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KERR-McGEE CHEMICAL CORPORATION
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

DECOMMISSIONING PLAN
FOR KERR-McGEE CHEMICAL CORPORATION
WEST CHICAGO, ILLINOIS FACILITY

December 20, 1978

11594

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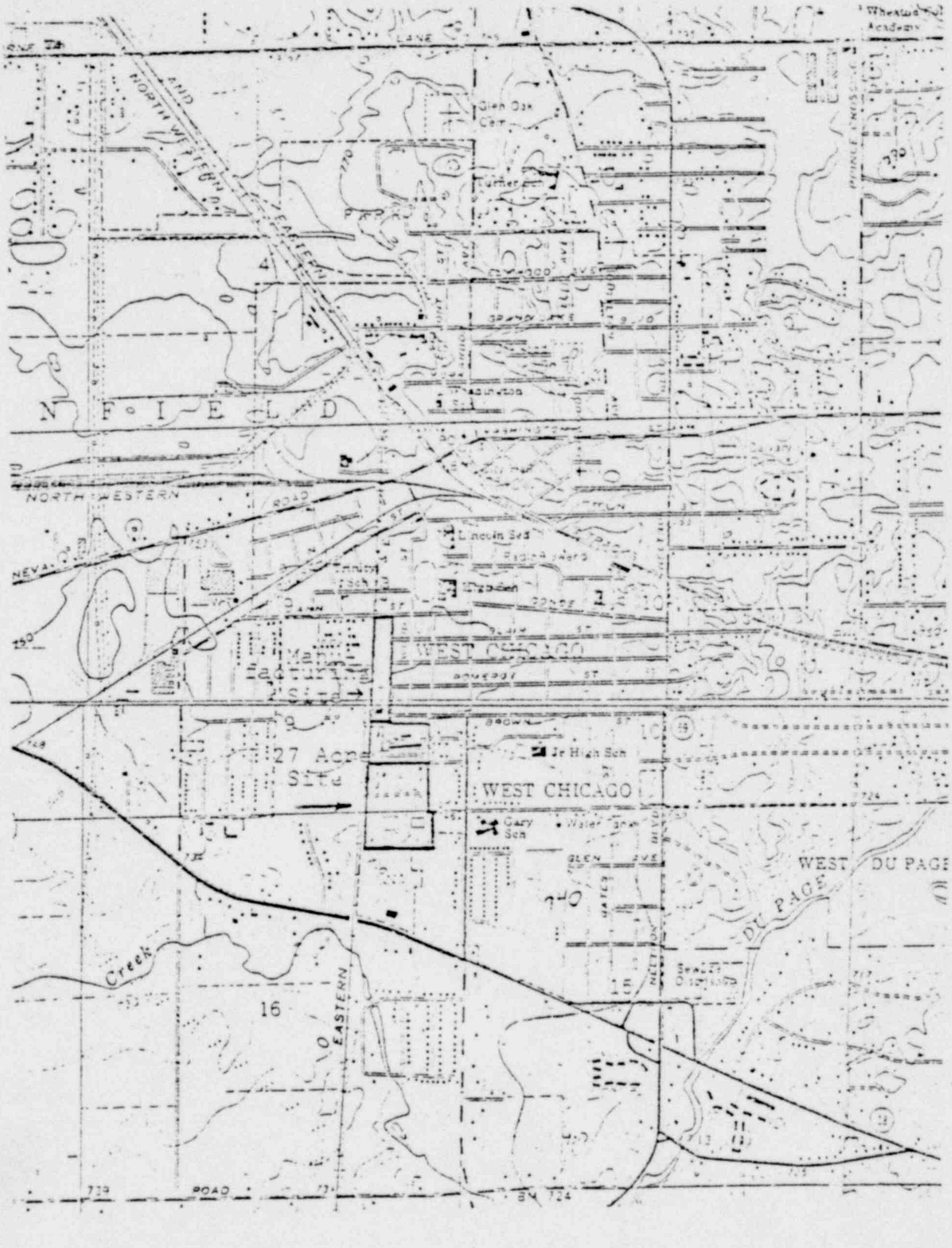

Glen Oak Cem
NORTH WESTERN
EASTERN
N F I E L D
Lincoln Sch
WEST CHICAGO
Manufacturing Site
27 Acre Site
Jr High Sch
WEST CHICAGO
Gary Sch
Water Tank
GLEN AVE
WEST DU PAGE
DU PAGE
Creek
Sewage Disposal
EASTERN
9
10
15
16
ROAD
BM 724
724
728
750
770

WEST CHICAGO FACILITY

DECOMMISSIONING PLAN

INTRODUCTION

In July, 1977, representatives of Kerr-McGee Chemical Corporation met with the Nuclear Regulatory Commission, the Illinois Department of Public Health and the Mayor of West Chicago. At this meeting, it was agreed that KMCC would develop a plan for decommissioning of the West Chicago Rare Earth Facility based on the principle that the minerals contained on the property could remain on the site if treated in an environmentally sound manner. The objective of KMCC would be to release the manufacturing and waste disposal site from the NRC license for ultimate disposition. The sites would be treated in a manner providing for long range protection of the environment and the public.

A plan meeting these criteria has now been developed and is conveyed herewith.

BACKGROUND

In 1931, Lindsay Light Company (which became Lindsay Light and Chemical Company in 1935 and Lindsay Chemical in 1952) commenced operation of the West Chicago plant. This plant processed thorium ores, chiefly monazite, to extract thorium for gas mantles. As the years passed and the use of electricity displaced gas for lighting, even in the rural areas, the use of thorium for gas mantles declined. Today gas mantles for lighting are almost completely restricted to recreational and ornamental uses. However, as gas mantle use declined, industrial use of thorium increased and the rare earth elements in the ore also became of more value. The West Chicago plant was acquired by American Potash and Chemical in May of 1958 which became part of Kerr-McGee in December of 1967.

Production operations at the West Chicago Rare Earth Facility were shut down as of December 31, 1973. Kerr-McGee continued to maintain the security of the facility while sales of product were made out of the remaining stocks, and surplus equipment was cleaned up and sold or transferred to other Kerr-McGee locations. The facility continued to be (and still is) under license from the United States Nuclear Regulatory Commission (NRC).

Following the cessation of operations, Kerr-McGee made an in-house investigation of alternate decommissioning plans. The result of this investigation was discussed with the NRC. Subsequently, Mr. Paul Klevin, a consultant with experience in decommissioning such facilities, was hired to assist in the development of a plan for submission to the NRC. The plan that was developed involved preparation of the site such that all of the 7.8 acre manufacturing site and about half of the 27 acre disposal site could be sold. The plan was submitted to the NRC on September 25, 1975. Over the next several months, Kerr-McGee responded to NRC requests for additional data and in April of 1976, the NRC hired The Argonne National Laboratory (ANL) to make an environmental assessment of the plan. Certain aspects of the plan were not totally acceptable to State and local bodies. Therefore, in November, 1976, this plan was withdrawn by Kerr-McGee.

While waiting for publication of the ANL report so it could be used in the development of a new plan, Kerr-McGee made further improvements in the security of the site and removed that portion of the waste material which had a higher level of thorium than the bulk of the wastes. This was done by ATCOR, Inc., a company with 12 years of experience of handling radioactive wastes and in decontamination and decommissioning.

In July of 1977, Kerr-McGee met with the NRC, the ANL, the Illinois Department of Public Health and the Mayor of West Chicago. Dr. Frigerio, ANL, reported that the ANL study found no migration of radioactivity from the site by way of underground water or by air-borne dust. Kerr-McGee described the general concept of the plan they wished to develop. It was agreed by all present that Kerr-McGee should develop its plan on this basis.

In July, 1977, ATCOR, Inc., was employed to assist in the preparation of a detailed plan for Kerr-McGee.

Since the shutdown of the West Chicago Rare Earth Facility on December 31, 1973, the facility has continued under a license from the United States Nuclear Regulatory Commission. The site has been maintained, through monitoring and security measures, in a safe condition that presents no hazard to the employees or the community. The safety of the site has been confirmed by the Argonne National Laboratory, the Illinois Department of Health and the Nuclear Regulatory Commission. The plan, submitted herewith, will assure continued safety of the site.

Alternate plans for accomplishing this have been reviewed. The preferred plan consists of clearing and rendering fit for uncontrolled use the 7.8 acre manufacturing site. All contaminated rubble and soil from the manufacturing site and from the 27 acre disposal site will be placed on an existing clay substructure at the disposal site and capped with a layer of clay plus several feet of soil. The entire 27 acre disposal site will be graded and planted with grass.

This plan renders both the 7.8 acre manufacturing site and the 27 acre disposal site environmentally safe. The 7.8 acre site will meet all criteria for unrestricted use. The only restriction on use of the 27 acre site will be that such use does not disturb or penetrate the clay cover without proper safeguards. The radioactivity will meet all environmental criteria. The wastes will be treated, before covering with clay, to render them even less soluable than they are now. This, plus the presence of low porosity clay both above and below the material, will assure that the material does not enter the underlying aquifer.

An intrinsic part of the plan is the protection of the environment, the community and the workers during the work of clearing the manufacturing site and preparing the disposal site. Close supervision and frequent expert inspections at every stage of the job will assure that the plan is carried out in detail, that protective measures are followed and that the result will be as represented in the plan.

Kerr-McGee Chemical Corporation is prepared to begin implementation of the plan immediately upon receiving the necessary approvals from the governmental agencies. Until such time as it is released to begin implementation, Kerr-McGee will continue to maintain the site in an environmentally safe condition.

SUMMARY OF PLAN

Kerr-McGee will salvage all remaining equipment and building material which it is practical to salvage. The remaining structures will be industrially cleaned using washing and vacuum techniques to remove loose surface contamination. Areas which have fixed surface contamination greater than the release criteria will then be painted in order to seal and contain the radioactivity within the pores and for identification.

The plan then considers the internal dismantlement of non-load bearing walls, rooms, process equipment, piping, etc. The flooring within Building No. 9 will be demolished from above allowing the rubble to accumulate and be processed from the first floor. The external building shells will then be dismantled using standard mechanical methods. The use of explosive demolition will not be allowed. The rubble which can be shown to be below the unconditional release criteria will be disposed of as clean fill at local, permitted refuse sites. In order to control dust, an air scrubber system will be employed. Kerr-McGee will transfer the remaining low level contaminated building rubble to the 27 acre site for disposal. All surface subsurface structures and soil which contain greater than one-twentieth of one percent by weight of source material (thorium) will be removed from the manufacturing site. This material will be disposed of at the 27 acre site.

Throughout the demolition phase, constant monitoring will insure that all planned precautionary steps are taken and fugitive dust is controlled.

The manufacturing site will be sampled and surveyed to insure all important quantities of source material have been removed. The site will then be levelled, replacing the removed material with clean fill where necessary to its present grade.

The 27 acre site will be contoured into a gently sloping area in which all radioactive wastes are graded, compacted, sealed and covered with earth. The 27 acre site will be contoured such that surface drainage around the site occurs with about one percent grade. The buried waste contoured surface will be at a grade to prevent erosion of the grass cover. To prevent flooding during rains, a surface surge pond will be located in the southwest corner of the site. This pond will empty into an adjacent storm sewer.

The insoluble contents of the lagoons will be exhumed and placed upon existing piles of waste material of a similar composition. To exhume the contents from lagoon No. 1, 2 & 3, Kerr-McGee plans to install well points to depress the perched water table in the vicinity of the lagoons Water will be pumped to another lagoon whose sediments are being removed. Each lagoon's pH will be adjusted by adding lime which will render the radioactive components insoluble. The sediments will be removed using drag lines and buckets.

If necessary and as an alternative to installing well points, an impervious barrier of bentonite will be introduced by slurry wall techniques. This barrier will reduce the quantity of water which has to be pumped to other lagoons and will have the least affect on the perched water table. The bentonite slurry wall will be tied into the clay lens which exists at a depth of about 25 feet. This impervious barrier would also be beneficial in refilling the excavations with compacted material.

The plan for the lagoons is to fill them with compacted building rubble which does not contain appreciable quantities of radioactive contamination; i.e., exterior wall sections. The lagoons, when filled, will be sealed with a layer of clay at the level of the existing clay surface soil on the site. This will eliminate paths for subsurface water to enter the wastes emplaced in this location. The contaminated process tanks will be filled with soil to prevent future settling when the containers eventually decompose by oxidation. The pile of ore residue will be repositioned on the site as will the low level contaminated rubble and soil from the manufacturing site. All waste materials will be completely covered with a clay layer to a depth of about 18 inches to provide an impervious barrier to surface water. (See sketch No. 1.)

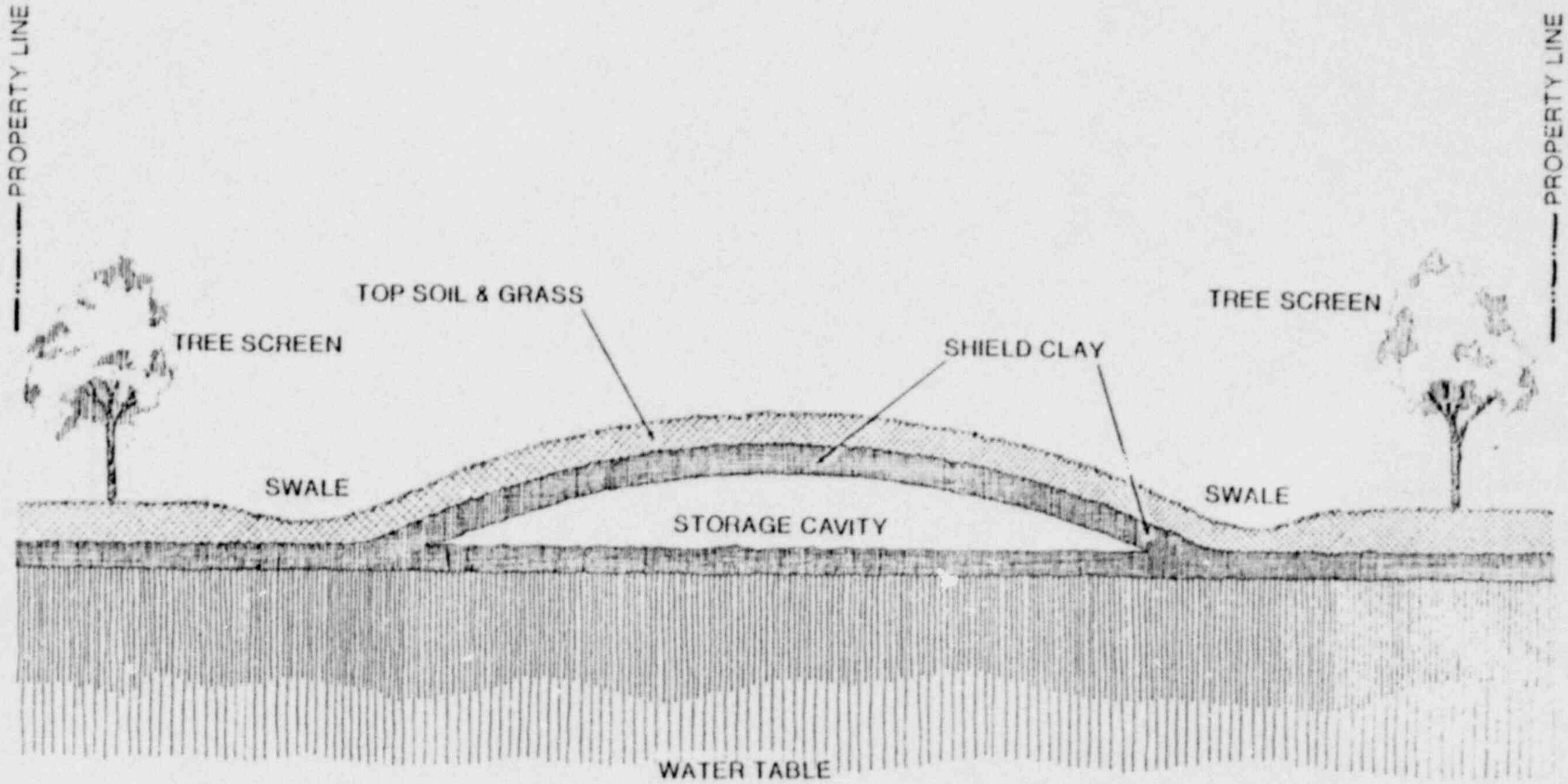
All wastes will then be covered with clean fill totalling 4.5 feet and followed by about six inches of top soil. The site will be planted with grass.

The 27 acre site presently contains a deep well and five boreholes which have been cased for obtaining samples of the perched water table. Kerr-McGee will cement these to prevent the migration of chemical and radioactive material via this route.

Along the southern portion of the site, there exists a sewer main which will require relocation. Kerr-McGee will relocate this sewer line through a portion of the site which will not contain buried radioactive material.

Throughout this phase of the work, constant monitoring and inspection will insure that all aspects of the plan are carried out as in the approved plan.

Details of this plan, showing the location and nature of all materials buried on site will be filed with the City and the County, as well as the NRC, as a permanent record.



NOT TO SCALE

SKETCH NO. 1

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HYDROLOGY AND WATER QUALITY

The geohydrology and water quality characterization of the site and contingous property has been completely described in "Environmental Assessment, Characterization, Geohydrology and Subsurface Chemistry," prepared by the Division of Environmental Impact Studies, Argonne National Laboratory, dated July, 1977. This report is a result of cooperative studies of ANL, Kerr-McGee Chemical Corporation, and the Illinois EPA performed in late 1976 on and near the site of the KMCC West Chicago plant.

The paper describes the recent history of the site and water quality, its composition, geology and water quality in the near surface groundwater and in a medium depth aquifer which is a source of domestic and city water in the near area. The principal conclusions of the report are:

A.) Subsurface materials are highly inhomogeneous and are water saturated and generally permeable to a depth of approximately 30 feet.

B.) No significant migration of radioactive elements on the surface into the water table exists and no measurable site-associated radioactivity is detectable in the aquifer.

C.) Effects of radioactive substances (sulfate, chloride, TDS) on groundwater can be controlled.

D.) The groundwater is cleansing itself, thus improving the water quality.

At the request of the Illinois EPA, these studies were supplemented by additional samples taken from the core holes on April 25, 1978, and leaching tests of the solids stored were performed in accordance with IEPA procedures.

PROJECTED IMPACT AFTER ADOPTION OF THE PLAN

Adoption of the plan attached to this report would result in the isolation of the waste pile components from exposure to weather conditions by the placement of a dense clay blanket over the waste and covered by topsoil. Rainwater percolating through the topsoil to the clay blanket would be diverted by the decreased permeability of the clay down the sloping sides of the clay blanket onto the surrounding surface material. This blanket will be installed with a curtain descending into the surface soil to a depth of 2 to 3 feet. Clay used for the blanket will be tested by an established soil laboratory and examined during emplacement to ensure that compaction and low permeability measured by laboratory tests is achieved in the field.

Decommissioning Plan

1. Decommissioning Criteria

1.1 The plan considers that the manufacturing site will be decontaminated to unconditional release levels as follows:

a. Acceptable fixed alpha surface contamination levels:

average 1,000 dpm/100 cm^2
maximum 3,000 dpm/100 cm^2

where measurements of surface contaminants are not averaged over more than one square meter.

b. Acceptable removable surface contamination levels:

maximum 200 dpm/100 cm^2

c. Radiation measurement at one centimeter as measured through not more than seven milligrams per square centimeter of total absorber:

average 0.2 mrad/hour
maximum 1.0 mrad/hour

where measurements of radiation are not averaged over more than one square meter.

d. Contamination in soil:

maximum of 0.05 percent by weight of natural thorium.

1.2 The plan considers that the twenty-seven (27) acre site will be stabilized such that:

a. Dose rate at the surface of the acres:

maximum 0.2 millirem/hour

b. Contamination in soil at the final covered surface:

maximum of 0.01 percent by weight of natural thorium.

c. Airborne emanation at final covered surface:

maximum of 0.05 working levels for radon-thoron with daughter product.

2. Details of Plan

2.1 Manufacturing site.

A. Package all loose contaminated material within the facility.
   1. Inspect all packaged material for shipment to the twenty-seven (27) acre site.
   2. Upgrade packages of material where required.
   3. Package all loose items which qualify as radioactive material in suitable packages.
   4. Industrially clean all floors using sweeping compounds for dust control and package waste into 55-gallon drums.
   5. Remove debris and brick linings within trenches and package within structures.
   6. Transfer packaged waste to twenty-seven (27) acre site for storage.

B. Vacuum clean building structures; floors, walls, and overhead.

C. Remove material having an instrument reading in excess of 1 mr/hr as determined with an Eberline E-120 detector equipped with an HP-190 probe.
   1. Survey and identify areas.
   2. Surface chip cement floor areas.
   3. Remove gratings and wooden flooring.
   4. Package waste.
   5. Reclean surrounding surfaces.
   6. Transfer packaged waste to twenty-seven (27) acre site for storage.

D. Paint all surfaces which have fixed surface contamination levels in excess of the release criteria with a yellow water base paint for contamination control and airborne particulate control.
   1. Survey and identify areas using an Eberline

PAC 4G or equivalent.

2. Paint areas.

E. Smear survey components, pipes, and non load bearing walls within structures.
   1. Smears to be taken and documented.
   2. Clean if deemed practical to less than 200 dpm/100 cm^2.
   3. Paint surfaces which exceed 200 dpm/100 cm^2 of loose surface contamination.

F. Dismantle items identified in step E.
   1. Dismantle items using the most cost effective means. Air pneumatic equipment should not be used without specialized controls.
   2. Segregate clean and contaminated scrap.

G. Disposal of clean scrap.
   1. Load clean scrap onto radiologically clean vehicles.
   2. Estimate weight and quantity of waste.
   3. Initiate clean scrap manifest.
   4. Transfer scrap to local land fill sites within vicinity of West Chicago.

H. Contaminated scrap control.
   1. Load scrap onto identified transport vehicle.
   2. Cover contents with suitable cover.
   3. Transfer scrap to twenty-seven (27) acres site.
   4. Wet surface of waste on vehicle, if necessary, for dust control.
   5. Compact waste and cover with uncontaminated earth daily.

I. Dismantle conveyors and bag filter housing on roof of building number 9.
   1. Disconnect and seal to eliminate dust release.
   2. Rig from roof.
   3. Upgrade units into "strong tight" packages for shipment as "Radioactive-LSA" waste.
   4. Transport to commercial "low level" radioactive waste disposal site.

J. Dismantlement of flooring within building number 9.
   1. Remove a portion of floor within south end of building number 5 and excavate earth to form a pit.
   2. Construct a lagoon in above pit using a double plastic liner.
   3. Install a water transfer system from existing trenches in building number 9 to the lagoon.
   4. Add coarse gravel above the tile pipes in the trenches to remove by filtration that material which could damage pumping equipment.
   5. Seal the window openings as required to prevent uncontrolled releases.
   6. Install pressurized pumping system which takes water from the lagoon and supplies pressure to fog nozzles.
   7. Demolish upper floors of building number 9 while using fog nozzles for dust abatement.
   8. Transfer the rubble to the twenty-seven (27) acre site.

