE NO.: 371 DATE: 10/27/89 TIME: 0800

SECTION D - PERSONAL PROTECTIVE EQUIPMENT REQUIRED

EQUIPMENT	YES	NO	SPECIFY
Face Shield		X	
Hearing Protection		X	noise > 90dBa
Eye Protection	X		safety glasses
Acid Splash Suit		X	
Gloves		X	see below
Respiratory Protection *(consult with IH rep.)*		X	see below
Flame Retardent Clothing		X	
Disposable Hood, Coveralls and Shoe Covers worn over Company-Issued Clothing		X	see below

OTHER PROTECTION REQUIREMENTS: Subcontractor should follow requirements outlined in letter work: DOE/CAE: 89-HHH

[redacted] BADGE NO.: 263 DATE: 10/27/89

SECTION E - CHEMICAL/HAZARDOUS MATERIAL PERMIT

TYPE OF MATERIAL:

NAME OF MATERIAL(S): N/A

PRECAUTION TAKEN	YES	NO	DNA
1. Equipment and/or lines have been drained, flushed, purged, or neutralized			
2. Valves have been closed and locked (when feasible) and danger tagged			
3. Area isolated			
4. Safety shower is operable close to worksite			
5. Special clothing or other protective equipment required			

Special precautions:

[redacted] BADGE NO.: 371 DATE: 10/27/89

SECTION F - CONFINED SPACE ENTRY PERMIT *(Valid for no more than 12 hours)*

ATMOSPHERIC GAS TESTING RESULTS

OXYGEN CONTENT		COMBUSTIBLE GAS		TOXICITY	
TIME	READINGS	TIME	READINGS	TIME	READINGS
0650	20.8%	0650	0%	0650	0 ppm
				0650	0 ppm

PRECAUTIONS TAKEN/NEEDED	YES	NO	DNA
1. Forced ventilation required		X	
2. Work requires staging or ladder		X	
3. Ground Fault Interupting protection required		X	
4. Adequate/proper illumination required		X	
5. Standby notified what action to take		X	
6. Safety line and harness required			X
7. Nonsparking tools required			X
8. Periodic gas testing required			X

STANDBY-WORKER COMMUNICATION: voice / visual

SPECIAL INSTRUCTIONS: call 6531 if emergency

TYPE OF CONFINED SPACE: [ ] CLASS A [x] CLASS B [ ] CLASS C

IH&S [redacted] BADGE NO.: 7310

PERMIT ISSUED DATE: 10/27/89 TIME: 0800

SECTION G - OPEN FLAME/WELDING PERMIT

PRECAUTIONS VERIFIED *(within 35 feet of work)*	YES	NO	DNA
1. Combustibles, magnesium and uranium have been removed, covered or shielded.			
2. Flammable liquids have been removed or isolated.			
3. Wall and floor openings are covered or protected.			
4. A flame retardent tarp has been suspended underneath work.			
5. A combustible gas check has been made.			
6. (work on walls/ceilings) All combustibles have been removed from opposite sides.			
7. A Fire Watch will be required and will remain posted during breaks and for 30 minutes after work is completed.			
8. Fire Watch is supplied with an extinguisher and know-how to activate the nearest fire alarm.			
9. Fire & Safety Inspector shall be present during the burning operation.			
10. Fire & Safety Inspector shall be present to monitor when the system is initially opened.			

COMBUSTIBLE GAS TESTING RESULTS:

EQUIPMENT/AREA CHECKED:

SPECIAL INSTRUCTIONS/PRECAUTIONS:

FIRE & SAFETY INSPECTOR SIGNATURE: BADGE NO.:

PERMIT ISSUED DATE: TIME:

SECTION H - WORK AUTHORIZATION REVIEWED AND FOUND ACCEPTABLE FOR USE

[redacted] BADGE NO.: 263 DATE: 10/27/89

NO.	
1	POST AT JOB
	SUPERVISOR-IN-CHARGE
	IH&S *(RECORD COPY)*

FMPC-OS&H-2930 (8/12/88)

65

168

EXO 2

FMPC WORK PERMIT

This work permit is to be completed in accordance with FMPC-516.

Work Permit Number: 02680

SECTION A - BACKGROUND INFORMATION *(To be completed by supervisor-in-charge)*

A. MAINTENANCE REQUEST NO.: D.E. PROJECT

B. STARTING DATE & TIME: DATE: 10/28/89 TIME: 7:00 AM

C. EXPIRATION DATE & TIME: DATE: 10/28/89 TIME: 6:00 PM

D. EXACT LOCATION: SILO #4

E. EQUIPMENT:

F. EXACT DESCRIPTION OF WORK TO BE CONDUCTED: CORE SAMPLING OF SILO DOME, WALL, AND FLOOR. THE SAMPLES WILL BE TAKEN FROM INSIDE THE SILO. AN ELECTRICAL DRILL WILL BE USED.

G. EMPLOYEE(S) ASSIGNED TO JOB: GERALD BLUST, NORMAN ADAMS, S.K.C. — BADGE NO.: — BECHTEL

H. SUPERVISOR(S)/WMCO PROJECT ENGINEER: P.A. SPANKS X 6537

SECTION B - TYPES OF PERMITS REQUIRED *(Checked by supervisor-in-charge)*

- [ ] ASBESTOS (Copy to be attached)
- [ ] RADIATION (Copy to be attached)
- [ ] CHEMICAL/HAZARDOUS MATERIAL
- [x] CONFINED SPACE ENTRY
- [ ] OPEN FLAME/WELDING

SECTION C - GENERAL PRECAUTIONS

ITEM	YES	NO
1. Equipment cleaned and purged	X	
2. Nuclear Safety checks completed		NA
3. Lock & Tag Procedures required and followed		NA
4. Water in space has been collected and sampled	X	
5. Complete isolation of process lines to space has been completed		NA
6. All mechanical equipment to the space have been tagged, disconnected and/or blocked		NA
7. Electrical isolation complete for Lock & Tag Procedure		NA
8. All lines within space have been cleaned and purged		NA

Equipment is safe and ready for work (FACILITY OWNER'S SIGNATURE): [signature]

BADGE NO.: 771 DATE: 10/27/89 TIME: 0800

SECTION D - PERSONAL PROTECTIVE EQUIPMENT REQUIRED

EQUIPMENT	YES	NO	SPECIFY
Face Shield		X	
Hearing Protection		X	unless >90dB
Eye Protection	X		safety glasses
Acid Splash Suit		X	
Gloves		X	see below
Respiratory Protection *(consult with IH rep.)*		X	see below
Flame Retardent Clothing		X	
Disposable Hood, Coveralls and Shoe Covers worn over Company-Issued Clothing		X	see below

OTHER PROTECTION REQUIREMENTS: should follow requirements outlined in letter WMCO: OS(S&F):89-444

[redacted] BADGE NO.: 263 DATE: 10/25/89

SECTION E - CHEMICAL/HAZARDOUS MATERIAL PERMIT

TYPE OF MATERIAL: NAME OF MATERIAL(S):

PRECAUTION TAKEN	YES	NO	DNA
1. Equipment and/or lines have been drained, flushed, purged, or neutralized			
2. Valves have been closed and locked (when feasible) and danger tagged			
3. Area isolated			
4. Safety shower is operable close to worksite			
5. Special clothing or other protective equipment required			

Special precautions:

[redacted] BADGE NO.: 771 DATE: 10/27

SECTION F - CONFINED SPACE ENTRY PERMIT *(Valid for no more than 12 hours)*

ATMOSPHERIC GAS TESTING RESULTS

OXYGEN CONTENT TIME	OXYGEN CONTENT READINGS	COMBUSTIBLE GAS TIME	COMBUSTIBLE GAS READINGS	TOXICITY TIME	TOXICITY READINGS
0940	21.1	0940	0.0	0940	CO 0.0
				0940	H_2S 0.0

PRECAUTIONS TAKEN/NEEDED	YES	NO	DNA
1. Forced ventilation required	✓		
2. Work requires staging or ladder	✓		
3. Ground Fault Interupting protection required	✓		
4. Adequate/proper illumination required	✓		
5. Standby notified what action to take	✓		
6. Safety line and harness required	✓		
7. Nonsparking tools required		✓	
8. Periodic gas testing required	✓		

STANDBY-WORKER COMMUNICATION: [illegible] radio contact

SPECIAL INSTRUCTIONS: call 313 if emergency; wetting - [illegible]

TYPE OF CONFINED SPACE: [ ] CLASS A [x] CLASS B [ ] CLASS C

IH&S REPRESENTATIVE SIGNATURE: [redacted] BADGE NO.: 7358

PERMIT [redacted] TIME: 0945

SECTION G - OPEN FLAME/WELDING PERMIT

PRECAUTIONS VERIFIED *(within 35 feet of work)*	YES	NO	DNA
1. Combustibles, magnesium and uranium have been removed, covered or shielded.			
2. Flammable liquids have been removed or isolated.			
3. Wall and floor openings are covered or protected.			
4. A flame retardent tarp has been suspended underneath work.			
5. A combustible gas check has been made.			
6. (work on walls/ceilings) All combustibles have been removed from opposite sides.			
7. A Fire Watch will be required and will remain posted during breaks and for 30 minutes after work is completed.			
8. Fire Watch is supplied with an extinguisher and know-how to activate the nearest fire alarm.			
9. Fire & Safety Inspector shall be present during the burning operation.			
10. Fire & Safety Inspector shall be present to monitor when the system is initially opened.			