K. Raze all structures on manufacturing site.
   1. Dismantle and segregate waste material which is not contaminated fromthat which may be contaminated.
   2. Transfer clean rubble to local land fill areas and contaminated waste to the twenty-seven (27) acre site as described previously.

L. Excavation efforts.

1. Remove all surface earth and subsurface earth which have levels of contamination in excess of:
    a. 0.2 millirad/hour at one centimeter, and
    b. 1/20 of one percent natural thorium by weight.
2. Remove entire drainage system (trenches, tanks, pipes) upon the manufacturing site and between the manufacturing and twenty-seven (27) acre site and earth in the vicinity of these systems which exceed the above release criteria.
3. Exhume all lagoons and tanks on the manufacturing site which had been previously used and remove all portions which exceed the above release criteria.
4. Transfer the contaminated waste to the twenty-seven (27) acre site as previously described.
5. Surface soil which have readings in excess of 0.05 millirem per hour would be disposed of within manufacturing site excavations as fill and remaining low level contaminated earth will be transferred to the twenty-seven (27) acre site.

M. Conduct a radiological survey of the manufacturing site.

1. Grid area into twenty-five (25) foot by twenty-five (25) foot grids.
2. Conduct gamma scan surveys with NaI detectors to determine highest dose rate in each grid.
3. Sample and analyze surface earth.
4. Obtain pressurized ion chamber readings at one (1) meter above point where highest gamma readings were obtained.
5. Perform gamma scan surveys to depth of ten (10) feet in each grid.
6. Prepare report to be submitted to the regula-

tory agencies having jurisdiction.

N. Restore site.
   1. Replace earth fill where necessary.
   2. Level and compact earth to approximate topographic features of the surrounding property.

2.2 Twenty-Seven (27) acre site.

A. Reduction of ore residue pile height in order to meet the final site contour configuration.
   1. Dampen surface of pile with water spray to prevent dust from becoming airborne.
   2. Add lime, $Ca(OH)_2$ to the surface and on surfaces of the pile exposed during its relocation.
   3. Remove and place the ore residue in the designated areas on the twenty-seven (27) acre site.
   4. Compact waste and cover the waste with uncontaminated soil.

B. Add lime, $Ca(OH)_2$, to lagoons 2 through 5 to adjust the pH to 9.0 ± 1.0 as determined with pH paper.

C. Exhume contaminated sediments from lagoons 2 through 5.
   1. Place the removed sediment in the designated areas on the twenty-seven (27) acre site.
   2. Cover the removed sediment daily with uncontaminated soil.

D. Reduction of sediment pile height in order to meet the final site contour configuration. (This sediment had been previously removed from lagoons 1 and 2.)
   1. Dampen surface of pile with water spray to

prevent dust from becoming airborne.

2. Remove and place sediment in the designated areas on the twenty-seven (27) acre site.
3. Cover the sediment with uncontaminated soil.

E. Exhume contaminated sediments from lagoon 1.

1. Depress the water table locally around the lagoon by constructing local wells.
2. Pump the removed water to lagoon 3 or 4.

   Note: If it is determined that the water table cannot be depressed with manageable quantities of water being pumped from the perched water table, it will be necessary to have a bentonite slurry wall installed around this lagoon.
3. Dampen the surface fill over the sediment to prevent dust from becoming airborne.
4. Excavate surface cover and debris covering the sediment.
5. Remove sediment and place sediment in the designated areas on the twenty-seven (27) acre site.
6. Cover the sediment with uncontaminated soil.

F. Refill of lagoons.

1. Place building rubble of low contamination levels (less than 0.05 millirem per hour on contact) choked with clean fill.
2. Compact fill material as much as practical until fill is about two (2) feet below natural site grade.
3. Pump free standing water in lagoon, if necessary, to one of the lagoons which can still function as an infiltration pond.
4. Add clay fill over waste material and compact the clay to match the clayey layer which

covers the existing site.

G. Dismantle the three (3) buildings.
    1. Industrially clean internals of structures.
    2. Remove roof and walls and determine if this material can be unconditionally released.
    3. Place contaminated waste in designated areas within the twenty-seven (27) acre site.

H. Construction of natural drainage swale around the perimeter of the twenty-seven (27) acre site.
    1. Apply a fixative over portions of the building footings and floor which is required to be removed.
    2. Dismantle those portions of the building footings and floor required in order to install drainage swale and meet final site contours.
    3. Dispose of building rubble in designated areas within the twenty-seven (27) acre site.
    4. Excavate perimeter to install drainage swale storing the earth for use as cover for the radioactive waste.
    5. Relocate the force main.
    6. Construct a surge pond in south-west corner of the site to retard rain water diversion from the constructed drainage swale.

I. Capping of deep well and five (5) bore holes.
    Fill each of the bore holes and well casing with hydraulic cement to seel them to ground level.

J. Disposal of building rubble, chemical process equipment, and other waste material presently on the twenty-seven (27) acre site.
    1. Place waste material in designated areas and choke with filler material.
    2. Compact the choked waste.

    3. Cover the compacted waste with clean fill.
    4. The waste will be maintained damp with water spray in order to control dust from becoming airborne.

K. Disposal of process tanks which are rubber lined.
    1. Fill the tanks with rare earth ores residues and compact.
    2. Compact fill around these tanks to prevent differential settling.

L. Site fill cover.
    1. Add 1.5 feet of compacted clay to cover all portions of the site upon which radioactive waste has been placed.
    2. Cover the clay lens with a minimum of three (3) feet of earth fill. Most of the required fill will be obtained from off site sources.
    3. Compact the fill over the clay lens.
    4. Perform radiological surveys at one (1) meter with a pressurized ion chamber over the buried waste to determine if the dose rate is less than 0.05 millirem per hour.
    5. Prescribe additional fill shielding as required to reach 0.05 millirem per hour.
    6. Add top soil cover as required and revegetate the twenty-seven (27) acre site.

The attached drawings display topographical features, designated areas where the placement of the waste is planned, and typical cross-sections of the twenty-seven (27) acre disposal site. These drawings will be revised, as necessary, to accurately describe the final site.

List of Drawings

18.1 Existing Topographical Plan

18.2 Disposal Plan

18.3 Final Topographical Plan

18.4 Disposal Plan Cross Sections: 1+00, 0+20, 0+00

18.5 Disposal Plan Cross Sections: 2+90, 2+55, 2+00

18.6 Disposal Plan Cross Sections: 3+70, 3+45, 3+15

18.7 Disposal Plan Cross Sections: 5+00, 4+35, 4+15

18.8 Disposal Plan Cross Sections: 6+00, 5+85, 5+50

18.9 Disposal Plan Cross Sections: 7+00, 6+60, 6+16

18.10 Disposal Plan Cross Sections: 7+72, 7+50, 7+22

18.11 Disposal Plan Cross Sections: 8+80, 8+50, 8+20

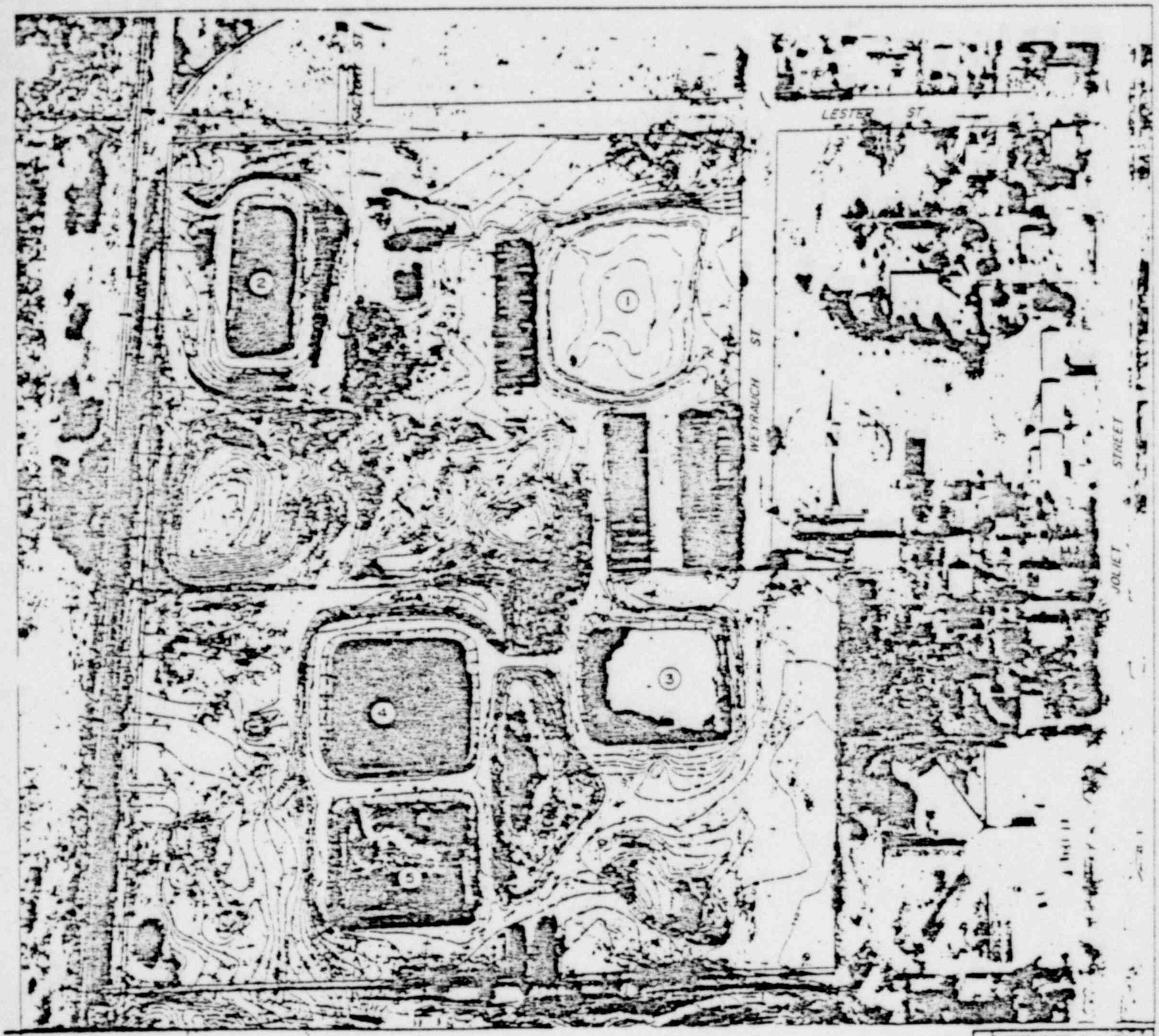
18.12 Disposal Plan Cross Sections: 9+65, 9+50, 9+10

18.13 Disposal Plan Cross Sections: 10+87, 10+50, 10+20

18.14 Disposal Plan Cross Sections: 12+00, 11+70, 11+00

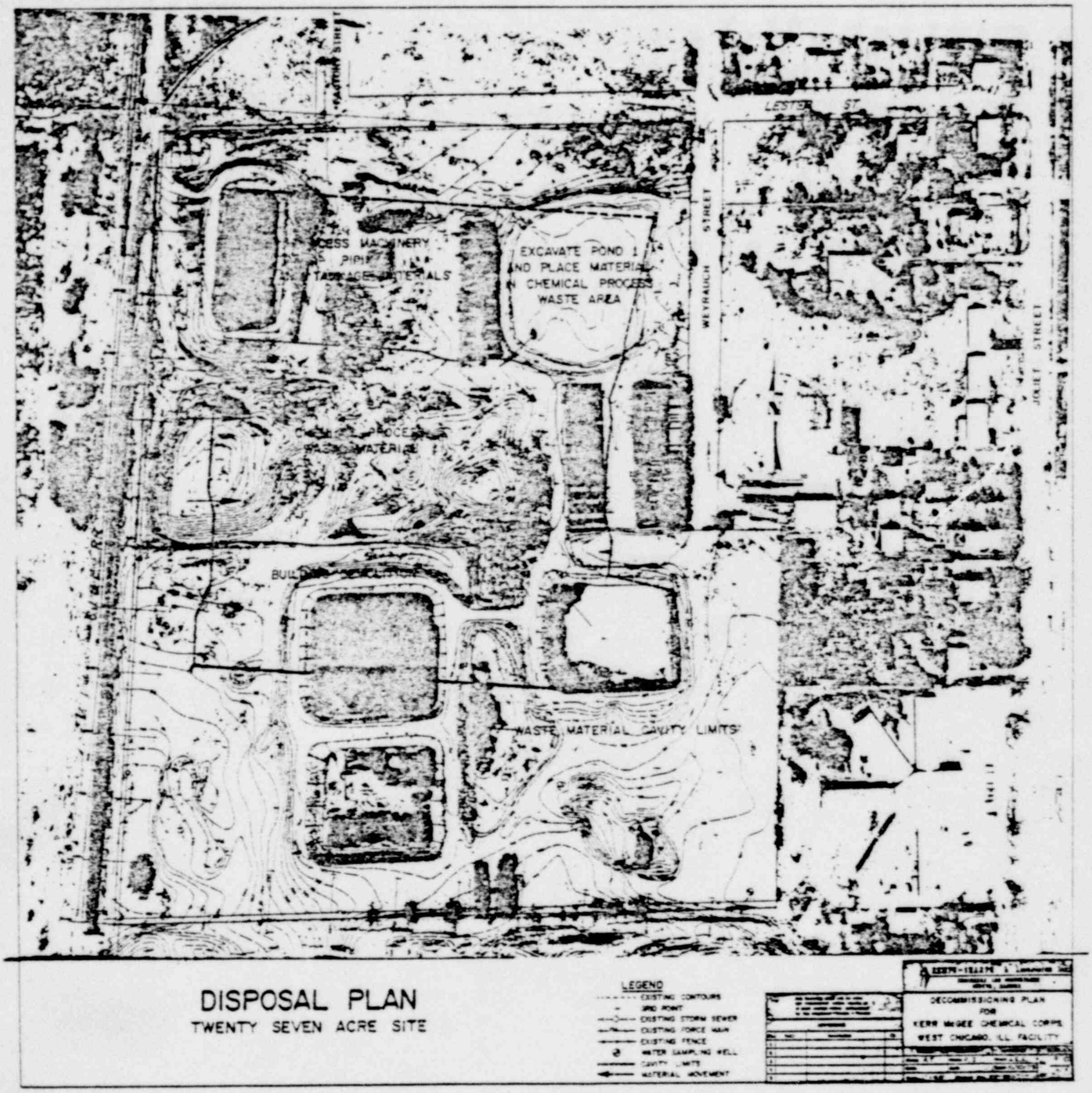
18.15 Disposal Plan Cross Sections: 12+55, 12+30