COMBUSTIBLE GAS TESTING RESULTS:

EQUIPMENT/AREA CHECKED:

SPECIAL INSTRUCTIONS/PRECAUTIONS:

FIRE & SAFETY INSPECTOR SIGNATURE: BADGE NO.:

PERMIT ISSUED DATE: TIME:

SECTION H - WORK AUTHORIZATION REVIEWED AND FOUND ACCEPTABLE FOR USE

[redacted] BADGE NO.: 263 DATE: 10/25/89

NO.	DISTRIBUTION OF COPIES
1	POST AT JOB
[redacted]	SUPERVISOR-IN-CHARGE
[redacted]	IH&S *(RECORD COPY)*

FMPC-OS&H-2930 (8/12/88)

66

RADIATION WORK PERMIT

No.: _____

SECTION I: TO BE COMPLETED BY THE JOB SUPERVISOR

JOB LOCATION:	(2) ISSUE DATE:	(3) SHIFT:	(4) EXPIRATION DATE:*
BUILDING: K-65 AREA TANK #4 DATE: 10/24/89	10/25/89	1ST + 2ND	10/31/89

DESCRIPTION:

TO TAKE CORE SAMPLES OF SILO 4

GRID LOCATION:

REQUESTING SUPERVISOR'S SIGNATURE: [signature]

* Maximum 7 days from issuance.

SECTION II: TO BE COMPLETED BY ERMT

(5) RADIATION LOCATION	(6) INSTRUMENT READING OW OPEN WINDOW mRad/hr	(7) CW CLOSED WINDOW mRad/hr	(8) EXTREMITIES OPEN WINDOW mRad/hr
Silo #4	0.3	0.3	0.3
2.			
3.			
4.			

(9) STAY TIME CALCULATIONS

BETA DOSE	SKIN DOSE	EXTREMITY
CORRECTION FACTOR (OW-CW)*F = mRem/hr	30/.3 = 100	150/.3 = 500
Side Window GM F = 8 mRem/hr	WHOLE BODY 150/.3 = 50	TIME LIMIT 500 hrs
CP Ion Chamber F = 3 mRem/hr		

INSTRUMENT TYPE	SERIAL NUMBER	CALIBRATION DATE
RO3C	669	Dec 89

(10) AMBIENT BACKGROUND B/Y 0.3 mrem/hr

(11) RADIOLOGICAL SURVEY FORM ATTACHED ☐ YES ☒ NO

(12) SURVEY MAP ATTACHED ☐ YES ☐ NO

(13) MONITORING REQUIREMENTS

- ☒ At start of job
- ☐ Intermittent
- ☐ Continuous
- ☐ On completion of job
- ☐ Not required
- ☐ Personnel survey at completion
- ☐ Air monitoring

(14) DOSIMETRY REQUIREMENTS**

- ☐ Direct reading dosimeter
- ☐ Wrist dosimeter
- ☐ Ring dosimeter
- ☐ Other _____

** TLD required for all radiation work

(15) PROTECTIVE EQUIPMENT

WHOLE BODY	BREATHING REQUIREMENTS	HEAD
☐ None	☒ Half face respirator Note (1)	☒ Safety glasses
☒ Cloth coveralls	☐ Full face respirator	☐ Goggles
☐ Disposable coveralls	☐ Airline respirator	☐ Face shield
☐ Lab coat	☐ Airline hood	☐ Cap
☐ Tape openings	☐ Combination canister	☐ Hood
☐ Other _____	☐ SCBA	☐ Hard hat
	☐ Other _____	

HANDS (GLOVES)	SHIELDING	FEET AND LEGS
☐ Cotton	☐ Rubber Mat	☐ Latex shoe covers
☐ Rubberized	☐ Aluminum	☐ Disposable shoe covers
☐ Surgical	☐ Plywood	☒ Safety shoes
☒ Gauntlet	☒ Other NONE	☐ Safety boots
☐ Other _____		☐ Other _____

(16) SPECIAL HEALTH PHYSICS INSTRUCTIONS AND REQUIREMENTS

Note (1) HALF MASK RESPIRATOR REQUIRED DURING DUST CAUSING EVOLUTIONS; LEATHER PALM GLOVES REQUIRED WHEN HANDLING SHARP EDGED OBJECTS. MATERIAL REMOVED FROM SILO REQUIRED MONITORING, SMOKING AND DRINKING IS PERMITTED IN AUTHORIZED AREAS ONLY AND ONLY AFTER PROPER MONITORING IS PERFORMED

ERMT SIGNATURE: James C. [illegible] DATE: ~~11-20~~ 10-25-89 TIME ISSUED: 1130

SECTION III: APPROVAL SIGNATURES (as required)

DISTRIBUTION OF COPIES	
1	Posting
2	ERM Supervisor
3	Health Physics

SECTION IV: TO BE COMPLETED BY EMPLOYEES ***

(17) NAME(S) OF EMPLOYEE(S) (SIGNATURE)	(18) BADGE NUMBER	(19) RESPIRATOR FIT TEST	(20) RADIATION WORKER TRAINING
1. [signature]	5041	☐ YES ☐ NO	☒ YES ☐ NO
2. [signature]	5042	☐ YES ☐ NO	☒ YES ☐ NO
3. [signature]	5043	☐ YES ☐ NO	☒ YES ☐ NO
4. [signature]	8-0410	☐ YES ☐ NO	☒ YES ☐ NO
5.		☐ YES ☐ NO	☐ YES ☐ NO
6.		☐ YES ☐ NO	☐ YES ☐ NO

*** Signature indicates employee has read this RWP.

FMPC-OS&H-1372 (REV. 3/31/88)

168

FMPC

WASTE STORAGE AREA SPECIAL PURPOSE ENTRY PERMIT

This form should be completed in compliance with FMPC-511.

PART ONE: *To be completed by the applicant(s) (PLEASE PRINT)*

NAME	DEPARTMENT/SECTION/COMPANY	BADGE NO.
NORMAN D. ADAIR	BECHTEL NATIONAL, INC.	N/A
GERALD A. BLUST	" " "	N/A
STERLING R. CURRY	" " "	N/A
CHRISTOPHER P. LEICHTWEIS	" " "	N/A
PATRICK A. SHANKS	WMCO	

REQUESTED DATES OF ENTRY: OCTOBER 24, 1989 to NOVEMBER 3, 1989

2. **PURPOSE OF ENTRY:** TO PERFORM CORE SAMPLES OF SILO #4.

PART TWO: *To be completed by the respective staff manager*

1. STAFF MANAGER'S SIGNATURE	DATE
[illegible] PCR.	10/19/89

PART THREE: *To be completed by the Manager of Waste Operations (or designee)*

1. EFFECTIVE DATES OF ENTRY: *(Not to exceed 14 consecutive days.)* 10/24/89 to 11/3/89

2. TWO-WAY RADIO REQUIRED? ☐ YES ☑ NO

SIGNATURE: [illegible] **DATE:** 10/19/89

INSTRUCTIONS FOR PREPARING THE WASTE STORAGE AREA SPECIAL PURPOSE ENTRY PERMIT

APPLICANT:

Part One, Section One: *Enters the name, department, section, company and badge number of those requesting access. If an applicant(s) is a visitor to the FMPC, the company for which the person works shall be included and the badge number space marked NA. Any lines left blank under this item must be marked with an "X" so names may not be added at a later date.*

Part One, Section Two: *Enters the dates for which entry into the Waste Storage Area is requested. If more than one day is required, the time period requested should not exceed 14 consecutive days.*

Part One, Section Three: *Describes the specific purpose for entering the Waste Storage Area.*

COGNIZANT STAFF MANAGER

Part Two: *Signifies concurrence with the information in the preceeding parts by his/her signature and date.*

MANAGER, WASTE OPERATIONS:

Part Three: *Takes action on the entry request in accordance with the criteria in 6.3 of FMPC-511.*

	DISTRIBUTION OF COPIES	
	Original	Applicant
2	Blue Copy	Manager, Waste Operations

FMPC-T-2726 (7/22/87)

68

INTEROFFICE MEMORANDUM

To: R. Land

From: N. D. Adair

Subject: Daily Report

Date: October 23, 1989

at: Fernald

Copy:

File: 9310

Weather: clear, 76°

Start: 1:30 to 3:30

ACTIVITY

Met with Pat Shanks to discuss access to the site, starting time, cameras & computers permits, use of 2-way radios, access control, and the training schedule.

Pat said the starting time will be 7:00 am, pickup temporary badge each day at the security building. Passes required for camera, radios, brief cases, and computers.

Training schedule for Tuesday will be as follows:

- 7:00 - 7:30 obtain security badges
- 7:30 - 11:30 radiation and site specific training
- 11:30 - 12:00 lunch
- 12:00 - 2:00 meet with Pat, review material arriving on-site, etc.
- 2:00 - 4:00 Review Work Plan with their Safety, IH, QA, Construction, security, and management representatives.

FIELD FORCES

Adair, Blust, & Curry

EQUIPMENT

None

INTEROFFICE MEMORANDUM

To: R. Land

From: N. D. Adair

Subject: Daily Report

Date: October 24, 1989

at: Fernald

Copy:

File: 9310

Weather: clear, 78°

Start: 7:00 to 4:00

7:00 to 8:00 Took one hour to obtain access badges, WMCO took the radios to check the frequencies for interference with their radios, obtained a camera pass and obtained permission to move the truck inside the gate.

8:00 to 11:30 Received site specific and radiological training.

11:30 to 12:00 Lunch

12:00 to 2:00 WMCO ask that the truck be removed from the controlled area until tomorrow. Made a visit to silo 4 and observed there was water on the floor of the silo, there are 9 access holes to the silo, prepared a sketch and fax to Roger Land. We completed submitting urine samples and completed paper work for dosimeters.

2:00 to 4:00 Meet with apx. 10 WMCO representatives from Safety, Construction, QA, and Management. Bechtel will be required to completely dress out to perform work at silo 4. Showers required when exiting into Access 1 areas (lunch & quitting time). Submit a copy of our QAPP for WMCO review, proof of training on the Work Plan, and MSDSs for all material.
The following permits will be required: 1) radiation permit, 2)access permit to the waste area, 3)confined space entry permit, and 4) excavation/penetration permit.

Problem: Our schedule does not address the extra time that will be required to work in a radiological contaminated environment. We lose apx. one to two hours per day working under these conditions. Water still remains in the silo. Respirator training may be required by WMCO for the patch material.

FIELD FORCE

Adair, Leichtweis, Curry, & Blust

EQUIPMENT

Man Lift, 50 KW generator, 2 concrete core drills, lights , etc.

INTEROFFICE MEMORANDUM

To: R. Land

From: N. D. Adair

Subject: Daily Report

Date: October 25, 1989

at: Fernald

Copy:

File: 9310

Weather: clear, 82°

Start: 7:00 to 5:30

ACTIVITY

7:00 to 7:30 Obtained access badge to site, changed into work clothing and drove to silo.

7:30 to 10:30 Were assigned work clothes, boots, and lockers. Waited two hours for WMCO to assign the clothing and lockers.

10:30 to 11:00 Lunch

11:00 to 5:00 Changed into work clothing and drove to silo 4. Moved equipment onto the dome of the silo. Grounded the generator and obtained all work permits required for this work effort. WMCO removed a blind flange from the bottom of the silo to gain access to silo with the discharge hose from their pump. Water still remains in the bottom of the silo.
Set up the fans and began sucking air from the silo at 4:00 pm.

Problem Water still remains in the bottom of the silo.
Awaiting decision from WMCO if respirators will be required when using the concrete patching material.
Instructed by WMCO to post all permits and rope the construction area off.

FIELD FORCE

Adair, Leichtweis, Blust, & Curry

EQUIPMENT

Man Lift, 50 KW generator, 2 drills w/3" core bit, Lights

INTEROFFICE MEMORANDUM

To: R. Land

From: N. D. Adair

Subject: Daily Report

Date: October 26, 1989

at: Fernald

Copy:

File: 9310

Weather: clear, 84°

Start: 7:00 to 5:30

ACTIVITY

7:00 to 7:30	Obtained access badges to site, changed into work clothing and drove to silo.
7:30 to 12:00	Moved drills and support tools to the top of the silo. Began core drilling at the southeast dome location. Obtained core sample B91C03D. Took air quality measurements from inside the silo and entered the silo at 11:00 am. One inch of water remains inside the silo and apx. 1/2" of sludge (weathered concrete) remains on the bottom. Air quality appears to be OK for work activities.
12:00 to 1:00	Lunch and change out.
1:00 to 5:00	Drilled nine more core holes into the doom. Only obtained two intact core samples. Six holes drilled on the north side and all samples came out broken into many pieces.
5:00 to 5:30	Shower and change into street clothing.
Problem	Called Roger at 3:45 pm about the cores breaking up, he will talk to Russ and the Consultant and let us know if we should try drilling more holes.

FIELD FORCE

Adair, Leichtweis, Curry, & Blust

EQUIPMENT

Man Lift, 50 KW generator, 2 Core drills, lights

OFFICE MEMORANDUM

To: R. Land

From: N. D. Adair

Subject: Daily Report

Date: October 27, 1989

at: Fernald

Copy:

File: 9310

Weather: clear, 78°

Start: 7:00 to 5:30

KACTIVITY

7:00 to 7:30	Obtained access badges, changed clothes and drove to silo 4.
7:30 to 12:00	Move the equipment inside the silo and constructed a temporary work bench and drilling platform to keep the equipment out of the water. Located the sample locations for the wall and floor.
12:00 to 1:00	Changed clothes and ate lunch.
1:00 to 3:30	Drill five holes and obtained four concrete core samples. Re-drilled at one location because the sample broke up. At apx. 3:30 the adapter which fits into the chuck of the drill broke and forced and early shut down of the drilling.
3:30 to 4:30	Cleaned up the area and removed trash from the work area. Called vendor for replacement part and to expedite the deliver of the parts. Vendor had the part in stock and would ship via local deliver firm so we would receive by 5:30 pm.
4:30 to 5:00	Shower and changed into street clothing
5:00 to 5:50	Waited for the delivery of the part.

Vendor sent two adapters so we would have a spare on hand.

FIELD FORCE

Adair, Leichtweis, Curry, & Blust

EQUIPMENT

Man Lift, 50 KW generator, 2 core drills, lights

OFFICE MEMORANDUM

To: R. Land

From: N. D. Adair

Subject: Daily Report

Date: October 28, 1989

at: Fernald

Copy:

File: 9310

Weather: Mostly sunny, 78°

Start: 7:00 to 6:30

ACTIVITY

7:00 to 7:30	Obtained access badges, changed clothes and drove to silo 4.
7:30 to 12:00	Waited until 9:15 am for WMCO's IH to survey the silo and issue a confined space entry permit. Completed drilling the walls and completed drilling one hole in the floor where we bent the second adapter. The drilling was stopped and the decision was made not to lower the other drill & stand into the silo and complete the floor samples. The floor samples were the least important and lowering the drill & and stand into the silo would have been awkward and difficult.
12:00 to 1:00	Changed clothes and ate lunch.
1:00 to 6:00	Moved all the tools out of the silo and into the van. Moved all equipment up the scan area for release from the site. WMCO will scan the tools on Monday for radiological release from the site.
6:00 to 6:30	Shower and changed into street clothing

Problem: Using a hand drill to perform core drilling requires that drill remain steady and if you hit a hard place (rebar) it will cause the drill to twist and bend the adapter. When the drill hits rebar it causes the drill to torque and could cause an injury to the operator. A drill mounted on a stand stabilizes the drill and resists the torque.

FIELD FORCE

Adair, Leichtweis, Curry, & Blust

EQUIPMENT

Man Lift, 50 Kw generator, 2 concrete core drills, lights

INTEROFFICE MEMORANDUM

To: R. Land

From: N. D. Adair

Subject: Daily Report

Date: October 30, 1989

at: Fernald

Copy:

File: 9310

Weather: Overcast, 75°

Start: 7:00 to 3:30

ACTIVITY

7:00 to 7:30 Obtained access badges, entered site.

7:30 to 11:00 Obtained a sample of the gunite. Unloaded van for radiological survey of the tools. Loaded tools and equipment back into van and left the rental equipment at the gate area for pickuo by the vendor. Submitted final urine sample and turned in dosimeter.