18.16 Typical Cross Section

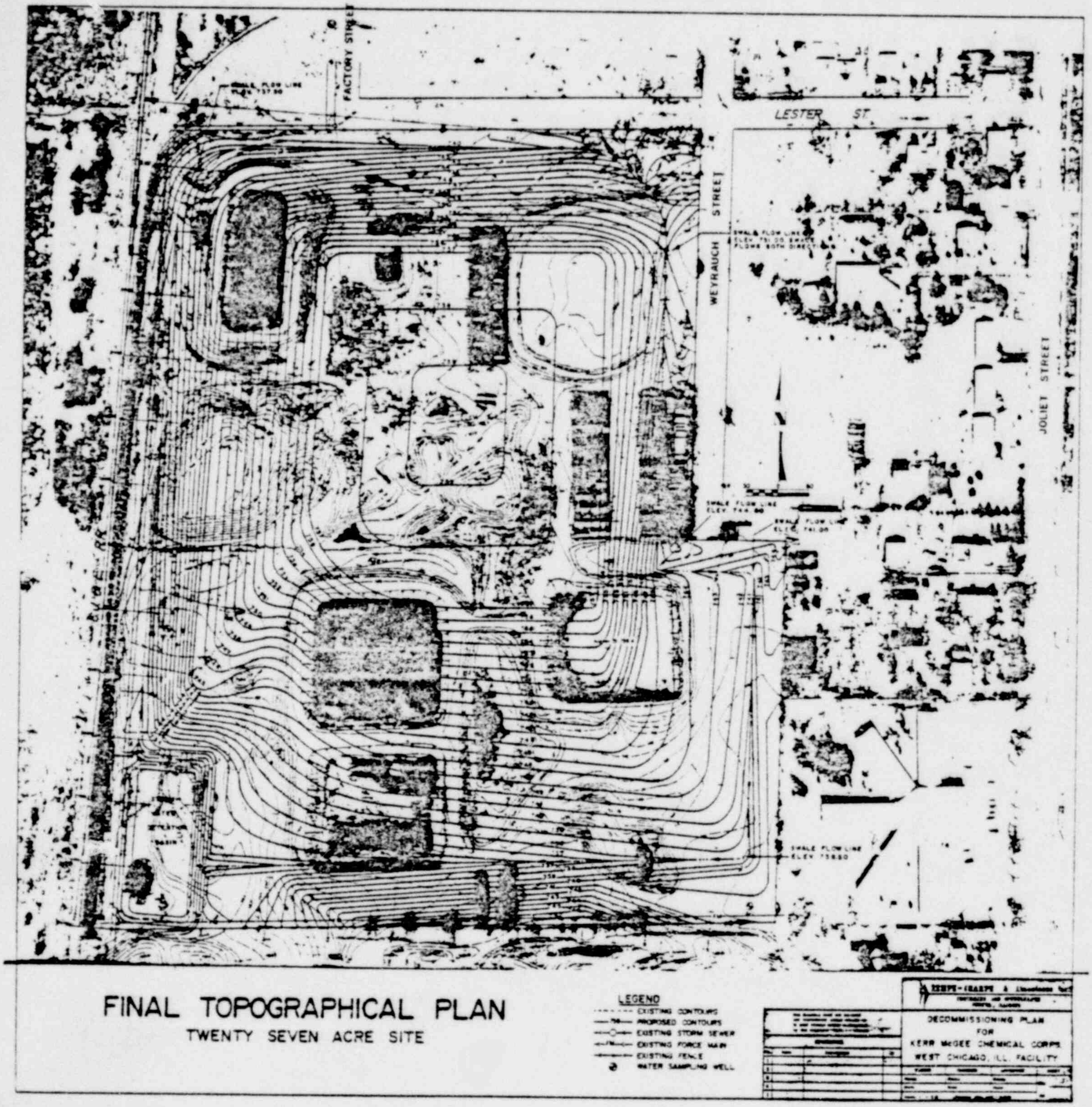


EXISTING TOPOGRAPHICAL PLAN

TWENTY SEVEN ACRE SITE



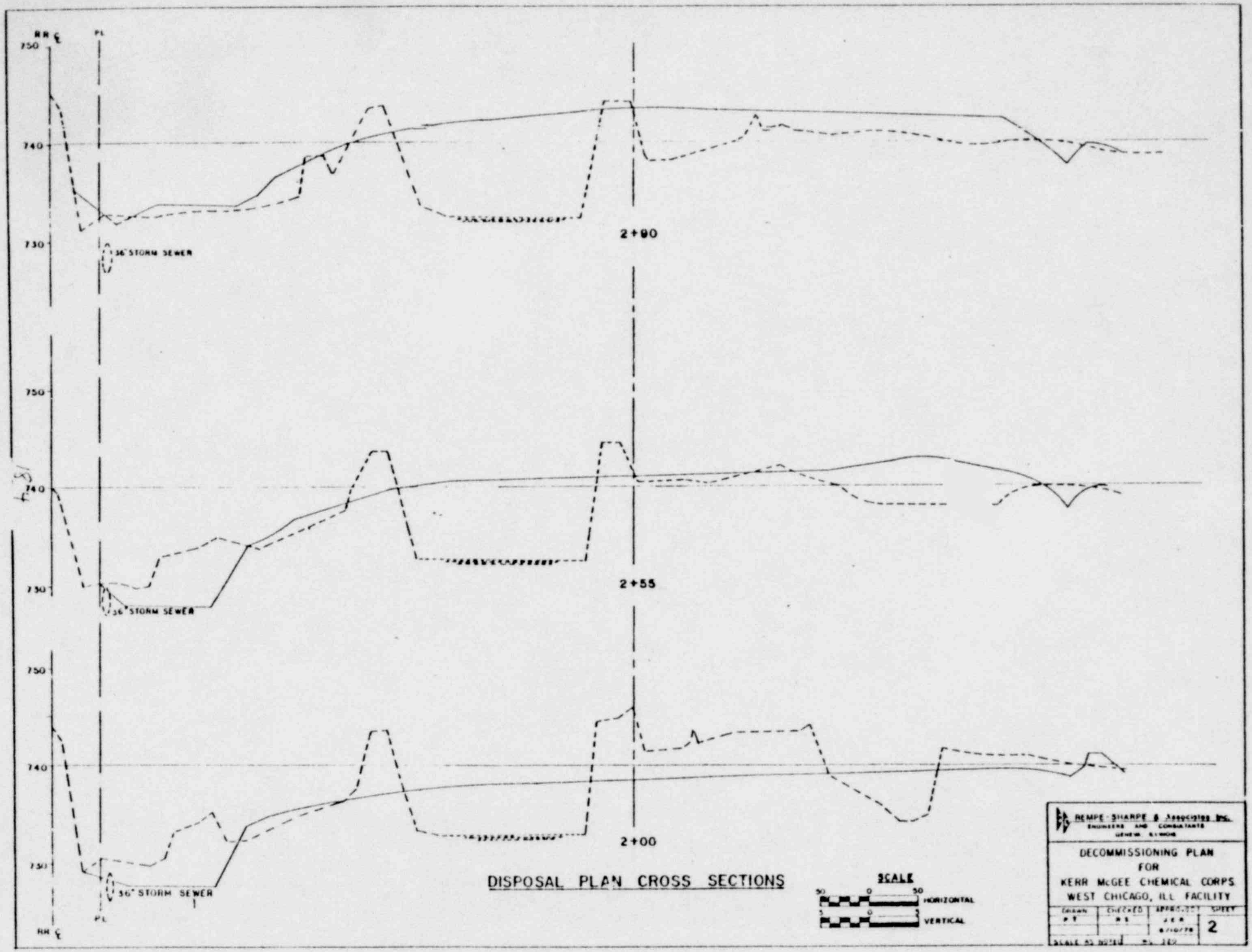
DISPOSAL PLAN
TWENTY SEVEN ACRE SITE



FINAL TOPOGRAPHICAL PLAN

TWENTY SEVEN ACRE SITE

18.3

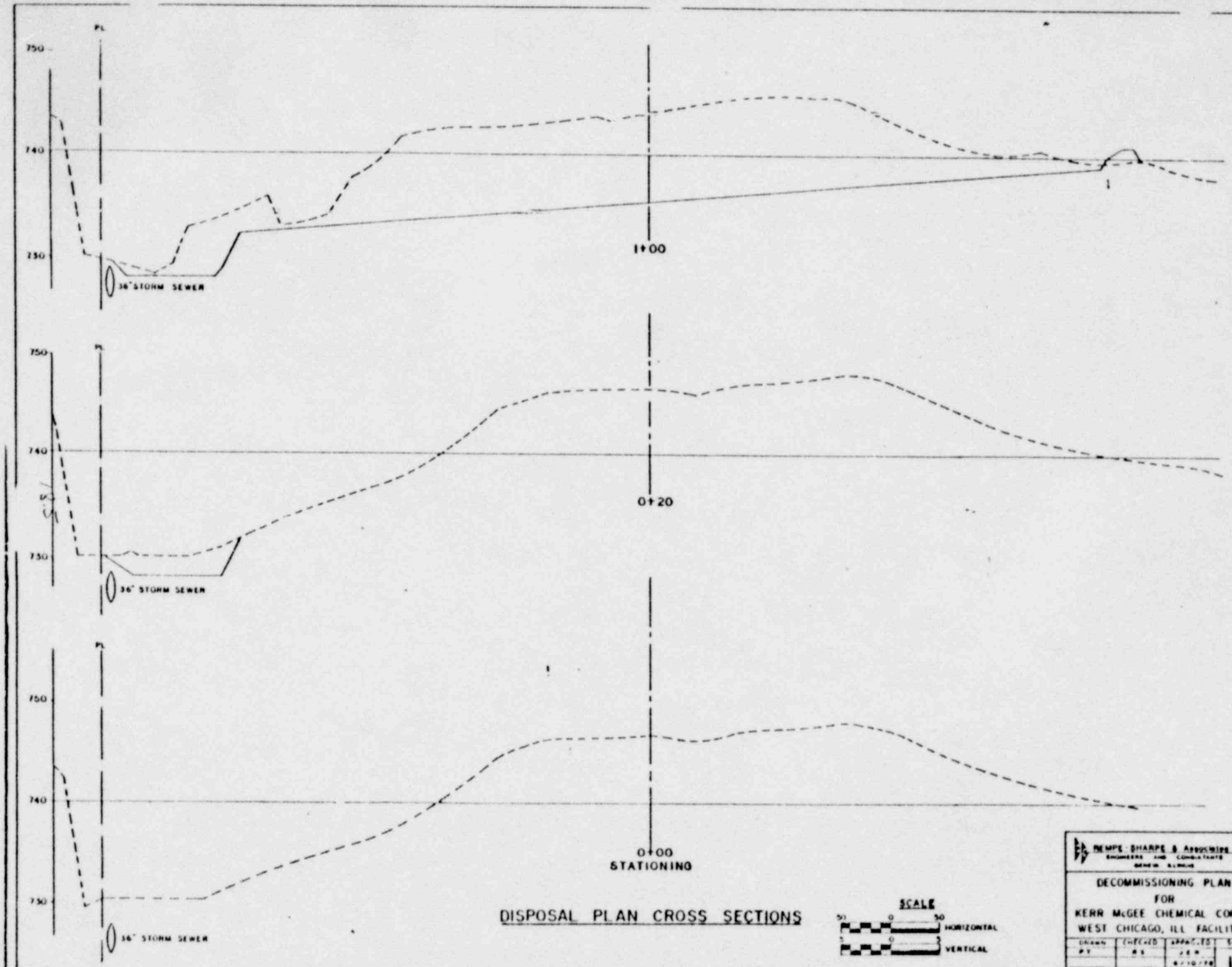


DISPOSAL PLAN CROSS SECTIONS

REMPE-SHARPE & Associates Inc.
ENGINEERS AND CONSULTANTS
GENEVA, ILLINOIS

DECOMMISSIONING PLAN
FOR
KERR McGEE CHEMICAL CORPS
WEST CHICAGO, ILL FACILITY

DRAWN	CHECKED	APPROVED	SHEET
P T	R S	J E R 6/10/78	2
SCALE AS NOTED			



DISPOSAL PLAN CROSS SECTIONS

REMPE-SHARPE & Associates Inc.
ENGINEERS AND CONSULTANTS
GENEVA ILLINOIS

DECOMMISSIONING PLAN
FOR
KERR McGEE CHEMICAL CORPS
WEST CHICAGO, ILL FACILITY

DRAWN	CHECKED	APPROVED	SHEET
P T	R S	J E R 6/10/78	1
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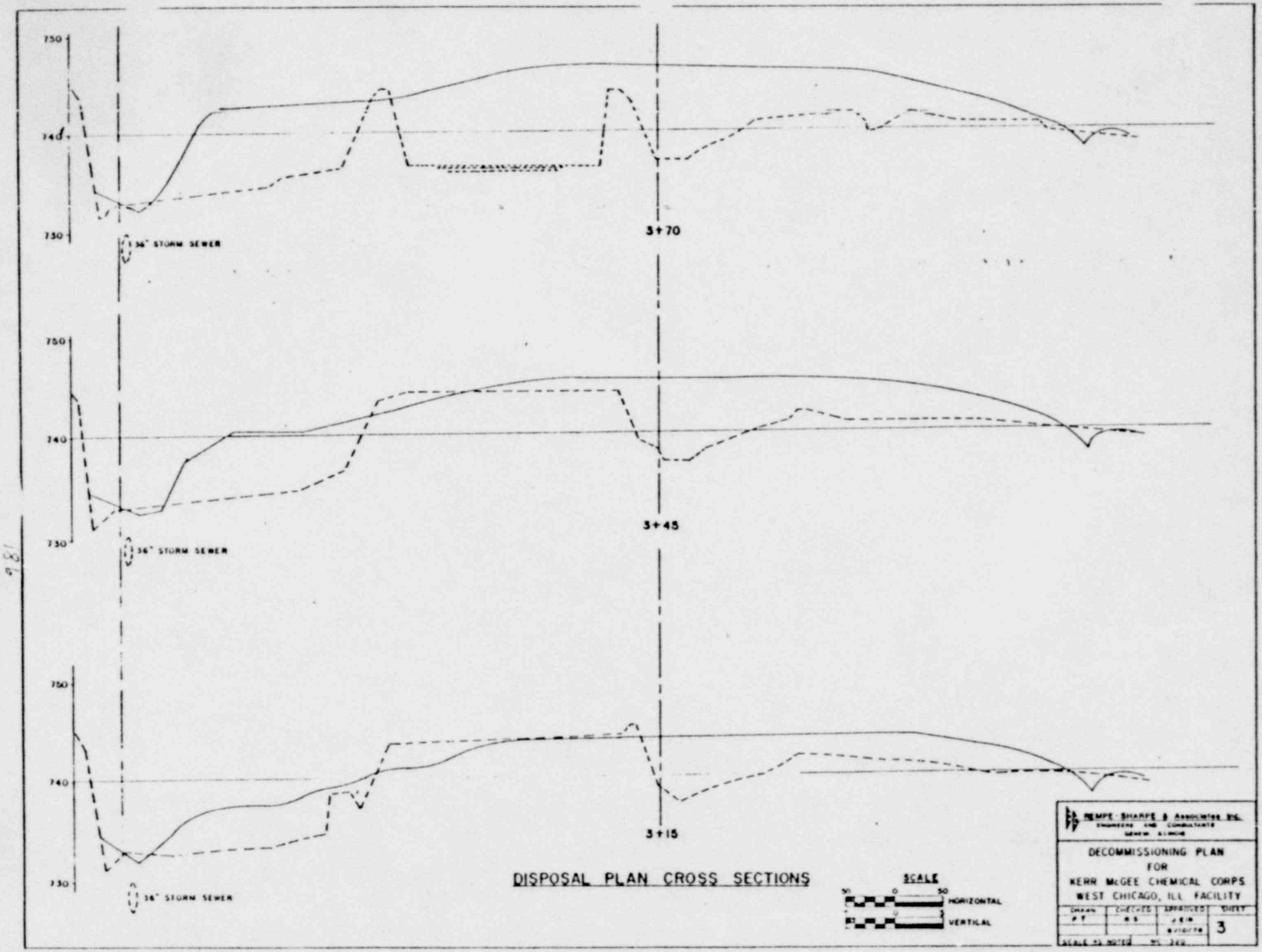

DISPOSAL PLAN CROSS SECTIONS

HEMPE · SHARPE & ASSOCIATES INC.
ENGINEERS AND CONSULTANTS

DECOMMISSIONING PLAN
FOR
KERR McGEE CHEMICAL CORPS
WEST CHICAGO, ILL FACILITY

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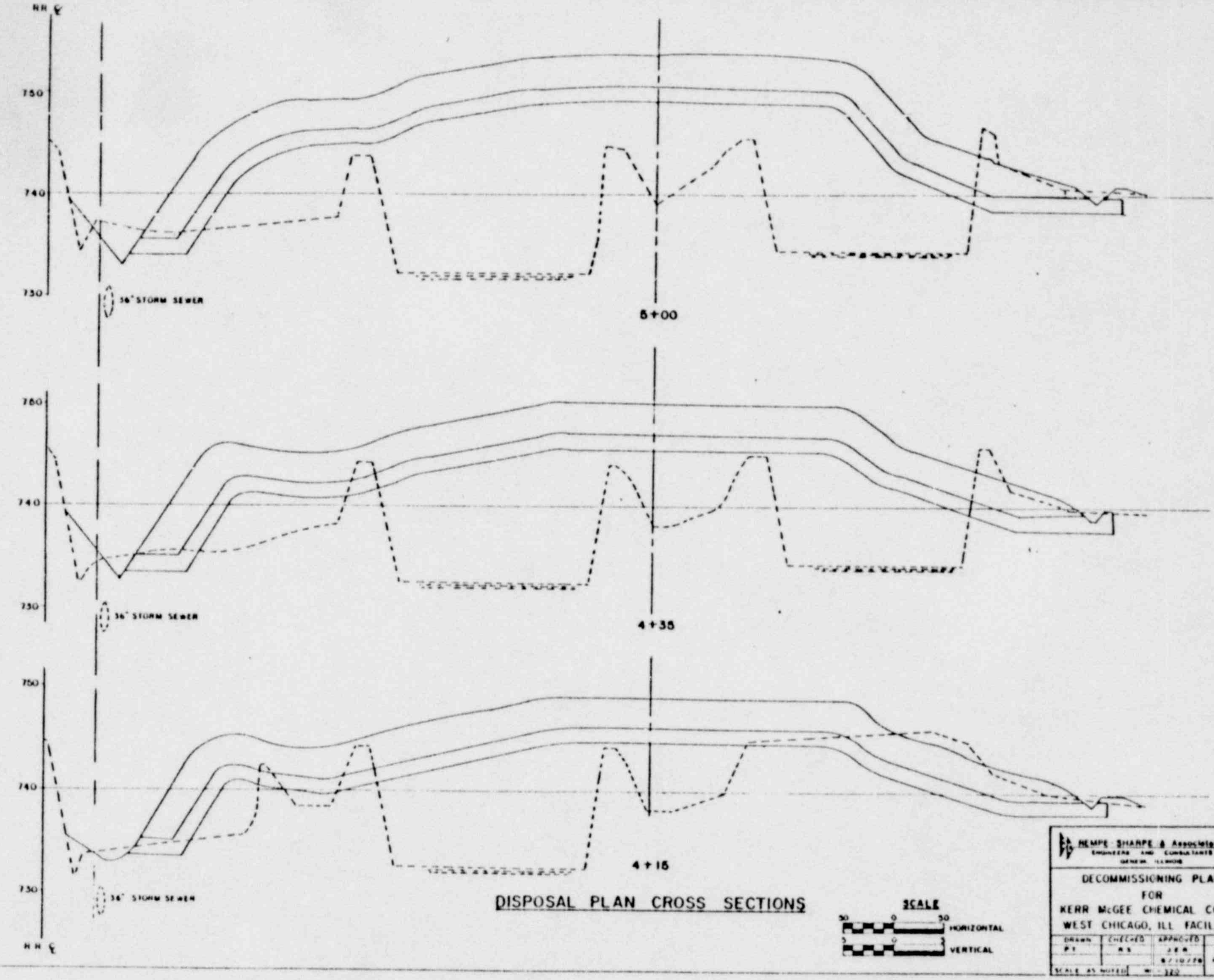

DISPOSAL PLAN CROSS SECTIONS

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GENEVA, ILLINOIS

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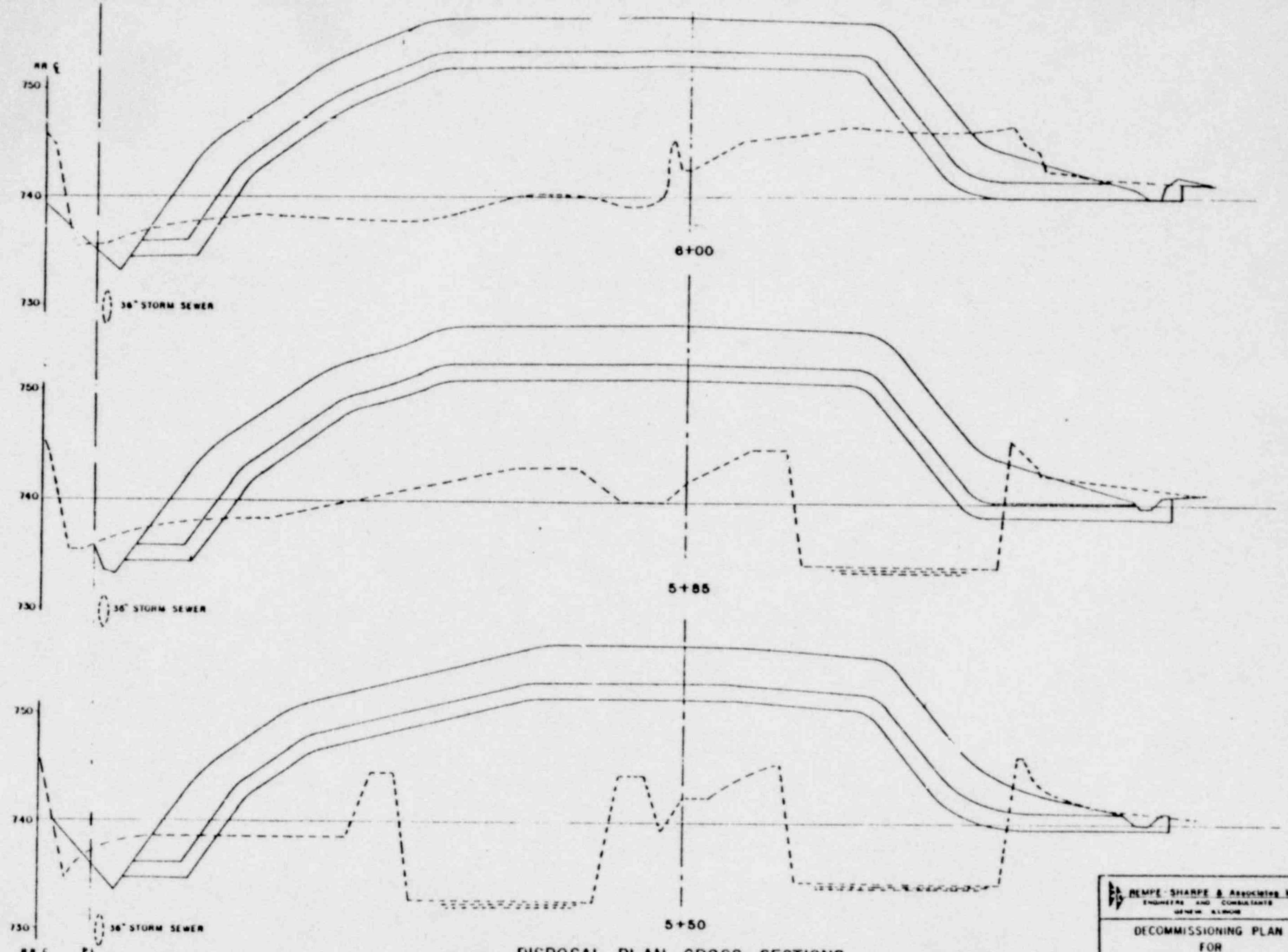

DISPOSAL PLAN CROSS SECTIONS

REMPE-SHARPE & Associates Inc.
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GENEVA ILLINOIS

DECOMMISSIONING PLAN
FOR
KERR McGEE CHEMICAL CORPS
WEST CHICAGO, ILL FACILITY

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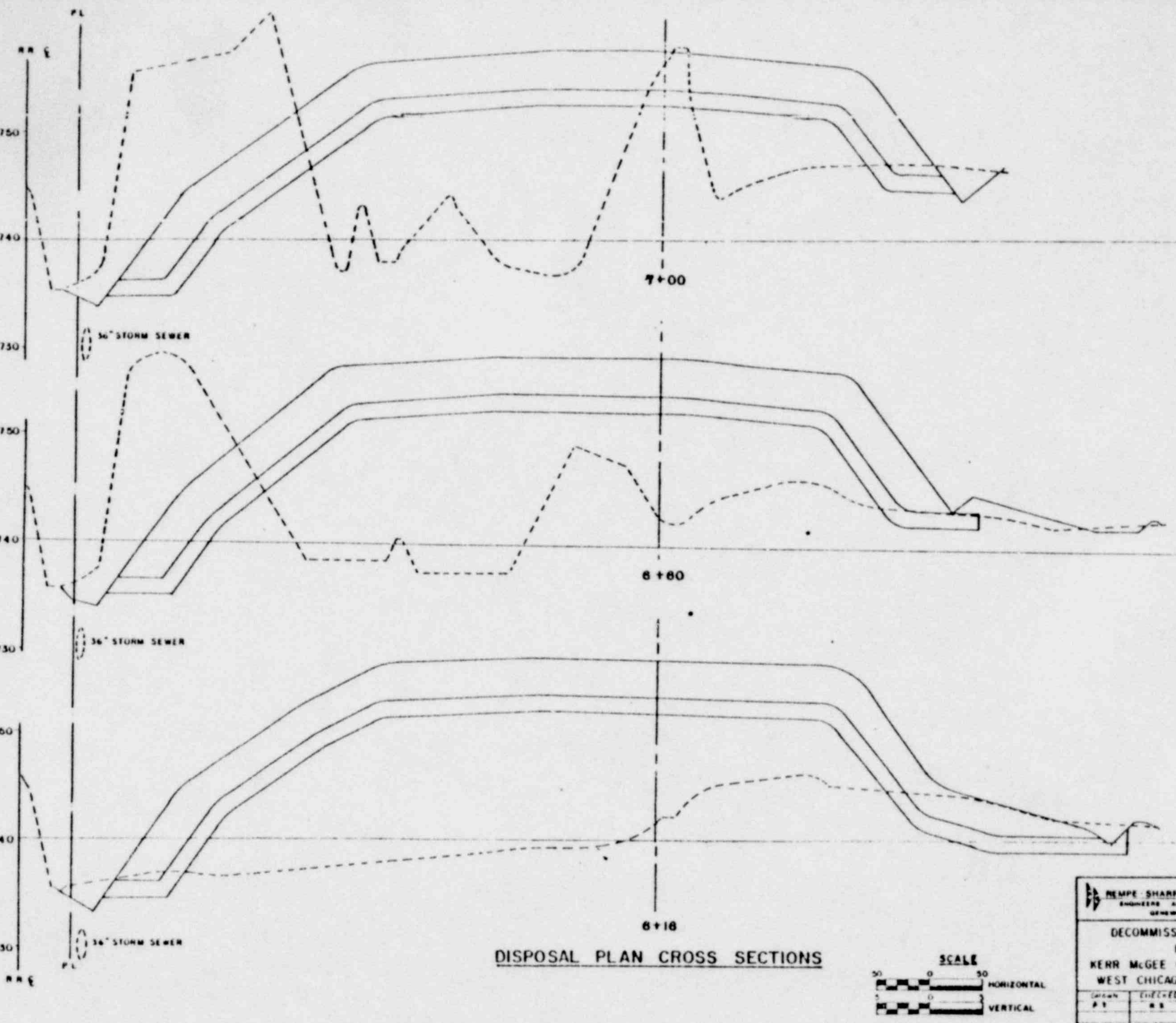

DISPOSAL PLAN CROSS SECTIONS

KEMPE SHARPE & Associates Inc.
ENGINEERS AND CONSULTANTS
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DECOMMISSIONING PLAN
FOR
KERR McGEE CHEMICAL CORPS
WEST CHICAGO, ILL FACILITY

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SCALE AS NOTED No. 329

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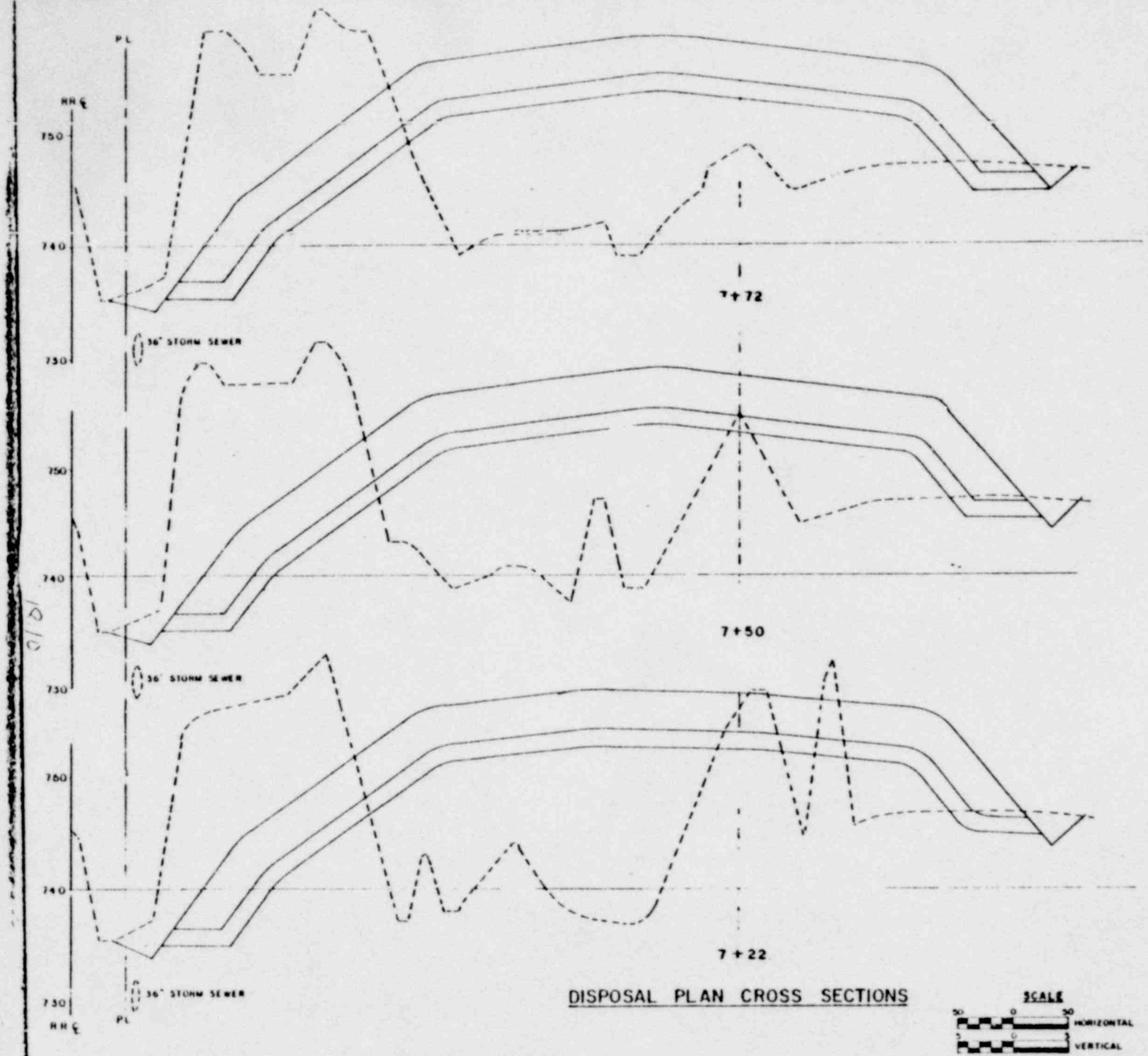

DISPOSAL PLAN CROSS SECTIONS

1010

KEMPE SHARPE & Associates Inc.
ENGINEERS AND CONSULTANTS
GENEVA ILLINOIS

DECOMMISSIONING PLAN
FOR
KERR McGEE CHEMICAL CORPS.
WEST CHICAGO, ILL FACILITY

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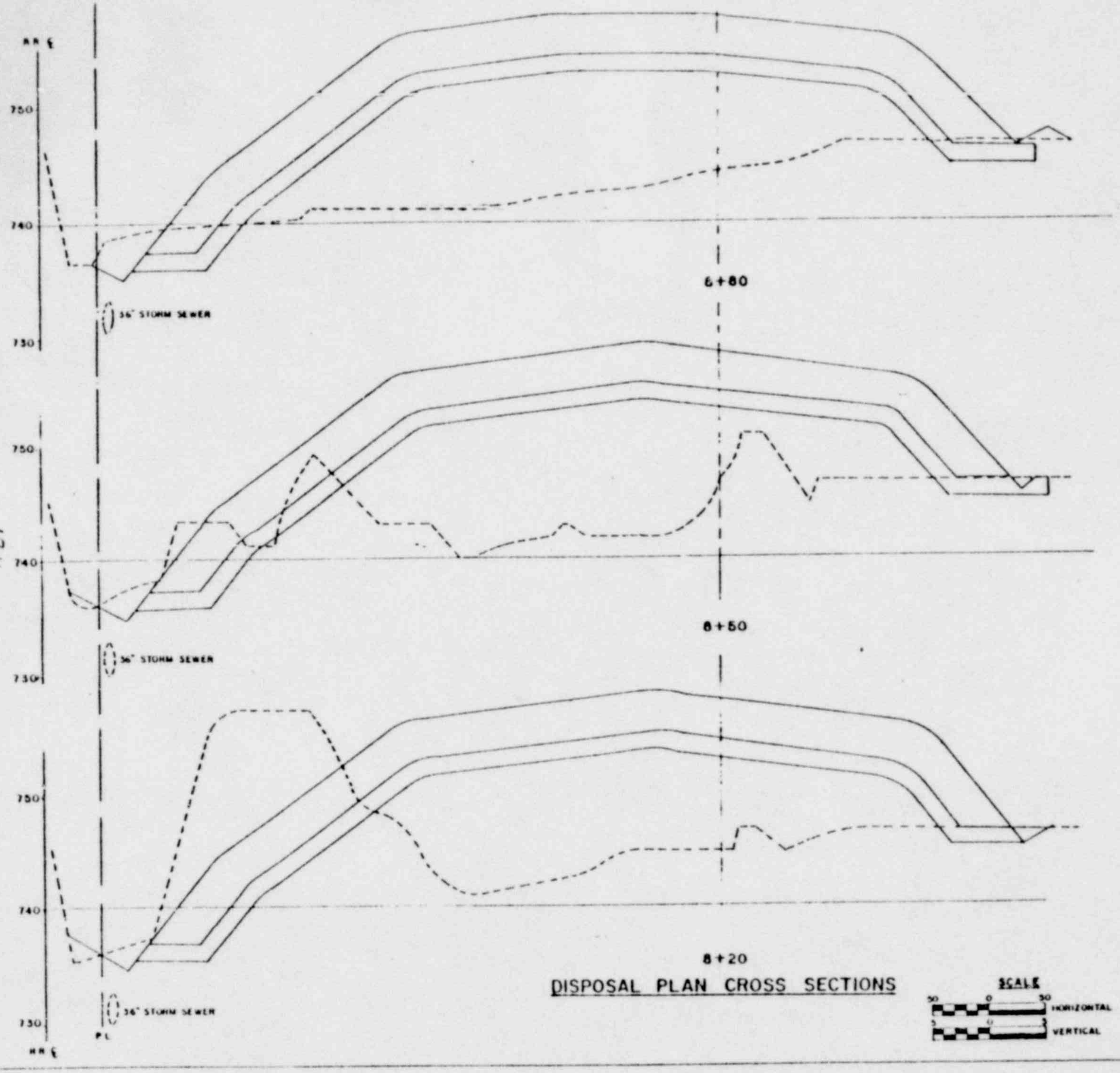

DISPOSAL PLAN CROSS SECTIONS

18.11

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FOR
KERR McGEE CHEMICAL CORPS
WEST CHICAGO, ILL FACILITY

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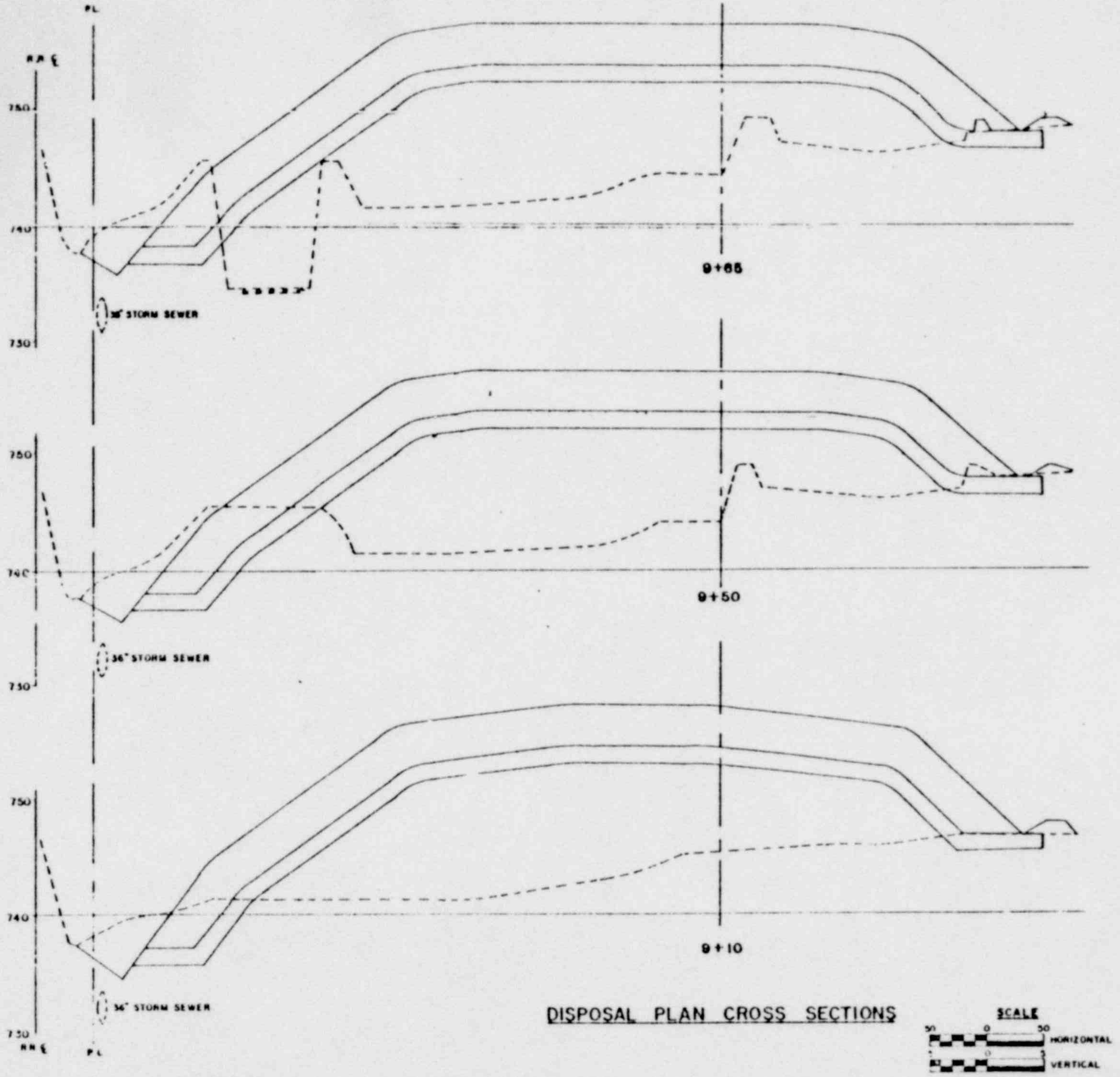

DISPOSAL PLAN CROSS SECTIONS

18.12

RENPE · SHARPE & Associates Inc.
ENGINEERS AND CONSULTANTS
GENEVA ILLINOIS

DECOMMISSIONING PLAN
FOR
KERR McGEE CHEMICAL CORPS
WEST CHICAGO, ILL FACILITY

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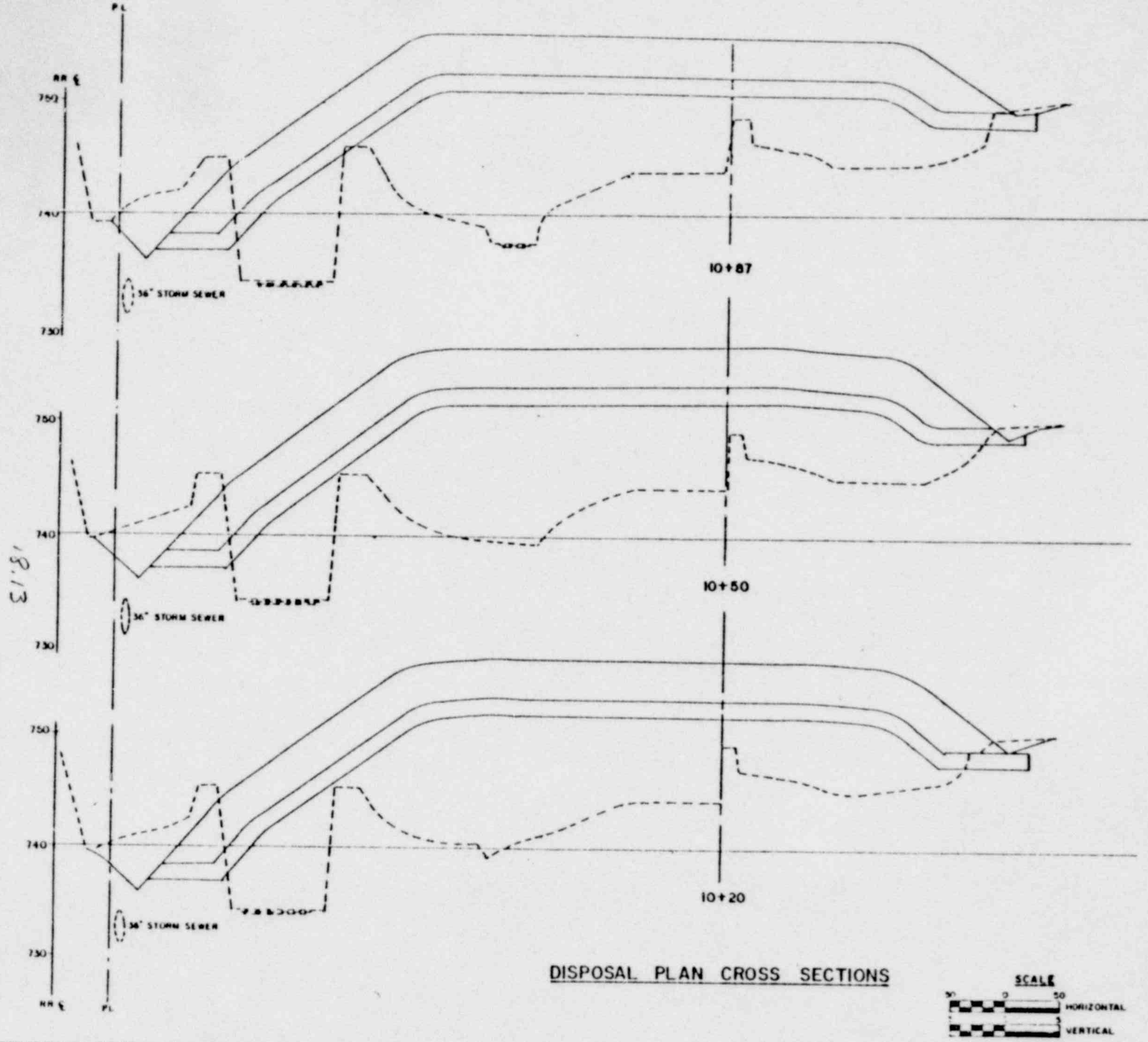

18.13

DISPOSAL PLAN CROSS SECTIONS

REMPE-SHARPE & Associates Inc.
ENGINEERS AND CONSULTANTS
GENEVA, ILLINOIS

DECOMMISSIONING PLAN
FOR
KERR McGEE CHEMICAL CORPS
WEST CHICAGO, ILL FACILITY

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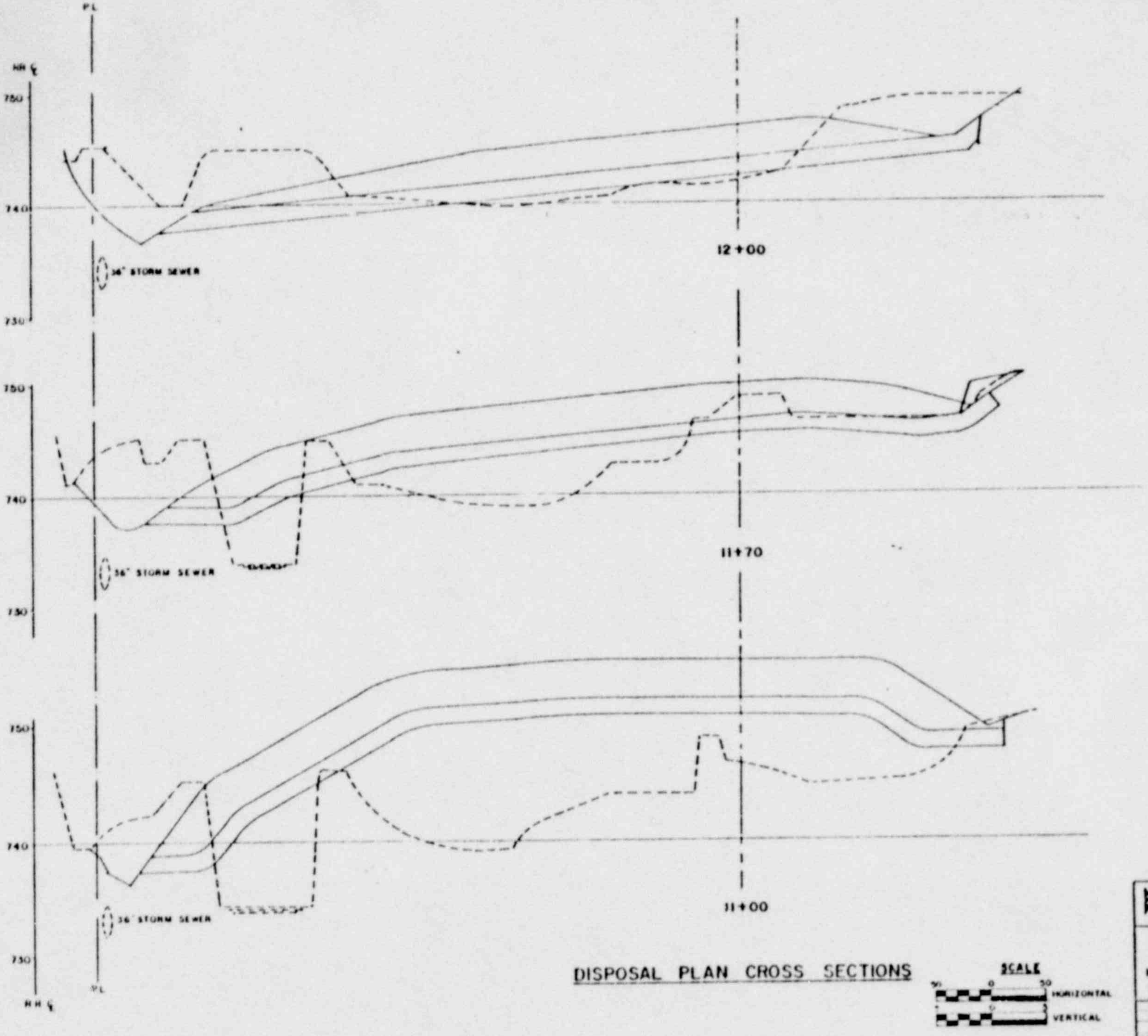

DISPOSAL PLAN CROSS SECTIONS

18.14

KEMPE SHARPE & Associates Inc.
ENGINEERS AND CONSULTANTS

DECOMMISSIONING PLAN
FOR
KERR McGEE CHEMICAL CORPS
WEST CHICAGO, ILL FACILITY

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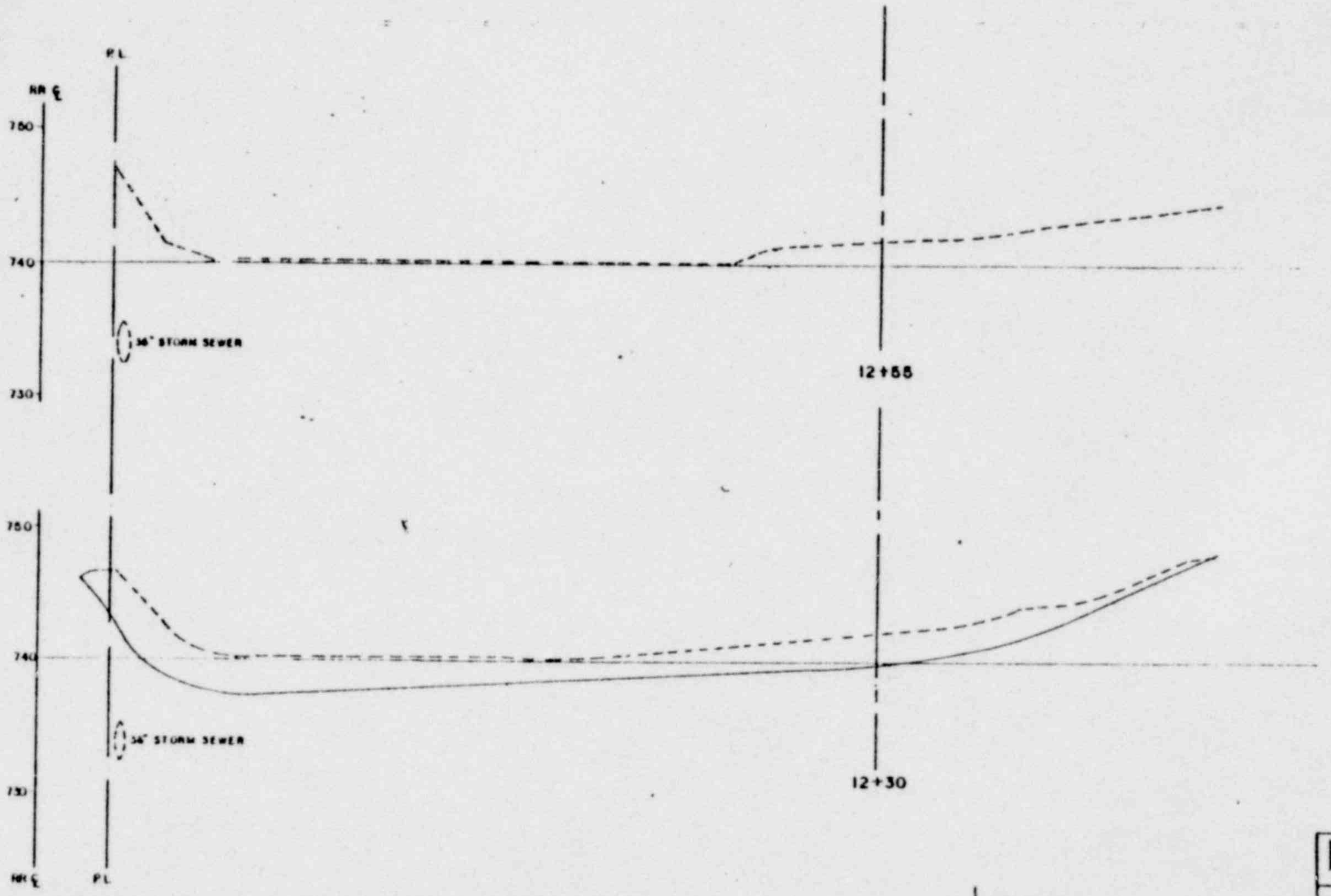

18.15

DISPOSAL PLAN CROSS SECTIONS

KEMPE SHARPE & Associates Inc.
ENGINEERS AND CONSULTANTS
GENEVA ILLINOIS

DECOMMISSIONING PLAN
FOR
KERR McGEE CHEMICAL CORPS
WEST CHICAGO, ILL FACILITY

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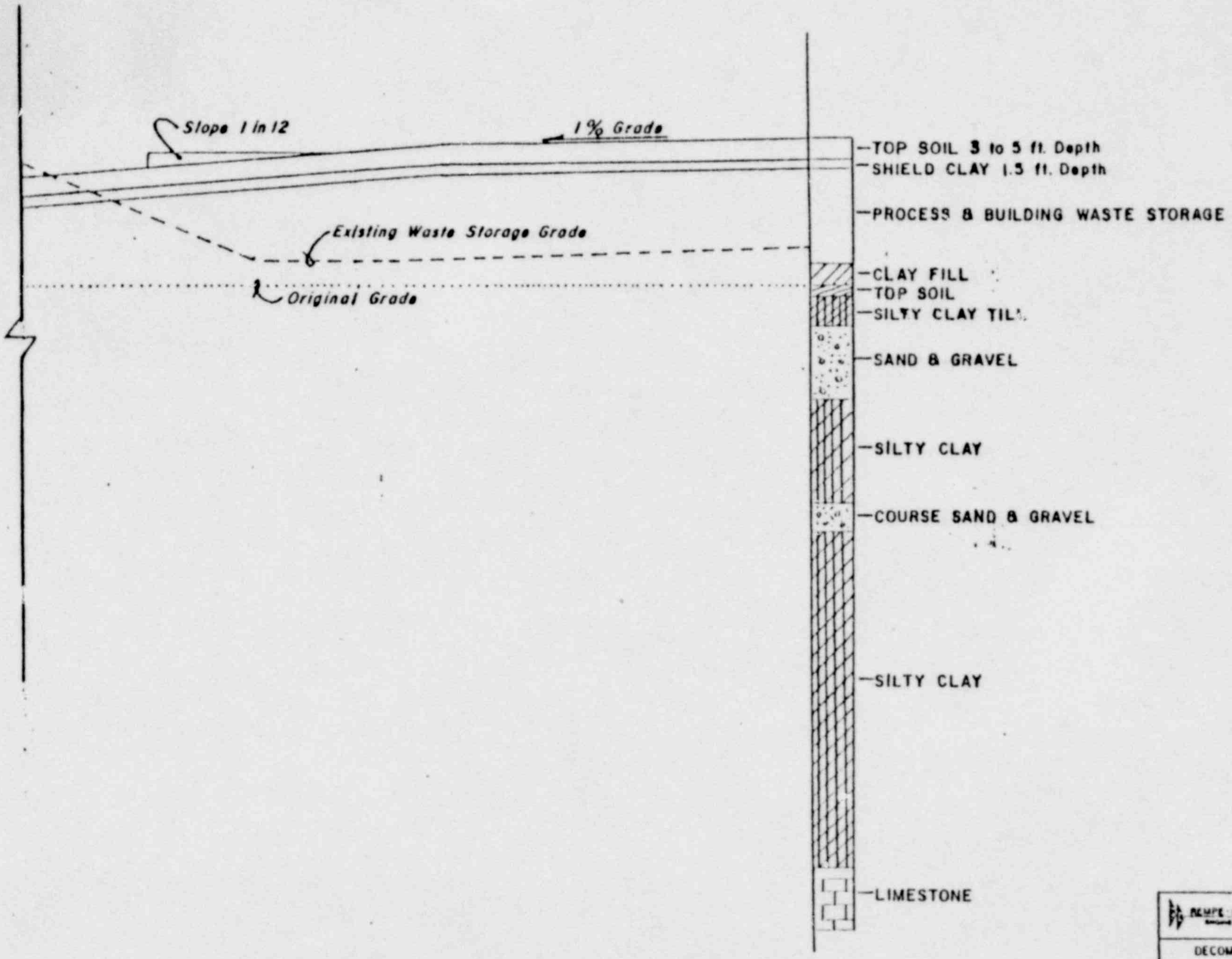

TYPICAL CROSS SECTION

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DECOMMISSIONING PLAN
FOR
KERR McGEE CHEMICAL CORPS
WEST CHICAGO, ILL FACILITY

DRAWN	CHECKED	APPROVED	SHEET
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18.16

3. Environmental Impacts

3.1 Air Quality

A. Section 2 of this plan lists procedural steps which will be required to control dust from becoming airborne.

B. Airborne activity resulting from decay products of Radon and Thoron is not a significant problem on the manufacturing and twenty-seven (27) acre site to workers or to the general public in the environment surrounding the two (2) sites.