11:00 to 11:30 lunch.

11:30 to 3:30 Blust waited at the site for vendor to pickup the rental equipment. Vendor arrived at 2:30 and pickup rental equipment from the K-65 area and the small tools at the gate. Adair and Curry demob from site.

FIELD FORCE

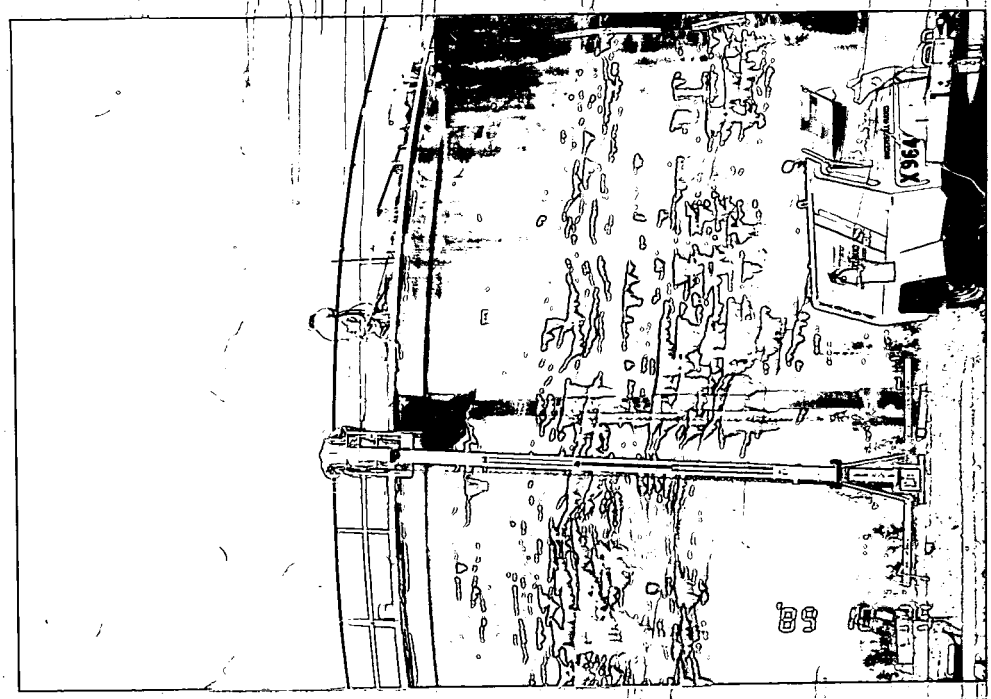
Adair, Curry, & Blust

EQUIPMENT

All rental equipment to vendor.

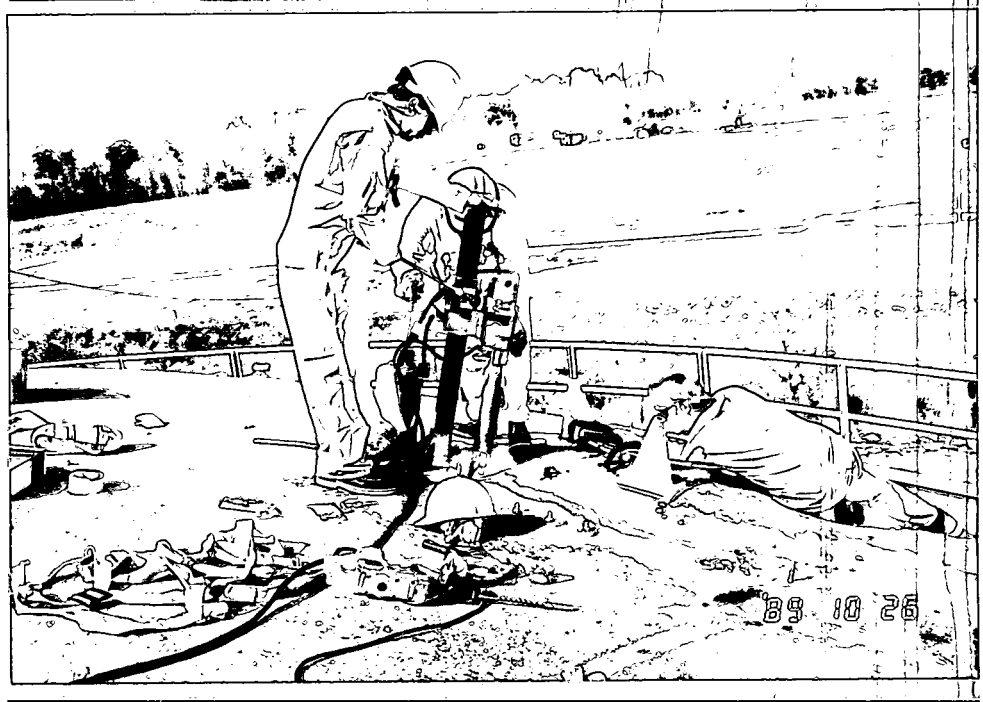
APPENDIX E

PHOTOGRAPHIC RECORD OF FIELD ACTIVITIES



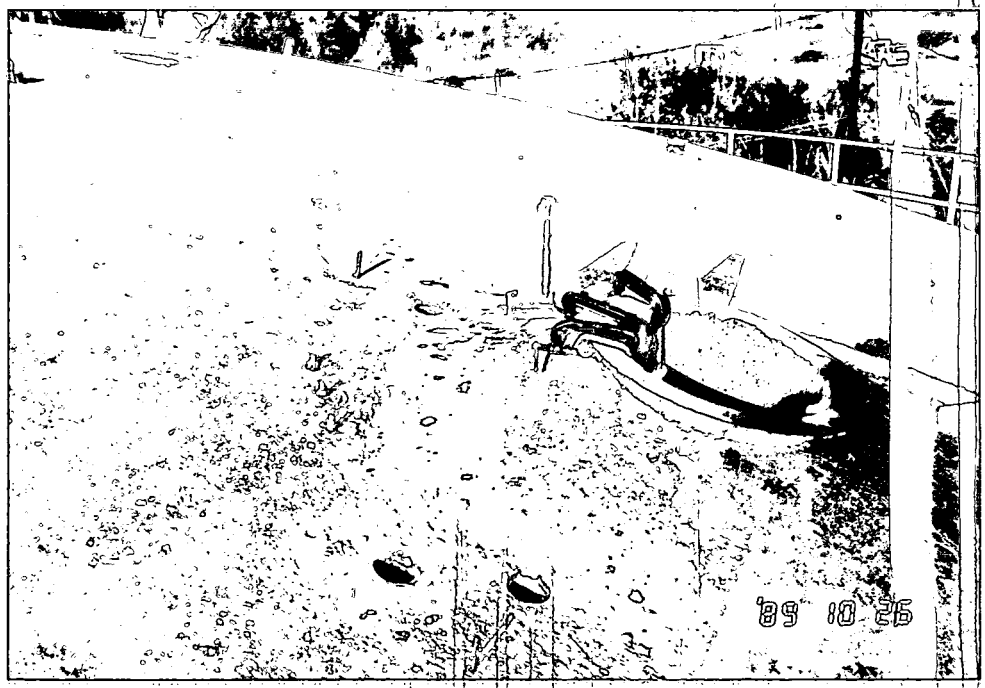
Photograph 401-2-8

SW quadrant of Silo 4 showing manlift and portable generator.



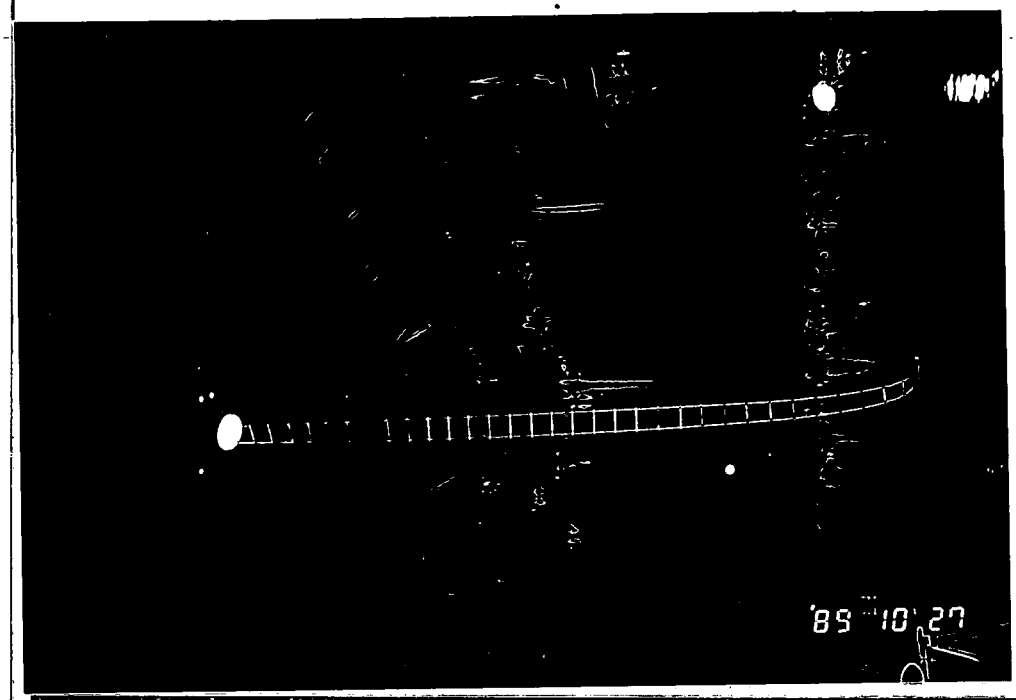
Photograph 401-2-16

Silo 4 dome coring activity.