C. During the implementation of the plan, the surface area to volume will be changed. Since the thoron emanation rate will increase, the resulting daughter product activity will also increase in direct proportion to the resulting in surface area. This will result in a temporary adverse impact on the environment, but even with this increase, the surrounding environment should not have concentrations of airborne particulate activity which will exceed 10 CFR 20 guidelines for a one hundred sixty-eight (168) hour week.

D. Once the waste has been covered with a clay cap and earth fill, the concentration of thoron and radon and associated daughter products will not be much greater than the natural emanation rate from the natural occurring activity within the uncontaminated earth cover.

3.2 Non-radiological

A. The work associated with this plan will create noise from work due to using pneumatic equipment, razing of buildings, and use of heavy duty power equipment. The work will be conducted only during normal work periods (8 a.m. to 6 p.m.) to limit the impact on the local residential area.

B. The extra vehicular traffic in the vicinity of the two sites because of work conducted under this plan will add to the local traffic at the beginning and end of the work shift, but this extra traffic will not overload the local roads. Traffic between the two sites will be off the local roads and will be across the present right of way along the railroad tracks.

C. The surface beneath the waste refuse will be a continuous impervious layer of clayey material which will act as a barrier to soluble chemicals. Entering the perched water table, the plan calls for adding lime to ore residues which will tend to neutralize any leachate and convert free sulfates to gypsum products. The clay lens over the waste will divert most of the ground water which migrates through the three (3) feet of earth cover above the upper clay barrier to the constructed swale. All steps within the plan act in the positive direction to minimize introduction of chemicals to the perched water table. Because of this, the plan will have no adverse impact on water quality.

Appendix 4 contains data and related information associated with this matter.

D. The dismantlement of the manufacturing site and covering the waste material within the twenty-seven (27) acre site will add to the aesthetic value of the local environment and will add to the real estate value of the adjacent property surrounding the two sites.

3.3 Radiological

A. Exposure to workers will result in any program used to stabilize the manufacturing site and the twenty-seven (27) acre site. It is estimated that this plan could result in about twenty percent (20%) less exposure to workers than other alternatives evaluated, because this plan minimizes the multiple handling of the radioactive waste.

B. The stabilization of the radioactive waste will eliminate dispersion of radon-thoron daughter products, windborne contaminated dust, percolation to the perched water table, and migration of the radioactivity by rain water surface runoff. The final cover over the stabilized waste consisting of 1.5 feet of clay and a minimum of three (3) feet of earth fill will reduce the direct gamma radiation to less than 0.05 millirem per hour. Although this radiation level is greater than natural background, the radiation level would not likely result in more than one hundred (100) millirem per year to any individual in any reasonable scenario. The total integrated features of the plan will result in a negative impact for the radiological considerations.

Appendix 1. Background Information

Contents Page

3.1 Description of Existing Facilities and Wastes 22-44

3. Description of Existing Facilities' Wastes

3.1 Facilities

3.1.1 Buildings and Structures

Table 3.1.1(A) contains a list of the major buildings and structures that exist at the manufacturing site.

Table 3.1.1(A) Manufacturing Site

Building/Structure Number Designation	Description or Use	Floor Area in Square Feet	Number of Floors or Levels
1 A	Front Office-Reception	16,111(total)	1
	Multilith		
	Office Space		
1 B&C	Solvent Extraction		
	Process Room		
	Blender		
	Furnace Room		
1 D	Washroom		
1 E	Elec. Furnace Room		
	Sub-Station		
	Dust Collection Room		
2	Process	19,200	2
	Mezzanine	5,875	
2 B	Salt Cake Storage	225	1
2 C	Nitric Acid Storage	121	
3	Process	20,160	1

Building/Structure Number Designation	Description or Use	Floor Area in Square Feet	Number of Floors or Levels
	C/C 140		
	Control Lab		
2 A	Maintenance Shop	280	1
3 A	Process ThO_2 Room	1,023	1
3 B	Storage	1,846	1
3 C	Storage and Process	1,730	1
3 D	Pilot Plant	1,404	1
3 E	Caustic Storage	1,400	1
3 F	P.T.S. Office	364	1
4 A	Ore Processing	5,249	1
4 B	Engine House	2,100	1
5	Process	20,000	2
	Mezzanine	5,078	NA
5 A	Hot Water Tank Room	528	1
5 B	Boiler House & Coal Storage	3,060	1
5 C	Water Treatment Room	700	1
5 D	Boiler House Locker Room	189	1
5 E	H_2SO_4 Tank Storage	1,610	1
5 F	Maint. Shop & Stores	4,462	1
5 G	Coal Hoist House	98	1
5 H	Misc. Stores Storage	1,680	1
6	Booster Pump House	126	1
7	Well House	81	1
8	Ash House	196	1
9	T.E. Plant (4 main floors)	66,289	6

Building/Structure Number Designation	Description or Use	Floor Area in Square Feet	Number of Floors or Levels
	Basement		
	Roof Structures		
10	P.S. Meter House #1	165	1
11	Misc. Storage Stores	1,800	1
12	Finished Prod. Whse.	15,367	2
14	Waste Pump House	860	2
15	Misc. Storage	576	1
16	P.O. Meter House #2	143	1
20	Plant Service Garage	6,240	1
21	Salt Extraction	5,191	2

Table 3.1.1(B) contains a list of the buildings that exist within the acres. All buildings have one floor.

Table 3.1.1(B) Acre Site

Building Number Designation	Description or Use	Floor Area in Square Feet
17	Bulk By-Product Storage	15,400
18	Monazite Sand Storage	13,200
19	Bulk By-Product Storage	7,200

The location of each structure in Tables 3.1.1(A) and (B) are shown in Drawing No.

Dimensional drawings for buildings and structures do not exist except for the addition of building No. 9. Table 3.1.1(C) describes the basic structure of the major facilities.

Table 3.1.1(C)

Building/Structure Identification No.		Construction Details
1	Framing:	Steel columns and girders with wood frame rafters and stringers in the northern portion of the structure. The stringers in this portion are made of four two inch by ten inch boards bolted together. In the southern portion of the structure, the truss and stringers are of steel.
	Ceiling:	Wooden roof structure.
	Exterior Walls:	Brick and mortar construction of 1-1/2 foot thickness.
	Inside Walls:	Constructed of 8 inch cement block and are not load bearing with the exception of the wall between building No. 1 and building No. 3. This wall is load bearing and is constructed of brick and mortar with a wall thickness being 8 inches.
	Floor:	Concrete slab construction of about 6 inch thickness.

Building/Structure Identification No.		Construction Details
2	Framing:	Steel angle on outside walls with steel girder truss supported by load bearing vertical I beams on about 20 foot centers.
	Ceiling:	Concrete slabs 2 feet x 3 feet with 1 inch thickness.
	Exterior Walls:	North wall is cement block construction faced with brick and mortar. The east and west walls construction to a height of 3 feet is the same as the north wall. Above 3 foot height, the walls consist of corrugated metal sheeting and plastic reinforced with fiberglass fibers. The south wall is constructed similar to that at the north end of the structure, however, a large freight door opening is included. Interior walls of 2 x 4 framing covered with plaster board inside and out with wooden floor exists in the south-east corner of this building.
3	Framing:	Mostly wood framing. The rafters are 2 inch by 6 inch which run east to west.

Building/Structure Identification No.		Construction Details
3 (cont'd)	Ceiling:	Wood roof with 8 inch wide planks that run north to south.
	Main Support Beams:	Wooden beam columns (6" x 6") support the rafters and cross ties.
	Exterior Walls:	Brick and mortar construction whose thickness is 1-1/2 feet.
	Interior Walls:	Most interior walls are constructed of wood and typical wall framing. Some interior walls are of brick and others are 8 inch cement block. All interior walls are non-load bearing.
	Floor:	Concrete slab construction about 8 inch thickness.
5	Framing:	Two level structure having steel framing with I beam columns on 25 foot centers and I beam girders and beams. The roof support is of a typical K truss construction.
	Ceiling:	Corrugated asbestos.
	Exterior Walls:	The walls are mainly 8 inch cement block construction faced with brick and mortar for lower level and second level construction is 6 inch cement block.
	Interior Walls:	On main level, consists of both 8 and 6 inch cement block and second level is 6 inch block with plywood curtain walls.

Building/Structure Identification No.		Construction Details
5 (cont'd)	Floor:	Typical 8 inch cement slab construction. See diagram 3.1.1(A).
9 (Office Area)	Framing:	Steel.
	Walls:	Glazed brick and cement pour interior.
	Floor:	Concrete with surface tiling.
9 (Process Area)	Framing:	18 inch I beam on 25 foot centers with floor supports of I beams running north to south and smaller I beams running east to west on 5 foot centers
	Exterior Walls:	1st floor is brick and mortar construction to height of 4 feet. From 4 to 14 feet are windows. The remaining height is corrugated metal siding to outside and asbestos board inside with 8 inch wall gap. The asbestos board is attached to 2 x 4 wooden framing.
	Inside Walls:	Consists mainly of 10 inch cement block and mortar construction. .
	Flooring:	1st floor 8 concrete slab construction. See diagram 3.1.1(B).
21	Framing:	Steel columns I beams on 25 foot centers and I beam roof supports. Each corner of roof support are cross-braced.

Building/Structure Identification No.		Construction Details
21 (cont'd)	Ceiling:	Corrugated aluminum (flat roof).
	Walls:	10 inch concrete block and mortar construction.
	Staircases:	Two exist of all steel construction.
	Ground Floor:	6 inch reinforced concrete slab.
	Upper Floor:	Walkways steel grating.
12	Framing:	10 inch concrete block wall with steel I beam roof support which runs north to south. The I beam is supported with steel post lolly columns.
	Roof:	Wooden rafters running east to west and wooden roof.
	Floor:	6 inch concrete slab which may be reinforced.
	Interior Partitions:	Plywood construction with 2 x 4 framing.
20		Construction similar to building No. 12.
5N	Framing:	Steel I beam.
	Roof and Exterior Walls:	Corrugated metal sheeting.
	Floor:	Concrete slab thickness unknown.
4	Framing:	Consists of steel girders and columns which are within wall.
	Exterior Wall:	10 inch concrete block.
	Floor:	Concrete slab.
All Remaining Buildings in Manufacturing Site		Normal 10 inch concrete block and construction, exceptions being coal

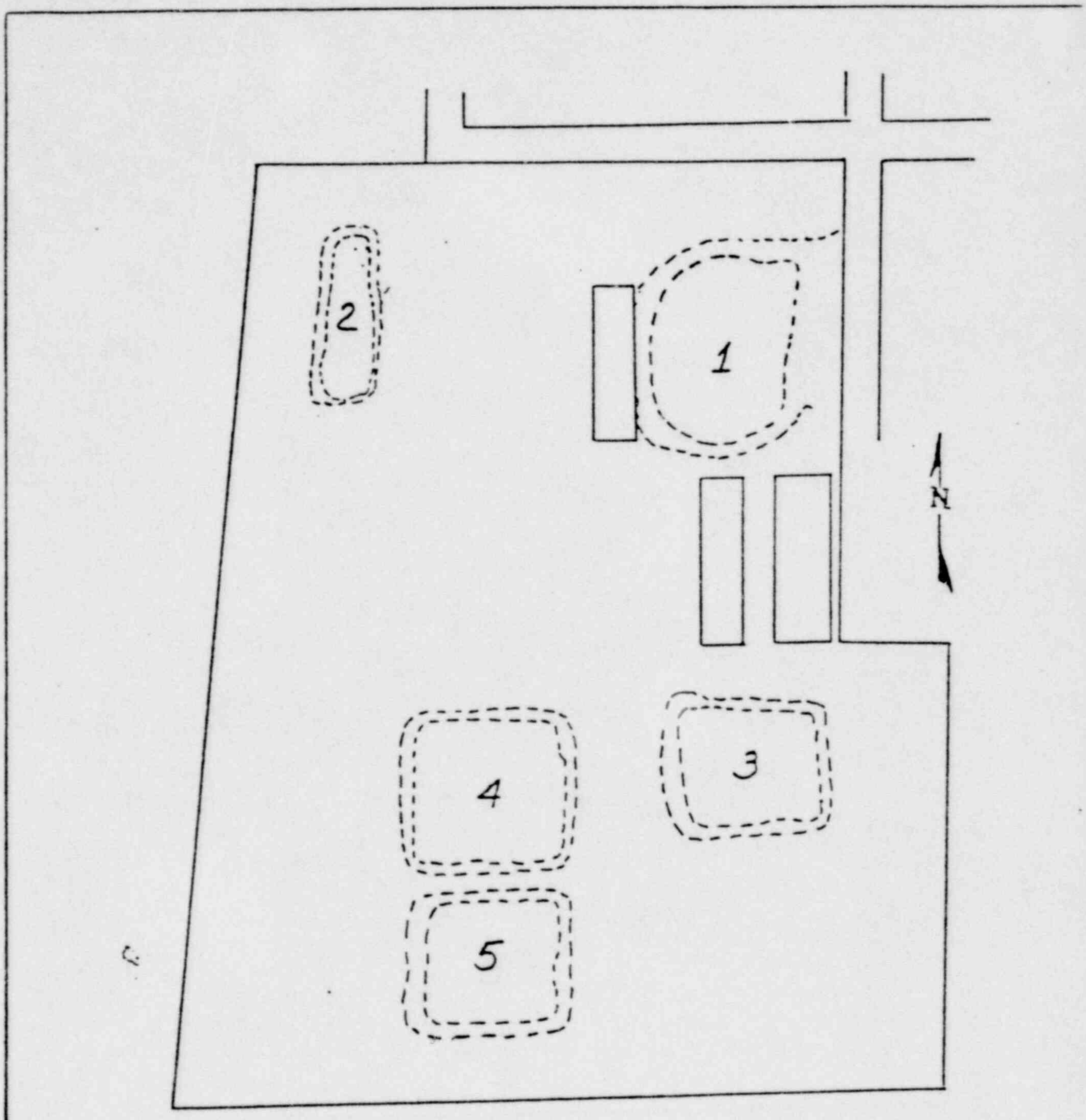
Building/Structure Identification No.		Construction Details
		and sand storage which are bays; i.e., no eastern walls and are unnumbered structures.
Sand Storage Bay	Framing:	4 x 4 steel angle.
	Roof:	Wood construction.
	Exterior Walls:	Corrugated asbestos walls.
Coal Storage Bay	Walls:	1 inch concrete block with inner partition.
	Roof:	Wood construction.
17 & 18	Framing:	Steel beams, columns and truss members.
	Exterior Walls:	Concrete pour to about 4 foot height and wood board to ceiling.
	Ceiling:	Wooden construction.
	Interior Wall Divider:	Wooden boards and 2 x 4 framing.
	Floor:	About 8 inch concrete pour which may be reinforced with steel rebar.
19	Framing:	Steel beams, girder and truss.
	Walls and Roof:	Wooden plank.
	Floor:	Concrete pour about 8 inches which may be reinforced with steel rebar.

3.1.2 Disposal Yards and Infiltration Ponds

The manufacturing site has a thin layer of unprocessed rare earth ores over its surface with the major concentrations existing near the buildings and along the railroad sidings. The southern portion of the site has been used for storage of dismantled process equipment. The cement basin and lagoons which had been used to process liquid effluent prior to the purchase of the 27 acre site have had the sediments removed and have been refilled. The process equipment which had been removed is stored upon the covered lagoons and basin.

Liquid process waste ran through open and closed trench drains to the pump house, building no. 14. The liquid waste was then pumped through underground piping which runs parallel to the railroad tracks to the acres.

Drawing 3.1.2. shows the location of the ore residue piles, process insoluble sediment piles, buildings, lagoons (infiltration ponds), and waste disposal areas. Lagoon no. 1 has been covered with fill. Lagoon no. 5 has been allowed to drain through removal of a portion of its dike. Lagoons no. 2, no. 3, and no. 4 contain insoluble sediments and have free standing surface water over the sediments.



IDENTIFICATION & LOCATION OF LAGOONS
WITHIN THE "ACRES"
KERR McGEE RARE EARTH DIVISION
WEST CHICAGO, ILLINOIS

ATCOR INC.

DWG. 3.1.2

The site also has had a deep well and five sample point wells called boreholes. The deep well has been concreted and partially sealed. The boreholes have been sealed below a depth of 25 feet by filling with clay.

Along the southern portion of the site, a sewerage line corsses the property from east to west. Although this particular portion of the site will not be used for the burial of radioactive low level debris, the area will require regrading for the purpose of providing surface drainage. This would require the relocation of this sewer section.

The twenty-sever (27) acre site has a natural grade from northeast to southwest and along the western edge of this site there exists a drainage ditch.

A storm drain crosses the property between the manufacturing and acre site near the northern border of the acres.

The lagoons were constructed by excavating through the relative impervious surface material which was used to construct dikes or berm material. Additional underlying gravel was then removed to depths up to

3.1.3 Adjacent Properties Not Owned by Kerr-McGee

The manufacturing site area's northern border is Ann Street and eastern border is Factory Street. The property north of Ann Street is residential. The property east of Factory Street is primarily open lots. A portion of these lots are owned by Kerr-McGee and have been used as parking areas for their employees. Some residential areas also exist in the vicinity of Brown Street with one dwelling on the corner of Pomeroy Street. The Elgin, Joliet, and Eastern Railroad borders the property on the west. Most of the property west of the railroad tracks is residential. The property to the south of the manufacturing site and which exists between the two sites is zoned for manufacturing. Economy Buildings, Inc. owns the property. The structures which were on this property have been dismantled and the property is not currently being used.

The 27 acre site is bordered on the north by Economy Buildings, Inc. and on the west ' the Elgin, Joliet, and Eastern Railroad. The property west of the railroad is mostly undeveloped. The property east of the acres contains a metal fabrication shop, Advance Sheet Metal and a number of private residences. The property along the southern end of the acres has been developed by Mr. Lee Staling, who has leased various buildings for industrial offices, restaurant, bowling alley, etc.

3.2.2 Existing Manufacturing Wastes

K-M aqueous waste was directed to Lagoon No. 1 or No. 2 and overfill protection was provided by diverting the wastes to Lagoon No. 3. Clarified waste overflowed to Lagoon No. 4 and No. 5. As insoluble sediments built up within Lagoons 1, 2 and 3, K-M would periodically dredge the contents and would store the waste directly west of building No. 18 in the acres.

The volume of process waste contained in the acres at the time of process shutdown is summarized in Table 3.2.2(A).

Table 3.2.2(A) Process Waste in the Acres

Item	Volume in cubic feet
Ore Residue Pile	636,000
Sediment Pile West of Bldg 18	86,000
Lagoon No. 1	406,000*
Lagoon No. 2	66,000
Lagoon No. 3	216,000

*This does not include the 80,000 cubic feet of fill covering this lagoon.

Samples of the process waste were analyzed and the quantity of Thorium and Uranium, source material, is expressed as oxides as ThO_2 and U_3O_8.

Table 3.2.2(B) Source Material Contained in Process Waste

Item	Estimated Quantity of Source Material in Pounds	
	ThO_2	U_3O_8
One Residue Pile	168,000	1,100
Sediment Pile West of Bldg 18	250,000	2,800
Lagoon No. 1	896,000	40,000
Lagoon No. 2	32,000	1,400
Lagoon No. 3	77,000	3,400

Nine samples of various wastes materials were submitted for isotopic analysis and leach testing. Tables 3.2.2 (C), 3.2.2(D) and 3.2.2(E) summarize these results plus a composite made from the pH-7 leach test solutions.

Table 3.2.2(C) Leach Test Sample Results

ISOTOPIC ANALYSIS FOR RADIUM*

Sample Identification	Ra-223	Ra-224	Ra-226	Ra-228
#1 Standing Water in No. 2 Pond, pCi/l	<.1	32	32	<.1
#2 Standing Water in No. 3 Pond, pCi/l	<.1	11	17	99
#3 Ground Water 9 ft/ Below Surface, pCi/l	<.1	6.7	6.7	1.5
#4 Solids from No. 1 Pond, pCi/g	9.3	7.2	<.1	410
#5 Solids from No. 2 Pond, pCi/g	1.4	<.1	<.1	160
#6 Solids from No. 3 Pond, pCi/g	7.1	<.1	<.1	1100
#7 Solids from Residue Pile, pCi/g	14	<.1	<.1	1800
#8 Solids Between No. 3 and No. 4 Ponds, pCi/g	.6	<.1	<.1	150
#10 Composite of pH-7 Leach Solution, pCi/l	<1	20	20	<1

*Multiple regression analysis of alpha/beta growth curves for samples carried through chemical radium separation.

Table 3.2.2(D) Leach Test Sample Results

ISOTOPIC ANALYSIS BY ALPHA SPECTROMETRY

THORIUM

Sample Identification	Th-232	Th-230
#1 Standing Water in No. 2 Pond, pCi/l	0.023	0.031
#2 Standing Water in No. 3 Pond, pCi/l	0.003	0.009
#3 Ground Water 9 ft. Below Surface, pCi/l	<0.003	0.014
#4 Solids from No. 1 Pond, pCi/g	75	25
#5 Solids from No. 2 Pond, pCi/g	660	240
#6 Solids from No. 3 Pond, pCi/g	1530	320
#7 Solids from Residue Pile, pCi/g	550	140
#8 Solids Between No. 3 and No. 4 Ponds, pCi/g	660	500
#10 Composite of pH-7 Leach Solution, pCi/l	No Thorium detected (<0.002)	

*These results appear to be low for Thorium Hydrate. Chemical ThO_2 was not performed on original sample. Recovery based upon Th-228 internal standard.

Table 3.2.2(E) Leach Test Sample Results

ISOTOPIC ANALYSIS BY ALPHA SPECTROMETRY

URANIUM

Sample Identification	U-238	U-235	U-234
#1 Standard Water in No. 2 Pond, pCi/l	25	2.1	25
#2 Standing Water in No. 3 Pond, pCi/l	.89	.034	.89
#3 Ground Water 9 ft. Below Surface, pCi/l	.18	.016	.22
#4 Solids from No. 1 Pond, pCi/g	270	13	240
#5 Solids from No. 2 Pond, pCi/g	340	14	310
#6 Solids from No. 3 Pond, pCi/g	65	3	65
#7 Solids from Residue Pile, pCi/g	9	.5	9
#8 Solids Between No. 3 and No. 4 Ponds, pCi/g	410	20	450
#10 Composite of pH-7 Leach Solution, pCi/l	6.1	.16	5.7

Since 1973, about 110,000 cubic feet of contaminated process equipment has been removed and stored in the acres. About 7,000 cubic feet consists of filled or partially filled steel and fiberboard drums and steel tote boxes whose contents vary from partially filled to empty, another 5,000 cubic feet of low level contaminated wood in the form of pallets; and the remaining consists mainly of various sized rubber lined process tanks which are now empty.

In addition to the waste presently stored in the acres approximately 1,680,000 cubic feet of waste would be transferred from the manufacturing site to the acres in the dismantlement and decontamination operations conducted at the manufacturing site. The majority of this volume will consist of brick, cement block, and cement floors which have external contamination on the surface which prevents the release to sanitary land fill. It is estimated an additional volume of waste material, about 400,000 cubic feet, will be released to sanitary land fill sites.

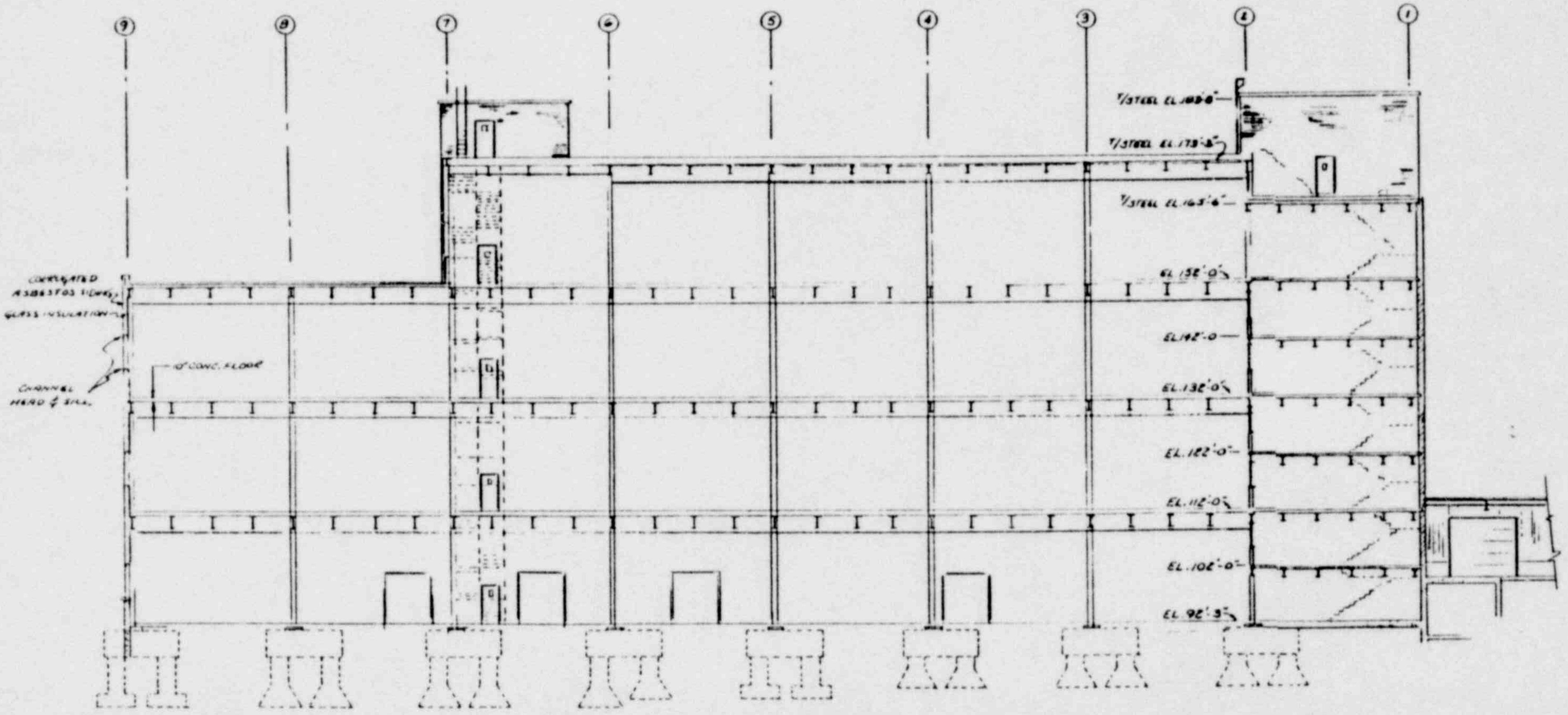
K-M has about 80,000 cubic feet of rare earth chemical compounds which do not contain accountable Thorium and which are presently stored in Building No. 17

and No. 19. There is a possibility that these compounds may be sold to the chemical industry, but if the sales cannot be made, then these compounds would be included in the disposal operations within the acres.

4.5 Building and Structures Drawings.

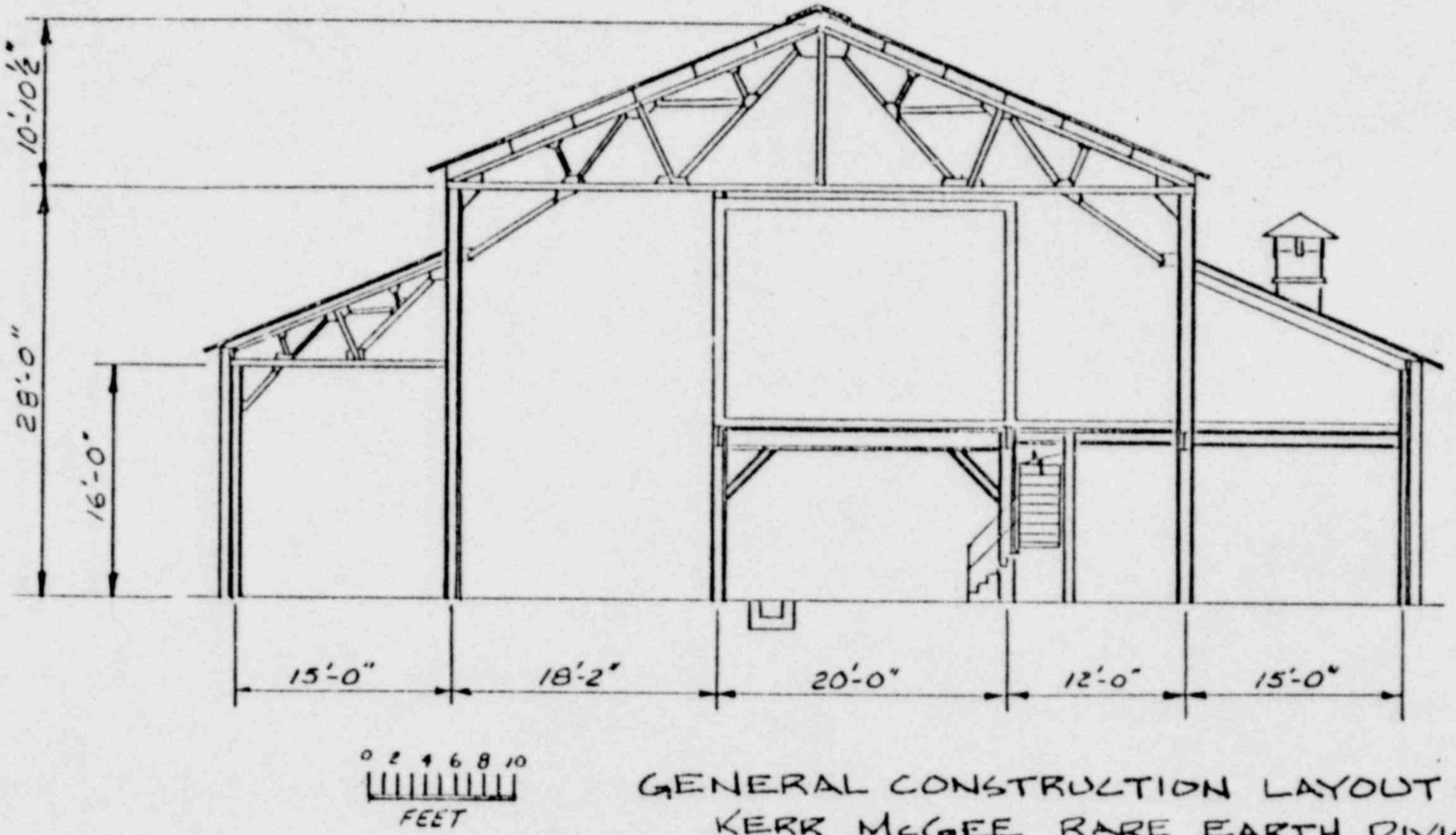
Drawings for each structure at the Kerr-McGee Rare Earth Division do not exist. Typical cross-section drawings which describe the general construction layout of Buildings 3 and 5 located on the manufacturing site is shown on DWG 4.3.A and DWG 4.3.B describes the general construction layout of Building 9 which is also located on the manufacturing site.

DWG 4.3.C displays the various structures on the two Kerr-McGee sites (Manufacturing and Acres).



GENERAL CONSTRUCTION LAYOUT - BLDG. G
KERR - McGEE RARE EARTH DIVISION
WEST CHICAGO, ILLINOIS

DWG. 43 B
PAGE # 63
[redacted] INC.

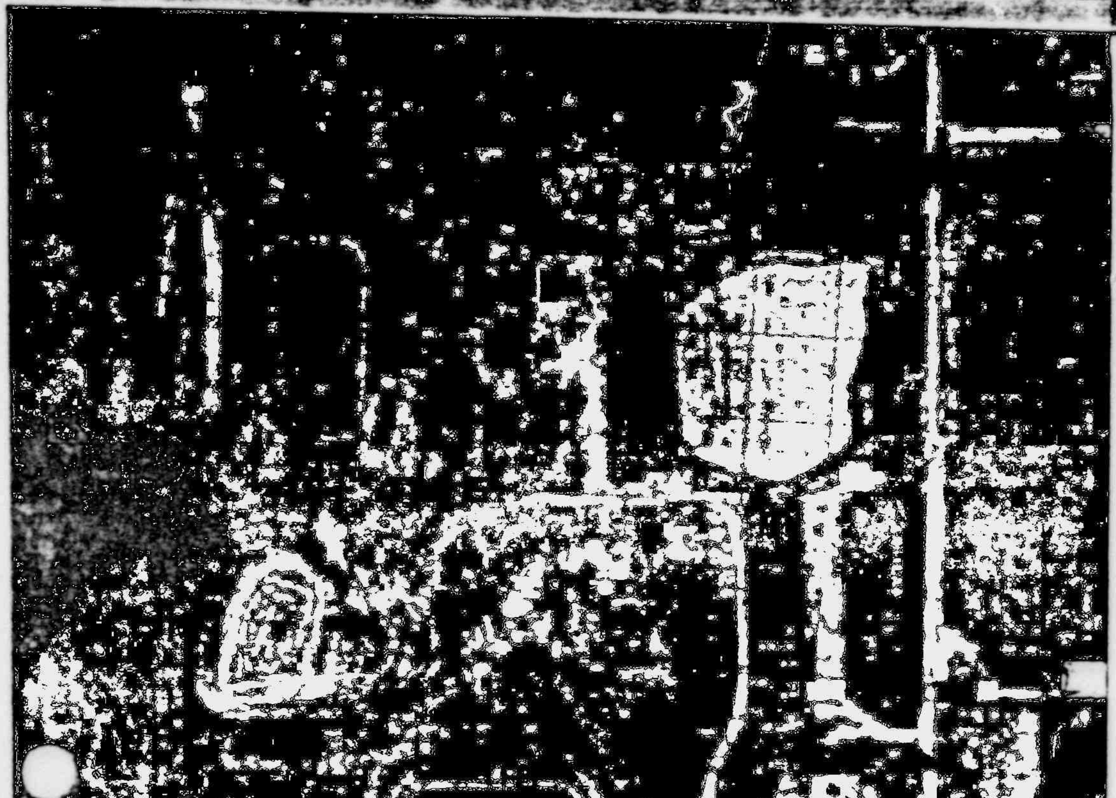


GENERAL CONSTRUCTION LAYOUT - BLDGS. 3&5
KERR McGEE RARE EARTH DIVISION
WEST CHICAGO, ILLINOIS
ATCOR INC.

DWG. 4.3.A.

Appendix 2. Radiological Data

Contents	Page
1. Radiological Survey Map of "Storage Area" Kerr-McGee Chemical Plant: West Chicago, Ill. (See Exhibit B)	46
2. Report of Radiological Assessment Survey Kerr-McGee Rare Earth Division West Chicago Facility February 1, 1977	47-113
3. Evaluations and Recommendations Relating to Reports on the Current Radiological Situation and Decommissioning Options for the Kerr-McGee Rare Earth Facility in West Chicago February 9, 1978	114-128



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CURRENT RADIOLOGICAL DOSE MEASUREMENT WITHIN THE TWENTY SEVEN ACRE SITE

DECOMMISSIONING PLAN
FOR
KERR McGEE CHEMICAL CORP.
WEST CHICAGO, IL FACILITY

REPORT OF
RADIOLOGICAL ASSESSMENT SURVEY
KERR-MCGEE
RARE EARTH DIVISION
WEST CHICAGO FACILITY

Prepared By:

ATCOR, Inc.
Park Mall
Peekskill, N.Y.

February 1, 1977

TABLE OF CONTENTS

		Page
1.	Introduction and Background	1 & 2
2.	Procedures and Instrumentation	3 & 4
3.	Results	4 - 65

1. Introduction and Background

The radiological survey of a portion of the Kerr-McGee Chemical Corporation, Rare Earth Division's facility located in West Chicago, Illinois was performed by ATCOR at the request of Mr. R. J. Vreeland, who is the Project Manager for this facility.

The facility, until a few years ago, produced a wide range of rare earth chemicals at various chemical purity levels from "commercial grade" to ultra high purity from monazite and other high grade Thorium ores. The facility is presently under caretaker status with on-site activities limited to the dismantlement of process equipment.

The facility can be described as consisting of two (2) separate areas which are designated as the "process area" and "the acres." Table 1 is a listing of major items contained in the area designated as "the acres."

Table 1 Major Items Contained in "the acres"

1. Two storage sheds basically empty.
2. One storage shed containing 23,000 cubic feet of unprocessed rare earth ores and chemical concentrates of these ores.
3. Process equipment removed from the process area with various levels of residual Thorium levels.
4. Piles of unprocessed rare earth ores.
5. Lagoons containing raffinate wastes.
6. Pile of insoluble sludge residues from processing the rare earth ores.

Table 2 is a listing of major building structures contained in the area designated as the "process area" along with their functional description.

Table 2 Process Area Main Structures

Building Designation	Function
1a	Offices
1	Fine chemical processing
2	Rare earth manufacturing
3	Lanthanum manufacturing, laboratories, warehouse, pilot plant and caustic soda storage
4	Ore processing and drying
4a	Engine use
5	Pink salt process area, boiler house, coal storage, acid storage, maintenance shops and stores
9	Thorium plant
9a	Finished products
9c	Pink salts storages and dryers
21	Rare earth process
12	Shipping and finished stock warehouse
20	Repair garage and storage
14	Pump house

ATCOR conducted a radiological survey of the "process area" and grounds in order to make an overall assessment of the potential hazards for the facility "as is", of actions which would be required to obtain an unconditional release from the Nuclear Regulatory Commission and of the potential hazard that could be experienced during a decontamination and demolishment activity. This survey was conducted during the period January 18, 1977 to February 2, 1977.

2. Procedures and Instrumentation

Since natural occurring rare earth ores, such as monazite, were the raw materials for the Kerr-McGee facility, the principle radioactive constituents are from the ^{232}Th series, but there is also some uranium present and, therefore, some ^{226}Ra. Since the ores are probably in equilibrium with their daughter products, both beta-gamma and alpha contamination are expected where the ore was the source of the contaminant. Whenever Thorium had been chemically separated from its daughter products, it would not be in equilibrium and, depending on the elapsed time from its separation, various alpha and beta-gamma emission rates would be expected. However, based on the production shutdown date, the daughter products in the facility were considered to be in equilibrium with ^{232}Th.

The survey approach for the interior of the buildings was to grid off the floors into grids twenty (20) to twenty-five (25) feet on the side and to measure the beta-gamma instrument response at about one (1) inch from the surface with an Eberline E 120 equipped with an HP 190 end window G.M. probe and a search to locate the highest instrument reading in the grid by scan survey. The highest beta-gamma instrument reading was then recorded and the location was identified. Alpha radiation measurements were taken in the vicinity where the highest beta-gamma reading had been obtained. The alpha measurement was made with an Eberline PAC-4S equipped with an AC-3 scintillation probe. Smear surveys were then taken on the floor surfaces in the same location the alpha instrument measurement had been taken along with other random smears on components, walls, cracks, beams, etc. The smears were counted with Eberline scalers equipped with an RD-13 scintillation alpha probe and HP 210 beta probe.

The survey approach for the exterior of the facility was conducted by a complete radiation scan survey along the site exclusion boundary which is either building structural walls or perimeter fence and specific points within the exclusion area were also measured for gamma dose rates at waist height with an Eberline E 120 equipped with an HP 190 G.M. probe.

All instrumentation used in the survey had been calibrated within one calendar quarter and were instrument source checked frequently throughout the day.

In addition, four (4) samples were taken for analysis by an independent laboratory in order to support the conclusion that ^{232}Th and the daughter products were the predominant contaminants. Two (2) samples of unprocessed ore were also analyzed in order to compare and standardize the findings.

3. Results

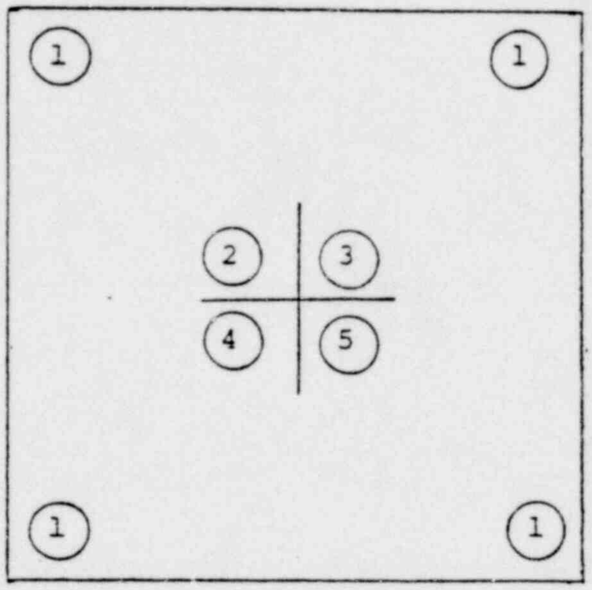
The results of the radiological building floor surveys are contained in section 3.1 of this report in grid format for the "process area."

The results of the random smear surveys of the buildings in the "process area" are contained in section 3.1 of this report in a table format.

The results of the gamma radiation surveys at the "process area" perimeter and within the exclusion area are displayed on a plan view drawing in section 3.2 of this report.

The results of the special soil analysis and of the unprocessed ore is contained in Teledyne Isotope Report in section 3.3 of this report. The results were obtained by gamma spectroanalysis using a Ge(Li) detector.

GRID FORMAT



① INSTRUMENT RESPONSE FOR BETA-GAMMA IN MREM/HOUR

② INSTRUMENT RESPONSE FOR MAXIMUM BETA-GAMMA IN GRID SCAN IN MREM/HOUR

③ INSTRUMENT REPONSE FOR ALPHA AT POINT ② IN 1000 DPM/100 CM^2

④ LOOSE BETA-GAMMA AT POINT ② IN DPM/100 CM^2

⑤ LOOSE ALPHA AT POINT ② IN DPM/100 CM^2

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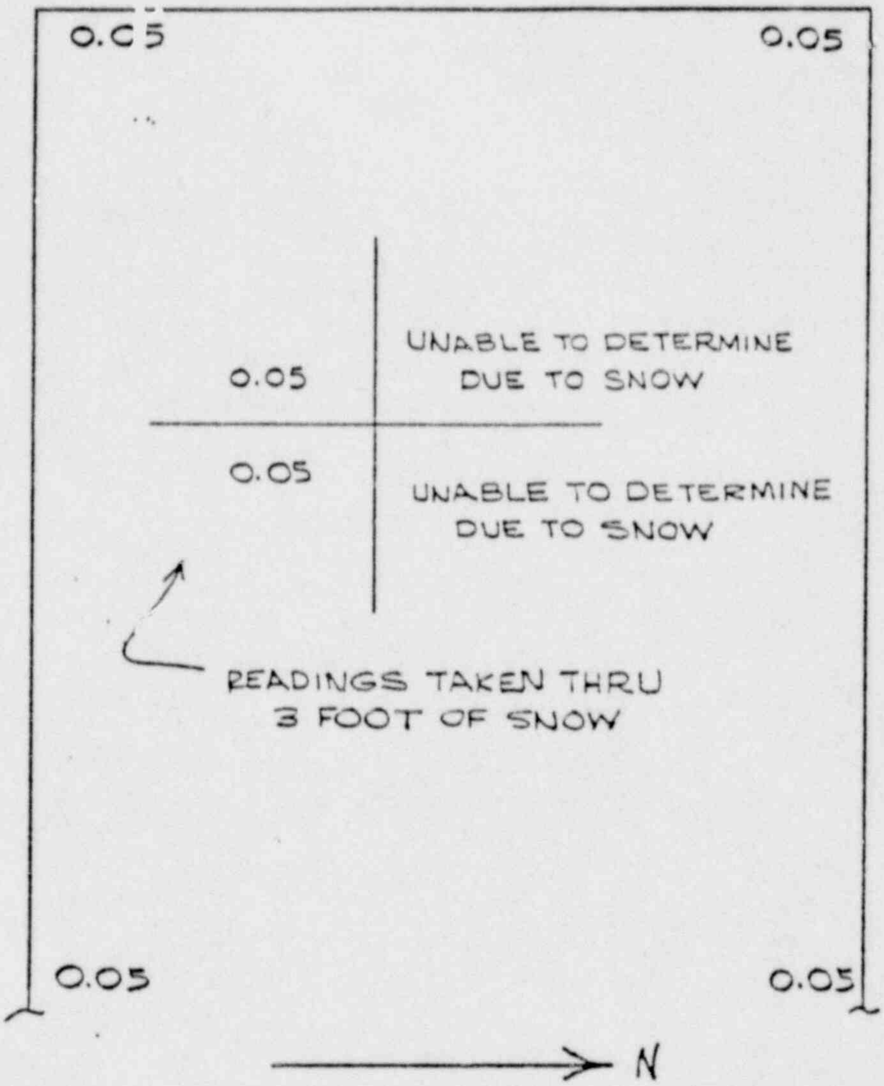
ROASTED SAND STORAGE (NO BLDG. NO.)



NOTE: OUT SIDE BLDG WITH OPEN FRONT LOCATED BETWEEN BLDG. # 5H AND COAL STORAGE AREA.

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ROASTED SAND AND STORAGE BLDG.

RANDOM WALL SMEARS

	LOOSE ALPHA IN DPM / 100 cm²	LOOSE BETA / GAMMA IN DPM / 100 cm²
SMEAR # 1	162	780
# 2	88	300
# 3	38	260
# 4	54	310
# 5	66	270

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Peekskill, N.Y. 10566

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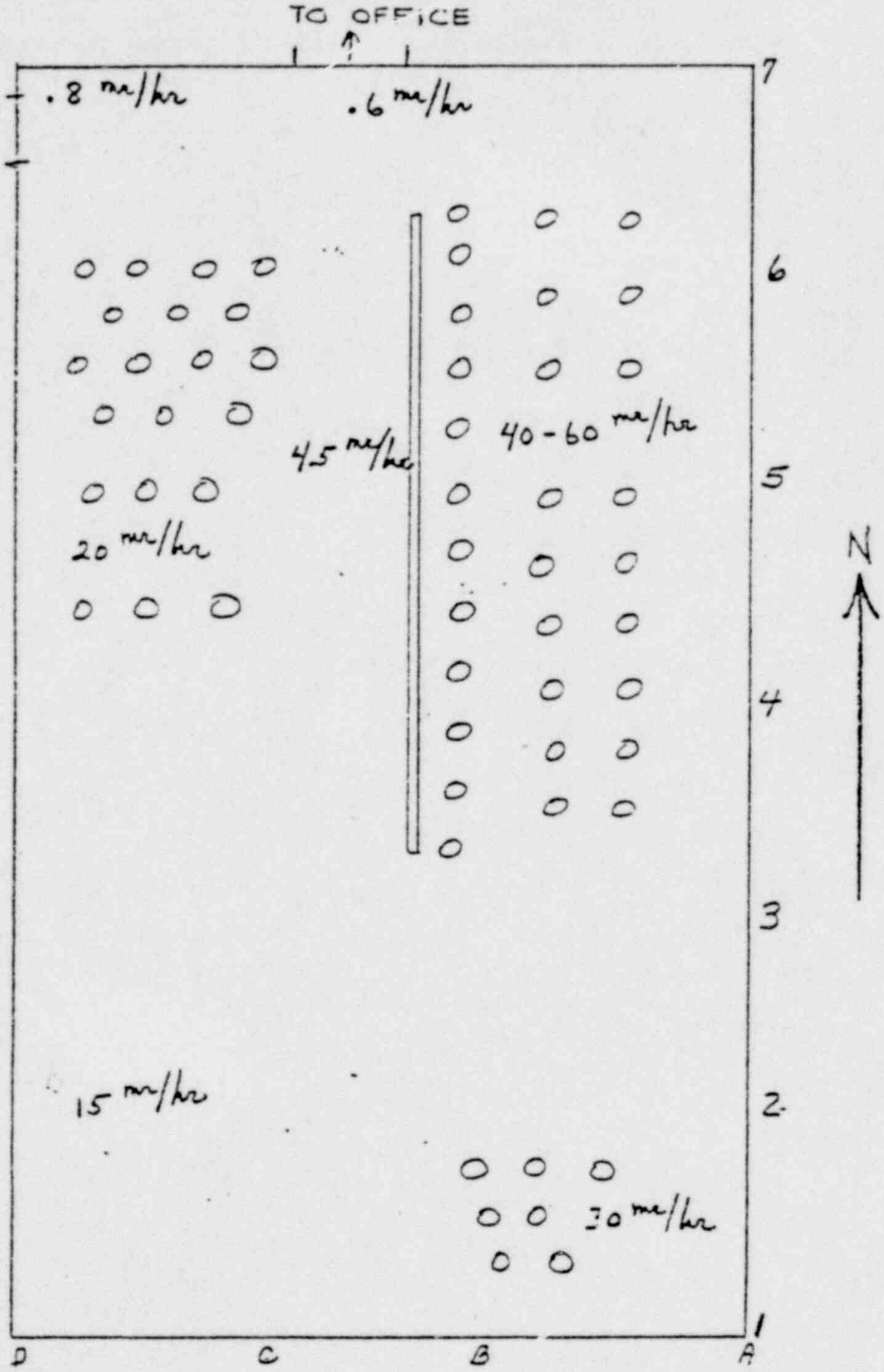
BLDG. NO. 1



NOTE:
CIRCLES DEPLICT DRUMS OF STORED THORIUM & YTTRIUM

By ______ Date ______
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Sheet No. ______ Of ______
Proj. No. *0-2265-P*

BLDG.#1 RANDOM FLOOR SMEARS FOR LOOSE ALPHA; BETA/GAMA AND FIXED ALPHA

SMEAR AREA	FIXED ALPHA IN DPM/100 cm^2	LOOSE ALPHA IN DPM/100 cm^2	LOOSE BETA/ GAMMA IN DPM/1
A 1.2	10.5K	122 Dpm/100 cm^2	370 Dpm/
A 3.5	9.0K	752 Dpm/100 cm^2	3420 Dpm/1
B 1.2	9.0K	128 Dpm/100 cm^2	560 Dpm/10
B 2.5	9.0K	92 Dpm/100 cm^2	200 Dpm/10
B 3.5	9.0K	76 Dpm/100 cm^2	400 Dpm/100
C 1.1	15.0K	224 Dpm/100 cm^2	820 Dpm/10
C 2.5	6.0K	188 Dpm/100 cm^2	1117 Dpm/100
C 4.0	45.0K	342 Dpm/100 cm^2	1114 Dpm/100
A 2.6	9.0K	220 Dpm/100 cm^2	870 Dpm/100
B 1.5	9.0K	434 Dpm/100 cm^2	1840 Dpm/100
B 2.4	7.5K	236 Dpm/100 cm^2	910 Dpm/100
C 1.5	15.0K	254 Dpm/100 cm^2	1113 Dpm/100
C 4.7	45.0K	624 Dpm/100 cm^2	2180 Dpm/100

RANDOM AREA SMEARS

LOCATION		
GRID AREA A 1.5 EAST DOOR	32 Dpm/100 cm^2	120 Dpm/10
GRID AREA A 1.1 PIPE RUN	18 Dpm/100 cm^2	60 Dpm/1
GRID AREA A 1.4 FLOOR DRAIN	38 Dpm/100 cm^2	360 Dpm/1
GRID AREA A 3.5 BARRELS	834 Dpm/100 cm^2	3110 Dpm/10
GRID AREA C 3.7 ELECTRICAL BOX	32 Dpm/100 cm^2	190 Dpm/1
GRID AREA C 3.5 WATER PUMP	174 Dpm/100 cm^2	540 Dpm/1
GRID AREA C 2.5 BARRELS	62 Dpm/100 cm^2	40 Dpm/10
GRID AREA B 2.9 FLOOR CRACK	100 Dpm/100 cm^2	370 Dpm/10
GRID AREA C 1.4 TABLE	124 Dpm/100 cm^2	2,20 Dpm/10
GRID AREA C 1.2 OVEN	32 Dpm/100 cm^2	120 Dpm/100
GRID AREA B 1.1 FIRE HOSE BOX	186 Dpm/100 cm^2	360 Dpm/

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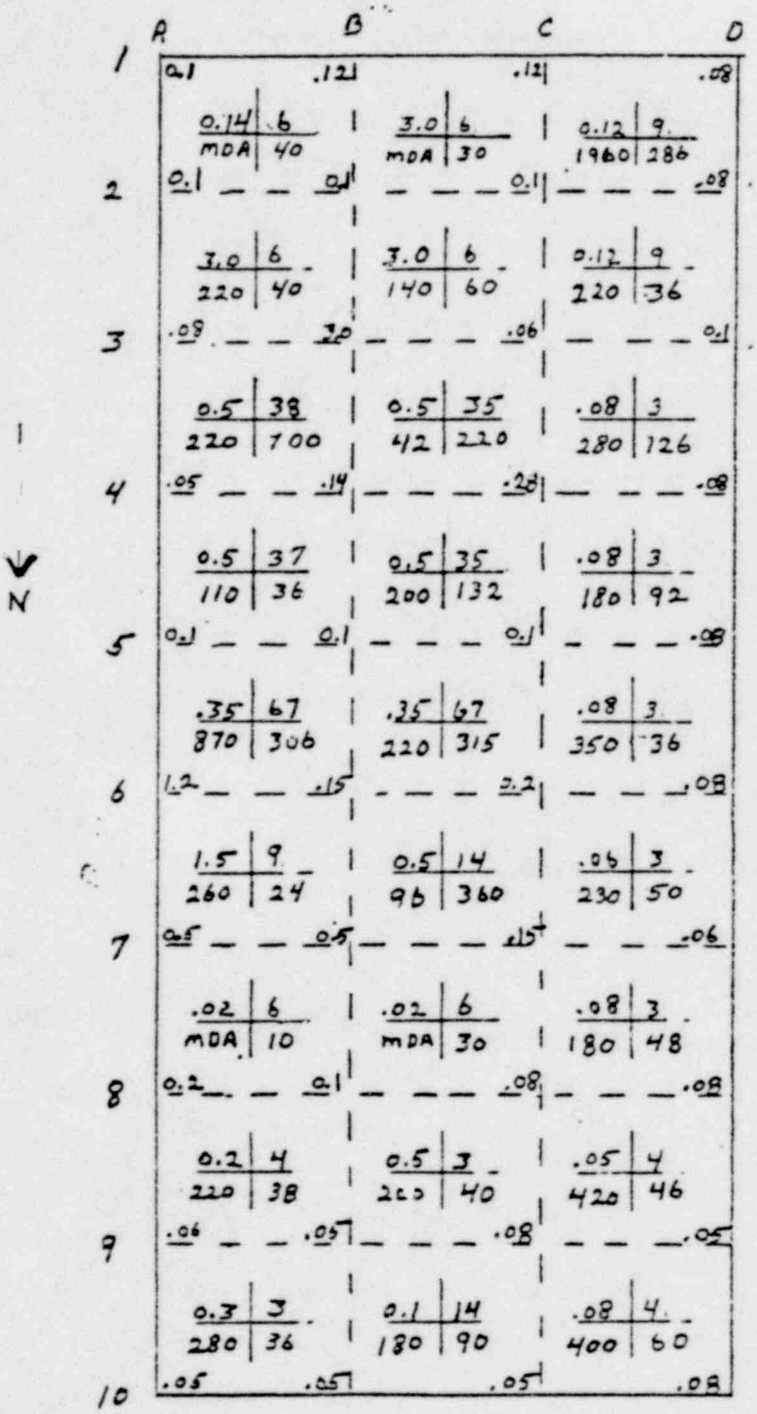
B'LDG. NO. 2



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BLDG. NO. 2

SMEAR AREA	LOOSE ALPHA IN DPM/100cm²	LOOSE BETA/GAMMA IN DPM/100cm²
1. FLOOR CRACK A5.5	44	530
2. FLOOR CRACK B1.4	46	400
3. FLOOR CRACK C9.5	MDA	180
4. VENT. DUCTING C9	16	720
5. FLOOR TRENCH C7	10	MDA
6. FLOOR CRACK B4.2	92	420
7. I BEAM C6	50	210
8. WATER TREATMENT TANK DRAIN	204	800
9. TOP OF MIXER #1	82.	780
10. OFFICE LIGHT FIXTURE	50	290
11. HOPPER N.E. CORNER	42	480
12. SAND UNDER MIXER #1	126	810
13. METAL FLOOR SHEETS	48	240

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Chkd. By HW Date 2-11-77

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BLDG. NO. 3

	A			B			C			D
1	0.1			.06			0.1			.08
		0.24	3		0.1	14		0.14	8	
		40	50		280	28		20	42	
2	.08			.06			0.08			.09
		0.12	5		0.10	12		0.12	8	
		MDA	30		290	22		120	34	
3	.06			.06			0.08			.12
		0.36	60		0.14	0		0.18	5	
		190	30		460	130		30	24	
4	.14			.3			0.2			.16
		2.0	53		1.2	23		0.18	6	
		1450	230		1020	288		340	86	
5	.05			2.0			0.08			.08
		.06	15		0.12	12		0.12	3	
		510	154		120	26		130	24	
6	.06			.06			.10			.10
		0.10	8		0.14	9		0.46	4	
		960	90		90	52		700	32	
7	.06			.06			0.10			.12
		0.12	8		0.30	30		*	45	
		500	116		450	118		7010	1466	
8	.10			.12			0.20			*
		0.12	5		0.22	9		*	300	
		110	46		130	54		1560	516	
9	.12			.1			0.22			*
		0.40	45		0.18	9		*	29	
		80	60		MDA	52		570	192	
10	.24			.34			0.08			*
		0.14	3		0.12	15		0.16	12	
		70	42		190	64		290	50	
11	.12			.08			0.12			.16
		0.40	3		0.20	15		0.40	6	
		70	54		530	120		550	58	
12	.05			.05			0.18			0.40

↓
N

NOTE: *

GRID 7D BACKGROUND 10 mR/

GRID 8D BACKGROUND 50 mR/

GRID 9D BACKGROUND 50 mR/

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Chkd. By AW Date 2-11-77

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BLDG. NO. 3

RANDOM SMEARS

SMEAR LOCATION	LOOSE ALPHA IN DPM/100 cm^2	LOOSE BETA/GAMM. IN DPM/100 cm^2
GRID A 2.1 WINDOW SILL	36	270
GRID A 8.5 GARAGE DOOR	156	1220
GRID A 5.5 INSIDE FURNACE	162	180
GRID A 10.3 LAB. TABLE TOP	226	910
GRID A 11.4 LAB. TABLE TOP	123	900
GRID B 3.5 WOOD BEAM SUPPORT	88	100
GRID B 9.5 4" STEAM LINE	214	990
GRID I 10.5 WOODEN CABINET	172	930
GRID C 5.7 MIXING TANK	26	370
GRID C 6.1 PUMP	18	40
GRID C 7.5 LARGE BASIN	78	270
GRID C 9.7 LIGHT FIXTURE	200	900
GRID C 10.0 WALL FAN	14	160
GRID C 8.5 SCALE	152	900
GRID A 6.5 FLOOR CRACK SAFETY ROOM	114	1330
LOCKER ROOM WEST WALL HEATER	78	350
LOCKER ROOM WEST WALL LOCKER	64	180
SHOWER ROOM WINDOW SILL	110	900
SHOWER ROOM FLOOR DRAIN	230	1060

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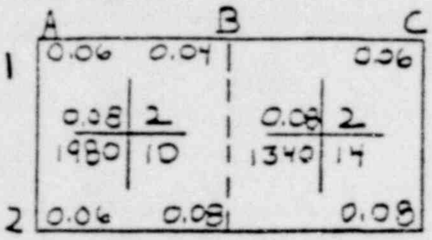
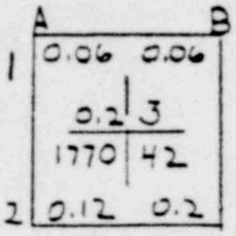
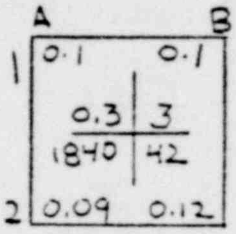
BLDG. NO. 3 OUT LYING ROOMS



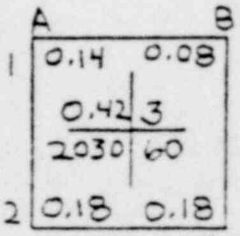
BLDG 3E CAUSTIC TANK RM.



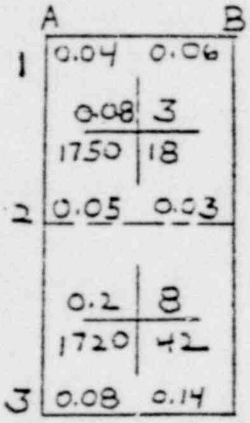
PRESS RM



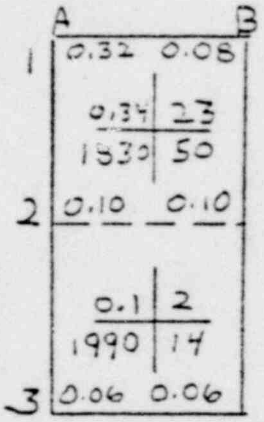
OFFICE "A"



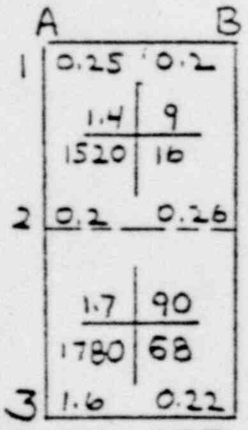
OFFICE "B"



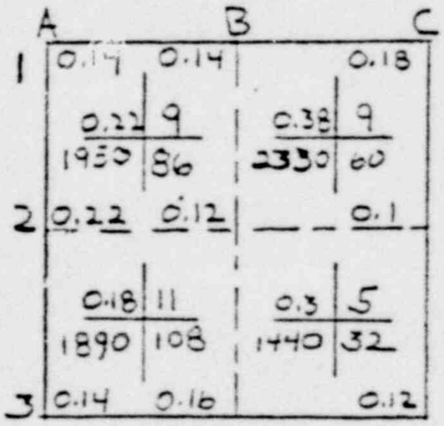
BLDG. 3C EUROPIUM PROCESS



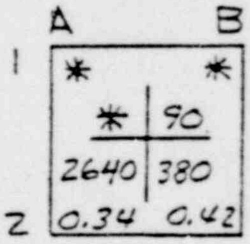
BLDG. 3D PROCESS RM.



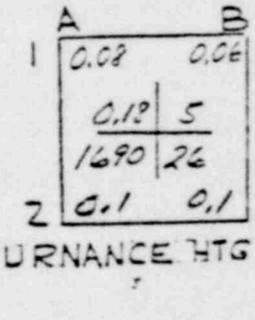
BALL GRINDER RM.



BLDG. 3B MAINT. RM.



BLDG. 3A THORIUM OXIDE FURNANCE



FURNANCE HTG RM.

* READING IN EXCESS OF 22.0 Mr/hr.