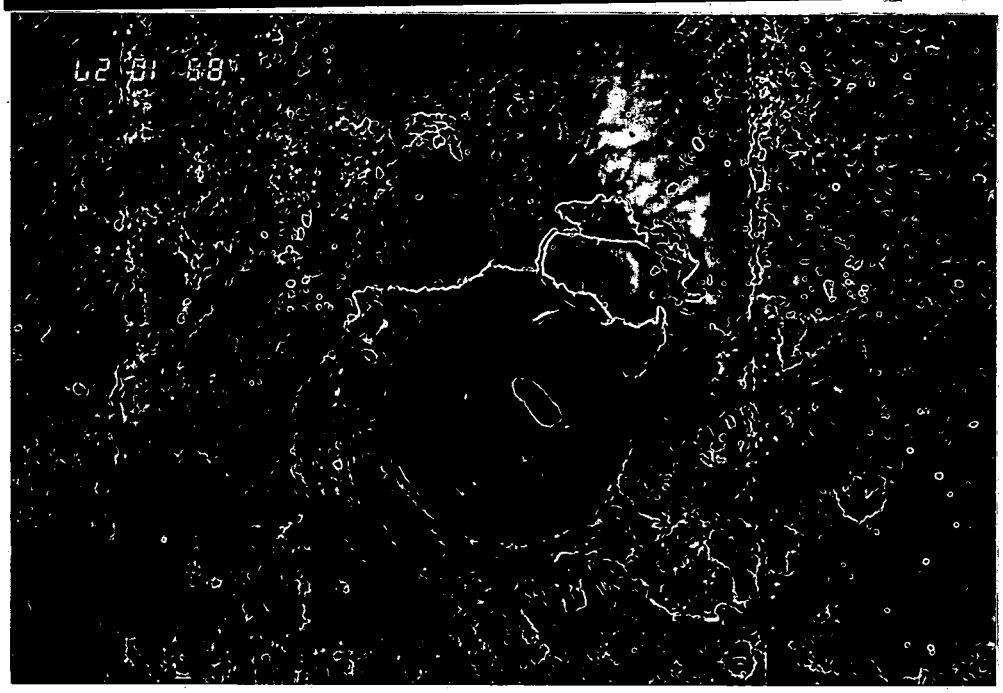
Photograph 401-2-21

Silo 4 dome showing 4 core locations at access manway.



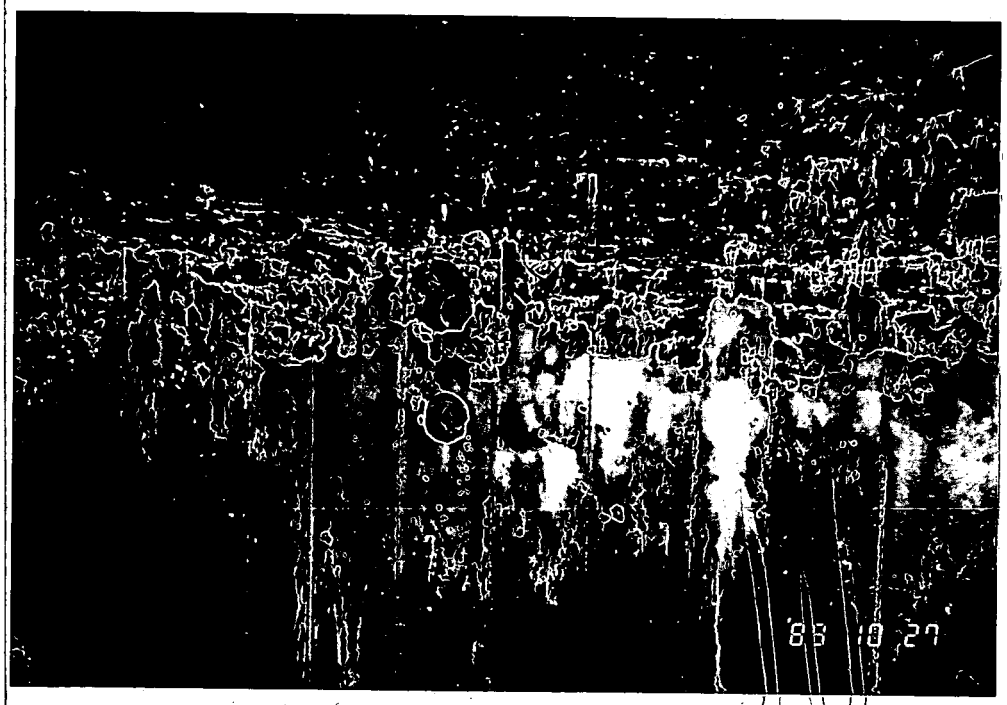
Photograph 401-1-7

Silo 4 interior showing manway, access ladder, and efflorescence .



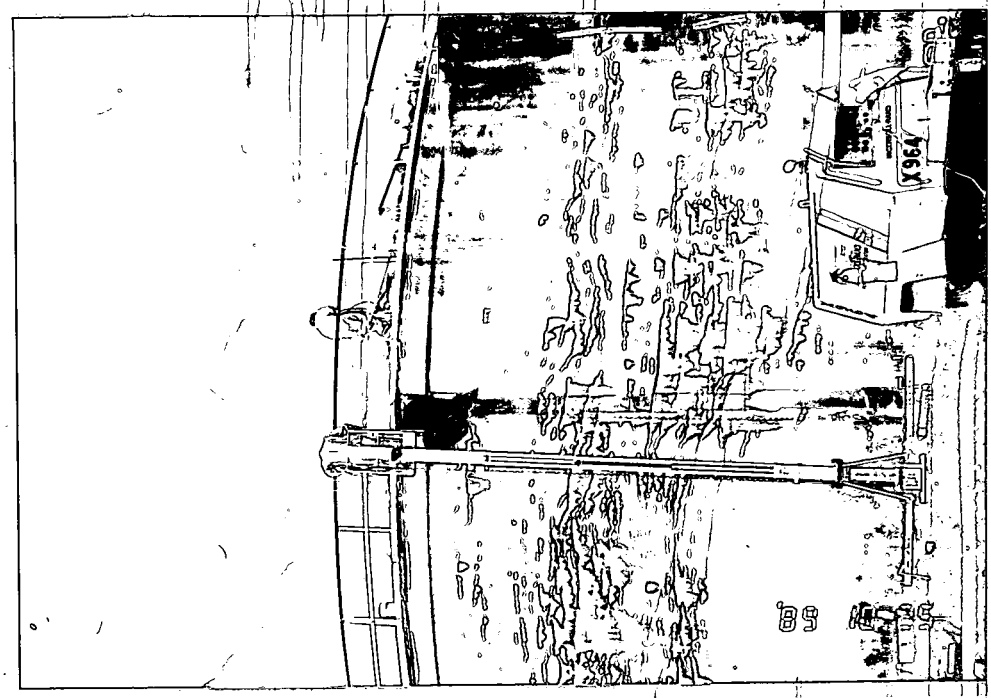
Photograph 401-1-5

Silo 4 interior showing core hole and efflorescence.



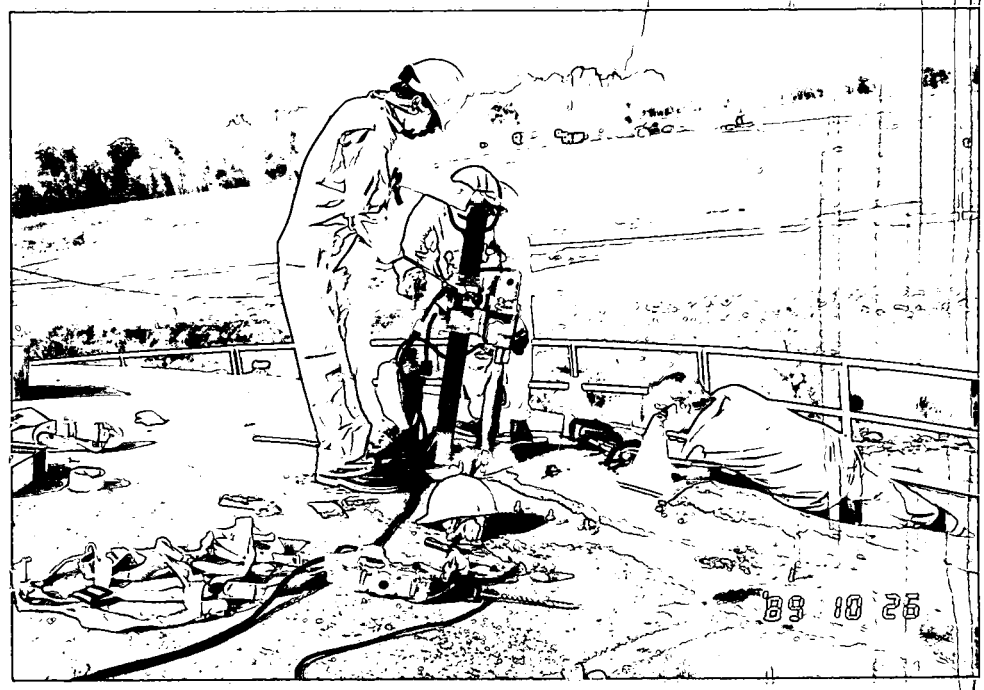
Photograph 401-1-4

Silo 4 interior showing core holes and efflorescence. on surfaces.



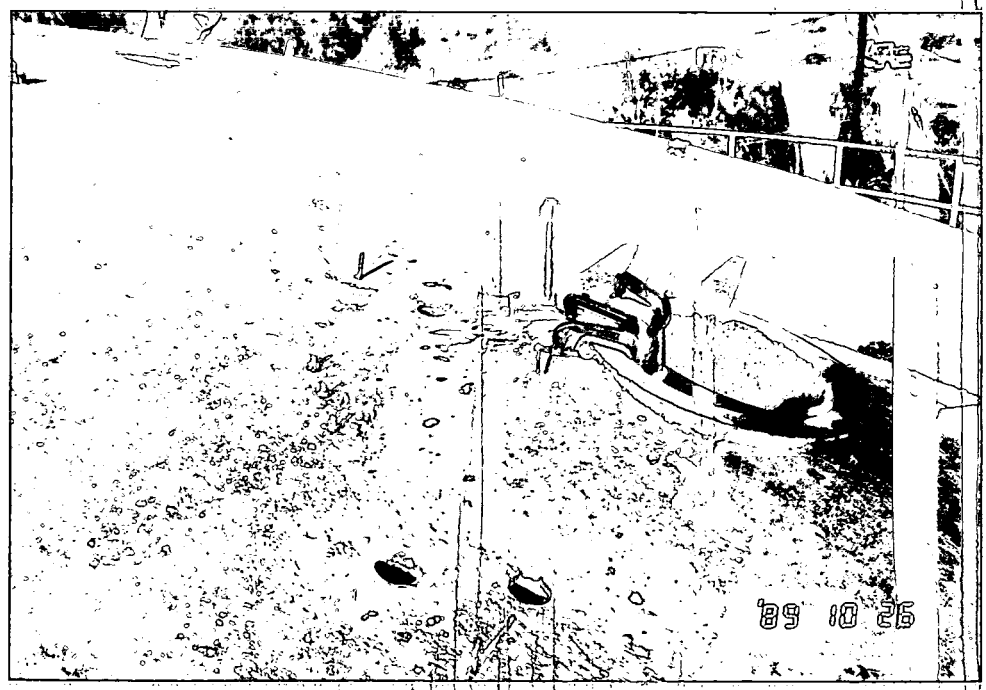
Photograph 401-2-8

SW quadrant of Silo 4 showing manlift and portable generator.



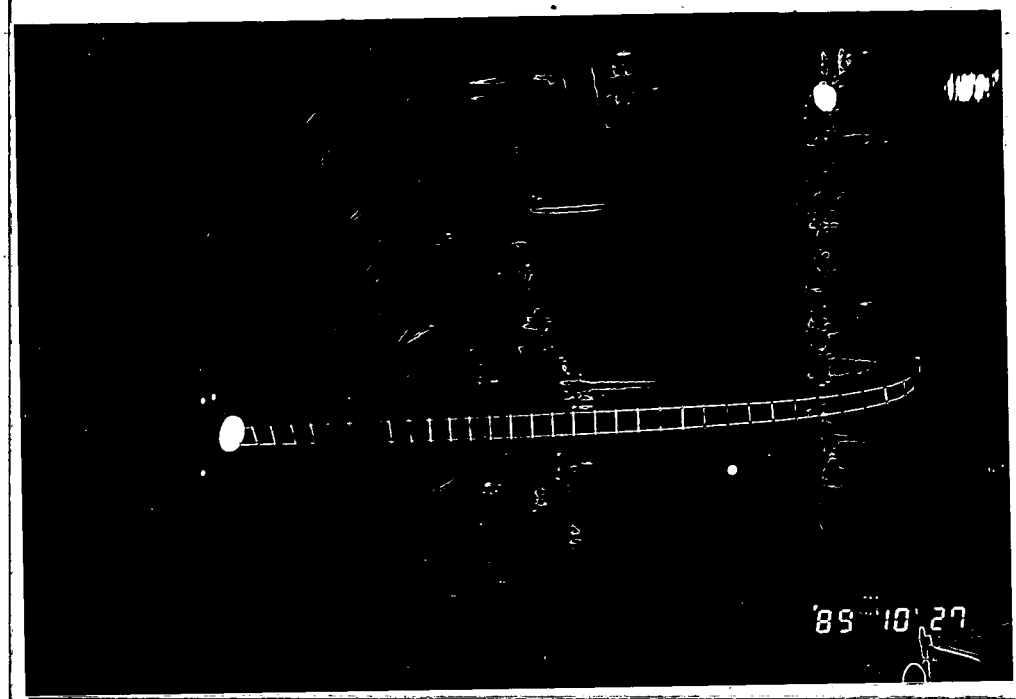
Photograph 401-2-16

Silo 4 dome coring activity.



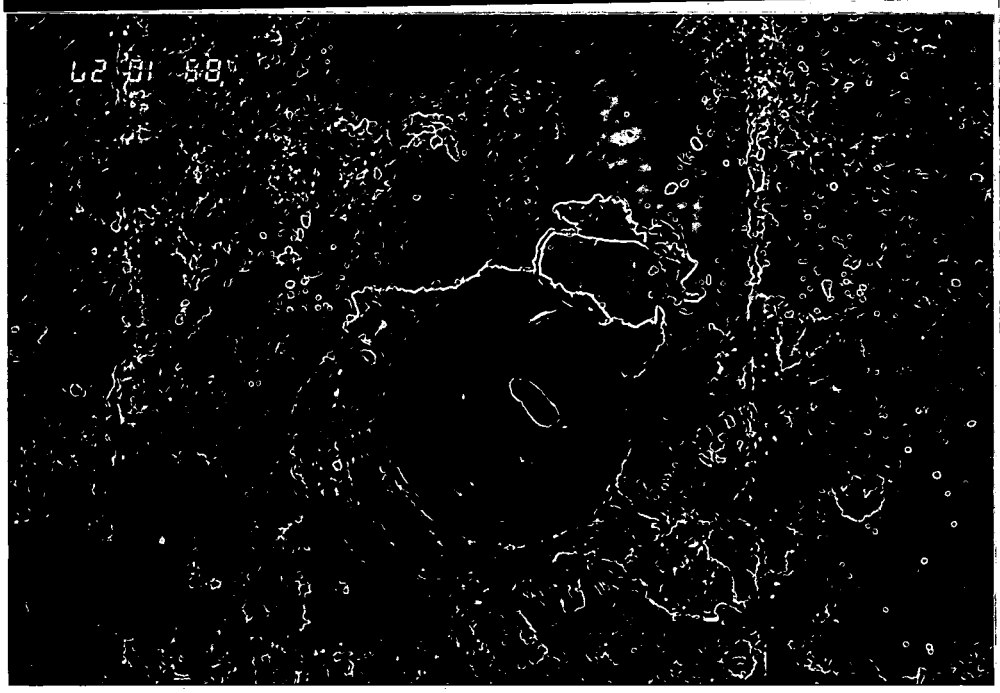
Photograph 401-2-21

Silo 4 dome showing 4 core locations at access manway.