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CHKD. BY AW DATE 2-11-77 JOB NO. 0-2265-P

RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100 cm^2	LOOSE BETA/GAMMA IN DPM/100 cm^2
BLDG NO. 3A		
1. FLOOR CRACK A1.5	1700	2110
2. FLOOR CORNER A1.0	674	5430
BLDG NO. 3B		
1. FLOOR CRACK A2.6	280	4200
2. FLOOR CRACK B1.4	180	2100
BLDG NO. 3C		
1. TOP OF DOOR	160	1900
BLDG NO. 3E		
1. FLOOR CRACK A1.9	140	2850
2. TOP OF DOOR	1000	1830
BLDG NO. 3D		
1. WORK TABLE A2.1	54	1800
2. WINDOW SILL A2.9	14	1530
3. STAIRS A1.5	34	2010

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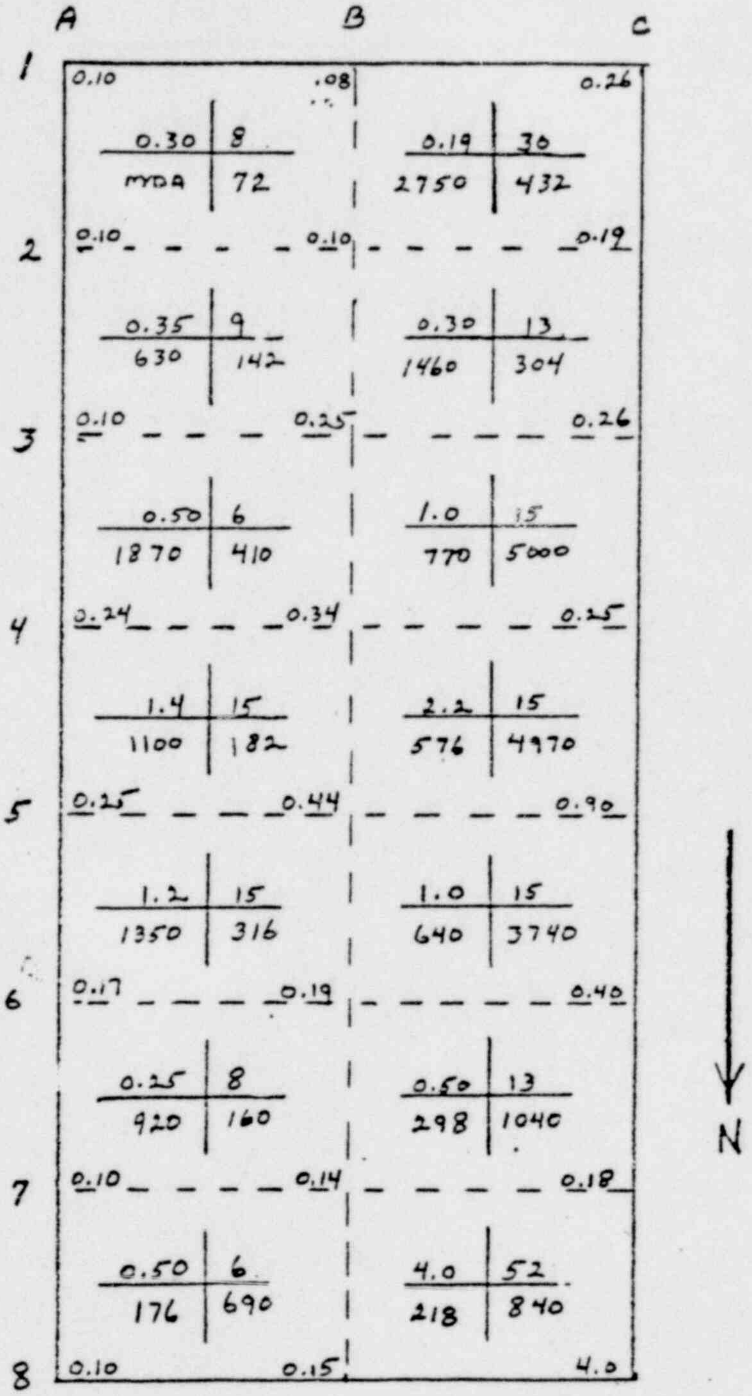
BLDG. NO. 4A



SP 11252C

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Proj. No. 0-2265-P

BLDG. NO. 4A ORE-STORAGE

RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100cm^2	LOOSE BETA/GAMMA IN DPM/100 cm^2
1. PIPES SOUTH WALL	74	260
2. WALL CRACK	414	1680
3. FLOOR CRACK NORTH FLOOR	44	260
4. WOOD DOOR NORTH END OF BLDG.	76	340
5. FIBERGLASS PIPES NORTH FLOOR	58	160
6. 5 GAL. CANS NORTH FLOOR	218	780
7. Plastic Acid Barrel	60	270
8. CONTROL BOX EAST WALL	204	540
9. 3'x3' "TURKEY" KETTLE	120	820
10. SOUTH CBS WALL; 5' UP	268	1230
11. STEEL SUPPORT B.3	64	300
12. WEST CBS WALL; 5' UP	450	1712

BY .... DATE .... SUBJECT .... SHEET NO. .... OF ......

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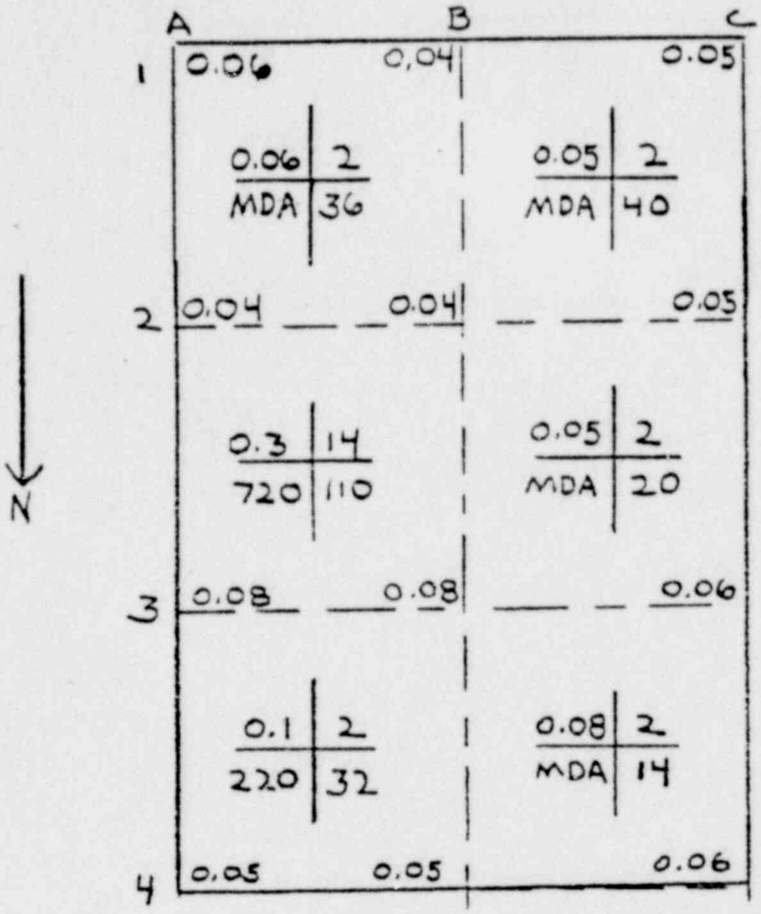
BLDG. NO. 4B



BY .... DATE .... SUBJECT .... SHEET NO. .... OF ....
CHKD. BY GW DATE 2-11-77 JOB NO. Q-2265-P

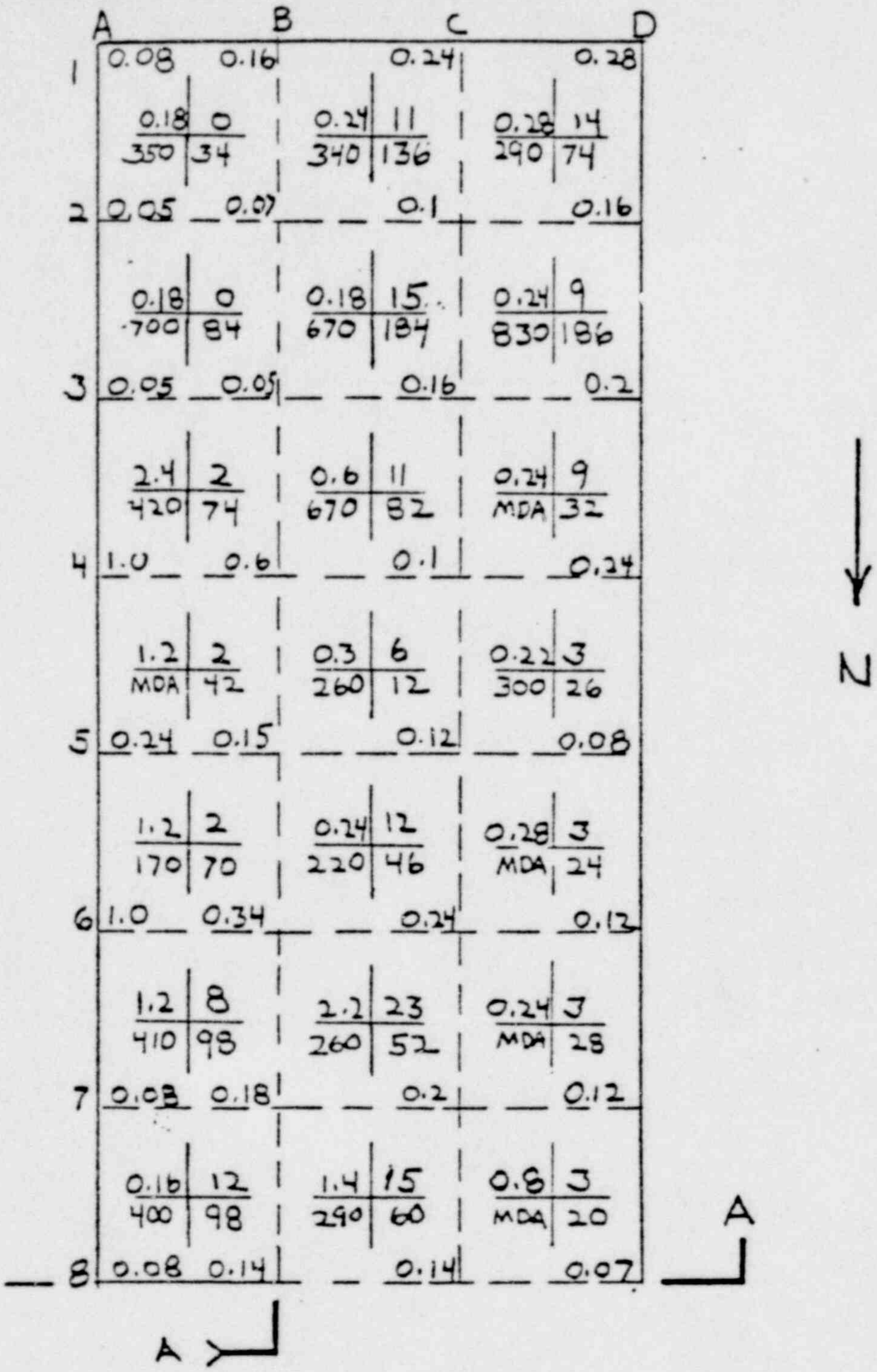
BLDG. 4B - ENGINE HOUSE

RANDON SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100cm²	LOOSE BETA/GAMMA IN DPM/100cm²
1. AIR COMPRESSOR B3	20	MDA
2. TOP OF SWITCH PNLS A3	60	140
3. INSIDE FlOOR TRENCK A2	110	240
4. TOP OF DOOR A1.5	90	210
5. FLOOR CRACK A2.6	110	220
6. LOCKERS B2.0	86	150
7. FlOOR CRACK C2.4	154	300

BY ____ DATE ____ SUBJECT ____ SHEET NO. ____ OF ____
CHKD. BY RW DATE 2-11-77 JOB NO. 0-2265-17

BLDG. NO. 5 - GROUND FLOOR

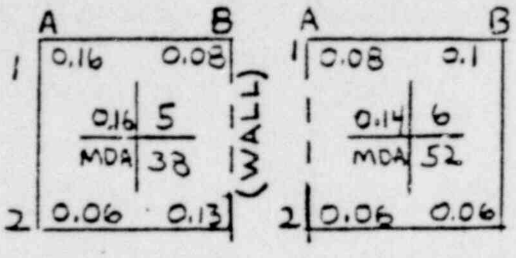


NOTE:
MATCH SECTION A-A
TO SECTION B-B ON
NEXT PAGE.

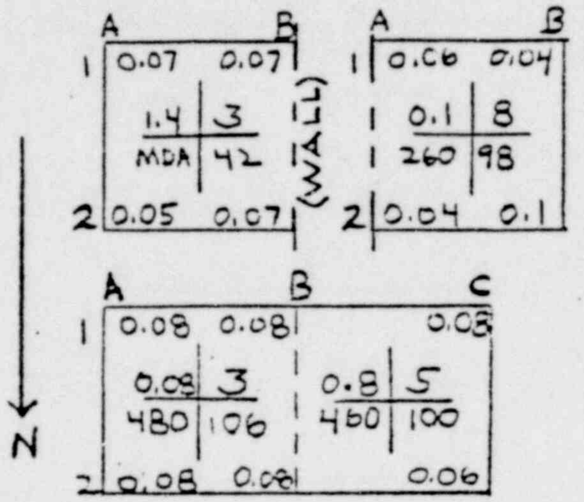
BY .... DATE .... SUBJECT .... SHEET NO. .... OF ......

CHKD. BY HW DATE 2-11-77 .... JOB NO. Q-2245-P

BLDG. NO. 5 N.-E. FURNACE & STORAGE ROOMS



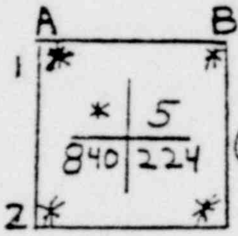
FLAT FURNACE ROOM



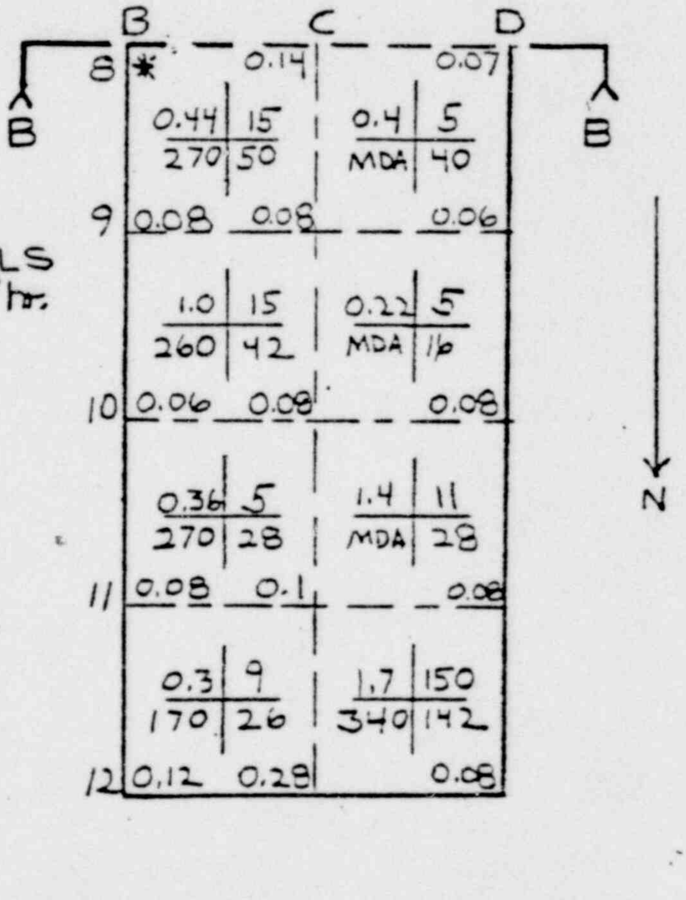
R & G FURNACE ROOM

LINGBURGH FURNACE ROOM

NOTE:
SEE PRIOR DWG. FOR
SECTION A-A TO MATCH
SECTION B-B.



OFFICE
(USED FOR STORAGE)



* - STORAGE OF CHEMICALS
IN EXCESS OF 30.0 mr/hr.

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BLDG. NO. 5 GROUND FLOOR

RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100 cm²	LOOSE BETA/GAMMA IN DPM/100 cm²
# 1 WEST WALL HT EQUIPMT. A1.	16	BKG.
# 2 SOUTH WALL CONDUIT A1.	18	320
# 3 DRAIN GRAIDING A1.	26	140
# 4 TANK B1.	24	120
# 5 STORAGE SHELVES	110	450
# 6 WORK BENCH B2.9	68	500
# 7 PIPE RUN (WALL) D4	36	200
# 8 I BEAM (WALL) A4.	70	460
# 9 I BEAM (OVERHEAD) B4.2	106	280
# 10 MIXING TANKS (TOP) D1.4	54	270
# 11 WALL, 15' HIGH C3.8	72	250
# 12 LADDER C5.5	40	50
# 13 FLOOR, CRACK	16	30
# 14 STORAGE BINS C5.1	142	350
# 15 FIRE HOSES (WALL) C4.	110	490
# 16 GUARD RAIL B4.	170	590
# 17 FLOOR CRACK B6.	36	250
# 18 PIPES ON FLOOR B5.	10	10
# 19 PILE OF PLANKS C5.	24	70
# 20 ELEC, BOX, WEST WALL	14	20
# 21 DRAIN C4.	32	180
# 22 ELEC. MOTOR C11.	80	10
# 23 DRAIN C11.	36	240

FLAT FURNANCE RM. (EAST HALF OF ROOM)

# 1 FURNACE	14	BKG.
# 2 DUCT WORK (NORTH SECTION)	14	130
# 3 WINDOW LEDGE (EAST WALL)	38	BKG

FLAT FURNANCE RM. (WEST HALF OF ROOM)

# 4 FURNANCE	14	BKG.
# 5 DRUMS	56	BKG.

R & G FURNANCE RM. (EAST HALF)

# 6 FURNANCE	18	200
# 7 WINDOW SILL (EAST WALL)	22	170
# 8 TABLES	14	110

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BLDG. NO. 5 CON'T

SMEAR AREA	LOOSE ALPHA IN DPM/100 cm^2	LOOSE ALPHA/GAMA IN DPM/100 cm^2
R&G FURNANCE RM. (WEST HALF)		
#9 BOXES	138	230
#10 METAL DOOR (WEST)	34	64
LINGBURGH FURNANCE RM.		
#11 FURNACE A1.	44.	270
#12 TABLES (WEST)	50	70
#13 CONDUIT (SOUTH WALL)	22	250
#14 CONTAINERS B1.	50	530
OFFICE (USED FOR STORAGE)		
#15 HEATING UNIT (SOUTH)	34	530
#16 TABLE TOPS	34	290
#17 BOXES	44	730
MAINTENANCE GARAGE		
#18 PIPES (NORTH WALL)	4	BKG.
#19 METAL DOOR (STL.) 7'X 7' HIGH	80	180
#20 ELEC. MOTORS & SHELVES	128	440
#21 WOOD SHELVES (EAST WALL)	86	340
#22 LIGHT FIXTURES	140	560
#23 WOOD LOFT (EAST WALL)	112	680
#24 FLOOR A1.3	106	430

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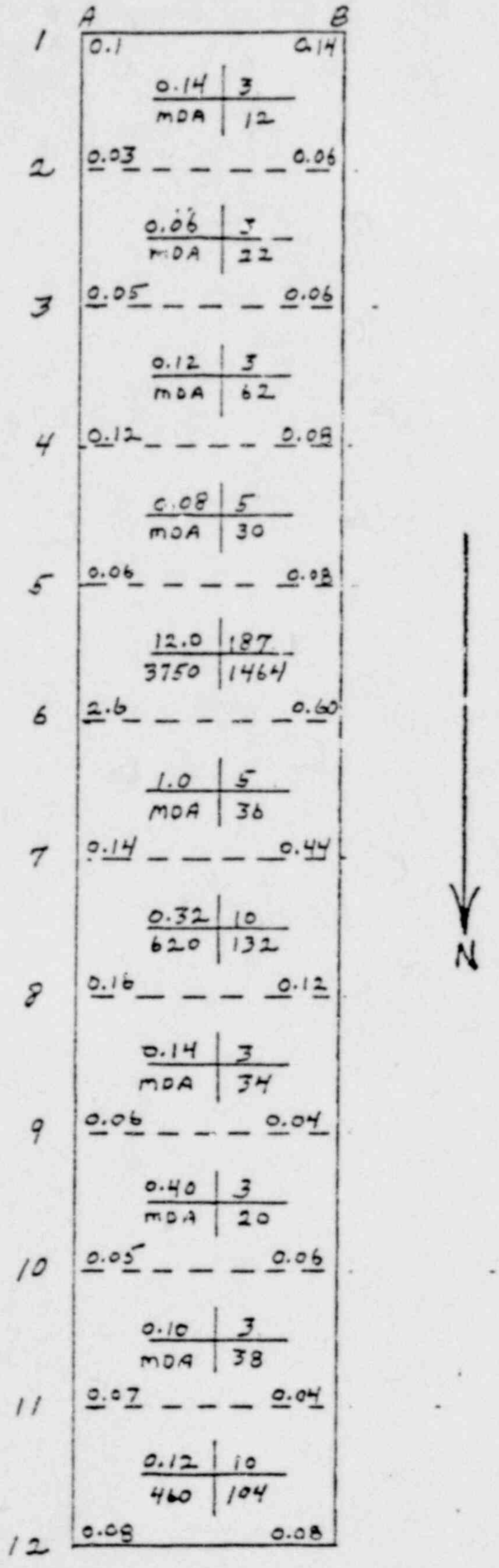
BLDG. NO. 5 MEZZANINE



SP 11252C

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Chkd. By RW Date 2-11-77
Sheet No. ______ Of ______
Proj. No. 0-2265-P

BLDG. NO. 5 MEZZANINE

RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100 cm^2	LOOSE BETA/GAMMA IN DPM/100 cm^2
1. STAIRS TO HOPPER AB.1	36	80
2. PUMP MOUNT C7.5	4	MDA
3. NORTH STAIRS	44	310
4. ELEVATOR FLOOR	126	240
5. I BEAM A2.6	12	MDA
6. OPEN PIPE A5.0	6	MDA
7. PIPE RUN B5.5	10	180
8. FRAME PRESS A7.5	410	1690
9. JUNCTION BOX A9.3	56	240
10. OVERHEAD FAN B9.8	18	100
11. HEATER DUCT A10.6	148	430
12. FILTER A10.12	40	290

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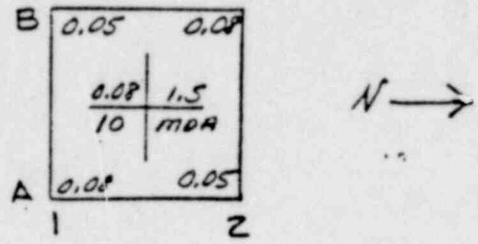
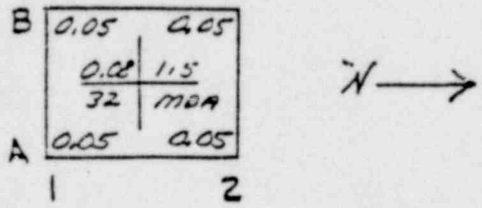
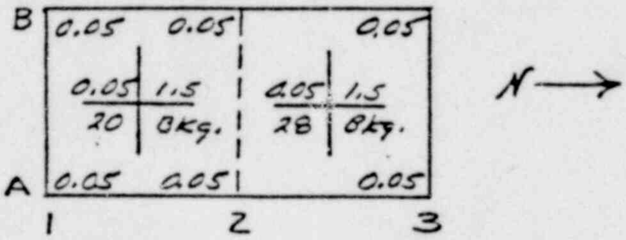
BLDG. NO. 5A HOT H_2O TANK RM.



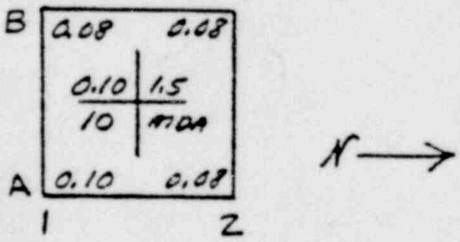
BLDG. NO. 5G HOIST HOUSE



BLDG. NO. 5-B BOILER HOUSE



BLDG. NO. 5C H_2O TREATMENT RM.



SP 112521

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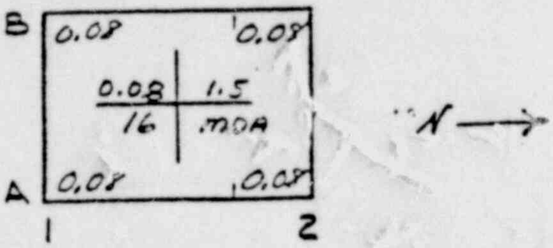