Photograph 401-1-7

Silo 4 interior showing manway, access ladder, and efflorescence .



Photograph 401-1-5

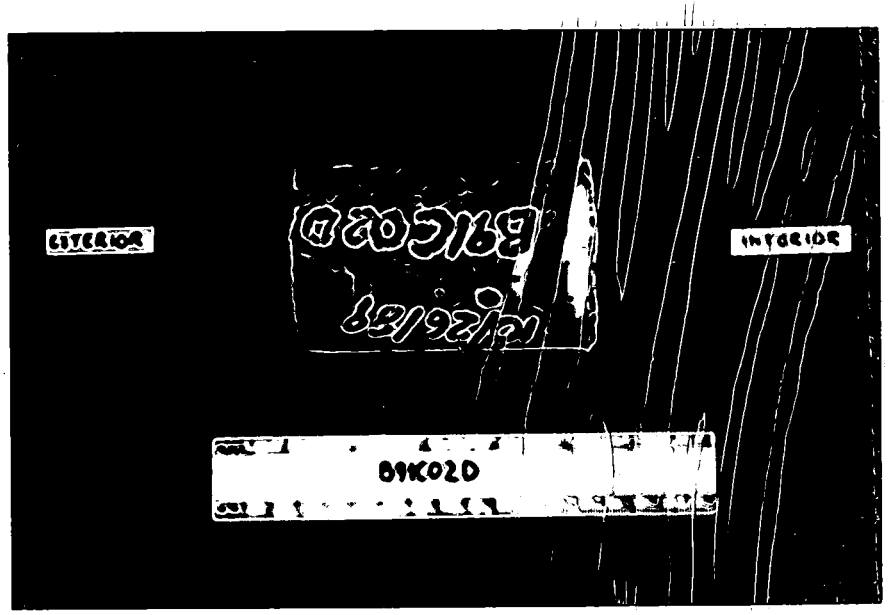
Silo 4 interior showing core hole and efflorescence.

Photograph 401-1-4

Silo 4 interior showing core holes and efflorescence. on surfaces.

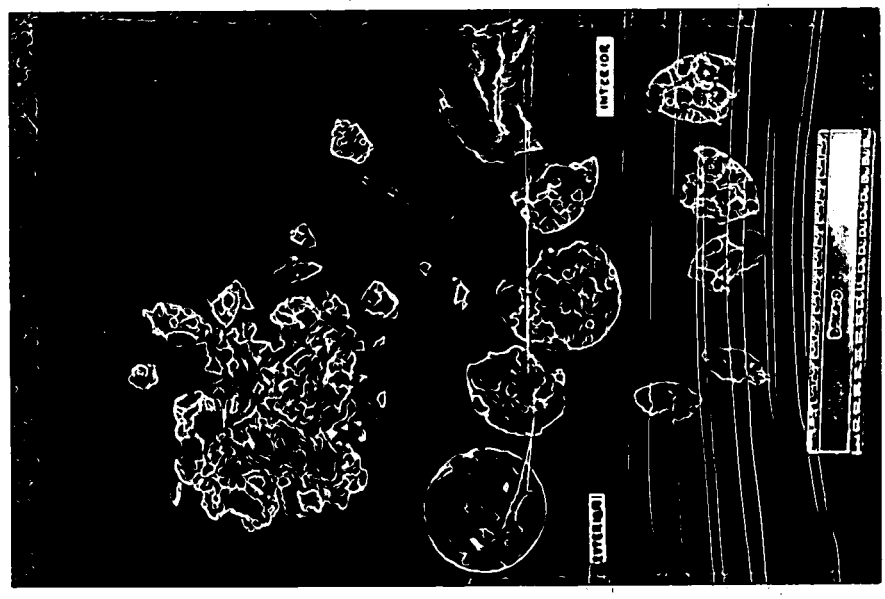
APPENDIX F

PHOTOGRAPHS OF SELECTED CORE SAMPLES



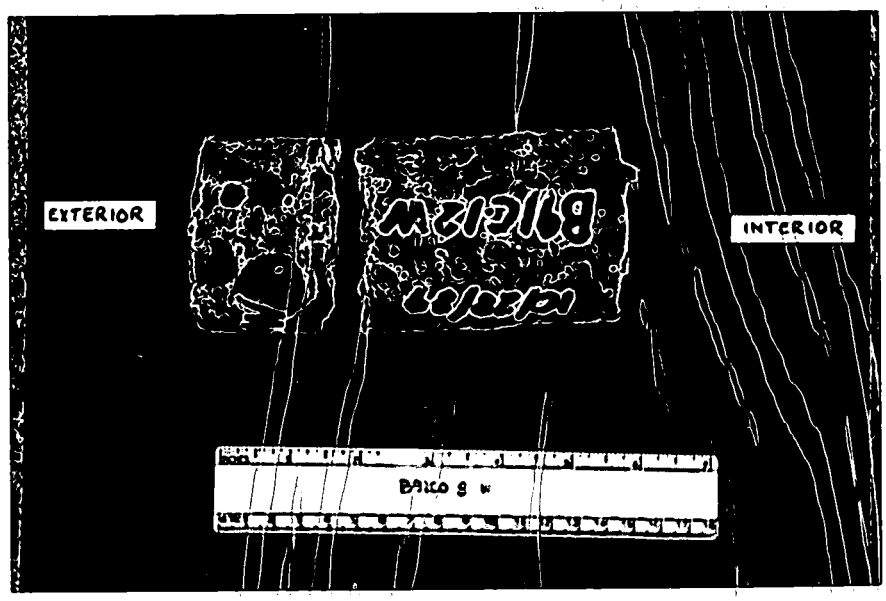
Photograph 401-4-2

Core B91C02D



Photograph 401-3-17

Core B91C04D



Photograph 401-4-17

Core B91C12W

APPENDIX G

LETTER, GEORGE PATRICK, GEOTEK ENGINEERING COMPANY TO R. B. BARBER, BECHTEL NATIONAL, INC. "SUMMARY OF UNCONFINED COMPRESSIVE STRENGTH AND SPLITTING TENSILE STRENGTH TEST DATA," CCN 64803, NOVEMBER 8, 1989

GEOTEK
ENGINEERING COMPANY

November 8, 1989

Bechtel National
P.O. Box 350
Oak Ridge, TN 37831-03530

ATTN: Mr. Russ Barber

SUBJ: FUSRAP
Geotek Project No. 89-2500Z

Dear Mr. Barber:

Please find below a summary of the unconfined compressive strength (ASTM C39) and splitting tensile strength (ASTM C49) test data you requested.

Sample Number	Sample Description	Unconfined Compressive Strength, psi
B91C02D	Concrete core containing one piece 1/8" diameter steel bar (L/D=1.47)	2062
B91C03D	Concrete core containing one piece 1/8" diameter steel bar (L/D=1.37)	1306
B91C04D	Concrete core containing one piece 1/8" diameter steel bar (L/D=1.46)	2475
B91C08W	Concrete core, no steel (L/D=1.36)	2531
B91C09W	Concrete core containing two pieces 3/8" diameter steel bar, top portion (L/D=1.01)	1463
B91C09W	Concrete core, no steel, bottom portion (L/D=0.82)	2501
B91C12W	Concrete core, no steel (L/D=1.28)	1614
B91C18F	Concrete core, no steel (L/D=1.10)	3214

Note: All sample ends capped in accordance with ASTM C617.

2711 FOSTER AVENUE
NASHVILLE, TENNESSEE 37210
(615) 833-3800

8321 OAK RIDGE HIGHWAY
KNOXVILLE, TENNESSEE 37931
(615) 690-0128

Sample Number	Sample Description	Splitting Tensile Strength, psi
B91C13W	Concrete core, no steel, diameter = 2.73" (L/D=1.61)	463

Note: ASTM C496, referred to ASTM C42 section 5.1, specifies concrete core samples have a minimum diameter of 4 in.

Correction factors used where necessary to determine all strengths.

Should you have any questions or need additional information, please feel free to contact us.

Sincerely,

GEOTEK ENGINEERING COMPANY

George Patrick
Operations Manager
Knoxville Office

Firas Mishu, P.E.
Principal Engineer
Knoxville Office

FM/GP/cb

Southern Calibration & Service, Inc.
460 PLASAMOUR DRIVE / P.O. BOX 13308 ATLANTA, GEORGIA 30324-0308

Certificate of Calibration

CERTIFICATE NUMBER: 891094
This is to certify that the following described machine has been calibrated in accordance with ASTM E4-83a and found to be within a tolerance of 1.0%

GEOTEK ENGINEERING CO.
8321 OAK RIDGE HIGHWAY
KNOWVILLE, TENN.

MACHINE FORNEY
(MODEL) FT40
(SER. NO.) 73080
COMPRESSION TEST

MACHINE RANGE 25,000 THRU 240,000 lbs.

MACHINE READING	RING READING	MACHINE ERROR lbs.	%	RING CODE
25,000.00	25,037.00	-37.00	.15	D
50,000.00	50,093.00	-93.00	.19	D
100,000.00	100,123.00	-123.00	.12	F
150,000.00	150,258.00	-258.00	.17	F
200,000.00	200,817.00	-817.00	.41	F
240,000.00	241,022.00	-1022.00	.42	F

CALIBRATION APPARATUS

PR	SER.#	CAP.	CALIBRATION LAB	CLASS "A" VERIF.	CAL. DTE	MANUF.
D	3583F	60000	NAT STDS TEST LAB	3600 LB.F.	08/28/87	MOREHOUSE
F	860510A	600000	NAT STDS TEST LAB	51600 LB.F.	06/26/89	STRAINSENSE

VERIFICATION METHOD USED: ELASTIC CALIBRATION DEVICE

LOAD VALUES CORRECTED FOR TEMP OF 74° RING TEMP 74 °F

Method of verification and pertinent data is in accordance with ASTM E4-83a. The testing device(s) used for this calibration have been verified per ASTM E74-83 and are directly traceable to the National Institute of Standards and Technology (NBS).

DATE OF CALIBRATION: 07/21/89 BY: KEVIN D. SMITH

SERVICE REPRESENTATIVE

Kevin D. Smith

APPENDIX H

LETTER, SCOTT F. WOLTER, TWIN CITY TESTING CORP. TO DAVID CHEN, BECHTEL NATIONAL, INC. "REPORT OF HARDENED CONCRETE TESTING," CCN 64865, NOVEMBER 16, 1989.

twin city testing corporation
662 CROMWELL AVENUE
ST PAUL MN 55114
PHONE 612/645 3601

REPORT OF:

HARDENED CONCRETE TESTING

PROJECT: DETERIORATION STORAGE TANK
OAK RIDGE, TENNESSEE

DATE: November 16, 1989

REPORTED TO: Bechtel Environmental Inc
Attn: David Chen
PO Box 350
Oak Ridge, TN 37831

FURNISHED BY:

COPIES TO:

LABORATORY No. 4121 90-043

INTRODUCTION:

This report presents the results of laboratory work performed by our firm on four concrete samples submitted to us by Mr David Chen of Bechtel Environmental Incorporated on November 2, 1989. The scope of our work was limited to performing a complete petrographic analysis including an air content on all four concrete samples.

Our work was requested and authorized by Mr David Chen of Bechtel Environmental Incorporated on November 2, 1989.

SAMPLE DESCRIPTION:

Sample Number -	B91C01D	B91C05D	B91C07W	B91C19G
Job Number -	14501-PO-2400			
Project -	Deteriorating Storage Tanks, Oak Ridge, Tennessee			
Sample Type -	<—— Hardened Concrete Core ——>			Hardened Gunite Section
Original Sample Size -	2 3/4" dia by 3" long	2 3/4" dia by 3" long	2 3/4" dia by 3 1/4" long	9 1/4" x 4" x 1 1/2" thick
Date Submitted -	November 2, 1989			
Submitted By -	Mr David Chen			

CONCLUSIONS:

Based on our observations, test results and past experience, our conclusions are as follows:

1. The overall quality of the concrete cores was poor. All three cores were extensively cracked throughout. The fractures were observed running both subhorizontal and subvertical to the long axis of the cores propagating through the coarse aggregate indicating probable structural cracking.

   The cores also appear to have been placed with a medium to high slump. A high slump concrete, in general, will be less dense, higher in porosity and be less durable overall. The higher porosity of the concrete, appears to have permitted the cement paste to carbonate and then dissolve into water migrating through the concrete. This phenomenon is evidenced by the extensive carbonate deposits along fractures within the concrete samples.

AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL

twin city testing corporation
662 CROMWELL AVENUE
ST PAUL MN 55114
PHONE 612/645 3601

REPORT OF: HARDENED CONCRETE TESTING

LABORATORY No. 4121 90-043

DATE: Nov 16, 1989

PAGE: 2

CONCLUSIONS: (cont)

In addition, secondary deposits of ettringite with reaction rims around coarse aggregate particles appear to indicate minor alkali-aggregate reactions.

2. The overall quality of the grout sample was good. The water/cement ratio was estimated at between 0.42 to 0.45 and the cement paste appeared relatively dense with medium to low porosity. No evidence of microcracking or deleterious chemical reactions were observed.

TEST RESULTS:

Our complete petrographic analysis test results appear on sheets #1 through #3, which are attached. The overall quality of the concrete cores was poor. This is based on the following factors:

1. The coarse aggregate in the cores was comprised of 3/4" maximum sized gravel that was fairly well graded with good overall uniform distribution.

2. Fly ash pozzolanic admixture was not observed in any of the concrete samples.

3. The paste color in both cores was medium tan to buff with the slump estimated to be medium to high (4" - 6").

4. The paste hardness of the cores was judged to be medium to hard with the paste/aggregate bond considered fair to good.

5. The depth of carbonation of the cores was negligible to 1/16" indicating medium porosity.

6. Microcracking and macrocracking was observed throughout all the core samples.

7. The water/cement ratio of the cores was estimated at between 0.50 to 0.55 with approximately 3% unhydrated cement particles.

S A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL

twin city testing corporation
662 CROMWELL AVENUE
ST PAUL MN 55114
PHONE 612/645 3601

REPORT OF: HARDENED CONCRETE TESTING

LABORATORY No. 4121 90-043

DATE: Nov 16, 1989

TEST RESULTS: (cont)

Air Content Analysis -

Sample Identification -	B91C01D	B91C05D	B91C07W	B91C19G	TCT Recommendations
Total Air Content -					
Air Void Content, %	0.6	0.5	0.8	2.6	5.0 - 7.0
Air Voids/Inch	0.18	0.13	0.45	5.47	7.5 - 14.0
Specific Surface, in^2/in^3	120	115	221	836	> 600
Spacing Factor	0.100	0.101	0.047	0.008	0.008 - 0.006
Paste Content, (Assumed) %	26.0	19.0	26.0	31.0	
Entrapped Air Analysis -					
Air Void Content, %	0.4	0.3	0.5	0.0	0.5 - 2.0
Air Voids/Inch	0.06	0.06	0.07	0.00	
Entrained Air Analysis -					
Air Void Content, %	0.2	0.2	0.3	2.6	3.0 - 6.0
Air Voids/Inch	0.12	0.08	0.38	5.47	

TEST PROCEDURES:

Laboratory testing was performed on November 9, 1989 and subsequent dates. Our procedures were as follows:

Petrographic Analysis -

A petrographic analysis was performed in accordance with ASTM:C856-83, "Standard Practice for Petrographic Examination in Hardened Concrete". The petrographic analysis consisted of reviewing cement paste and aggregate qualities on a whole basis as well as on a cut/polished section. The depth of carbonation was documented using a phenolphthalein indicator solution applied on a freshly cut surface of the concrete. Further, our analysis included a review for the presence of deleterious substances. The water/cement ratio of the concrete samples was estimated by reviewing thin sections of the concrete under a Leitz 12 POL petrographic microscope magnified up to 400X. A thin section is a thin slice of concrete approximately 30 microns thick mounted on a glass slide.

IN MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL

TWIN CITY TESTING
corporation
662 CROMWELL AVENUE
ST PAUL MN 55114
PHONE 612/645 3601

REPORT OF: HARDENED CONCRETE TESTING

LABORATORY No. 4121 90-043

DATE: Nov 16, 1989

PAGE: 4

TEST PROCEDURES: (cont)

Air Content Testing -

Air content testing was performed using ASTM:C457-82a procedures, "Determination of Air Void Content in Hardened Concrete, Linear Traverse Method". The concrete cores and grout were cut perpendicular with respect to the horizontal plane of the concrete as placed and then polished prior to testing.

REMARKS:

The test samples will be retained for a period of thirty days from the date of this report. Unless further instructions are received by that time, the samples will be discarded.

Should you have any questions concerning this report, or if we may be of further assistance, please feel free to contact Scott at (612) 641-9407.

TWIN CITY TESTING CORPORATION

Scott Wolter

Scott F Wolter
Geologist/Petrographer
Materials Engineering

SFW/jle

AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL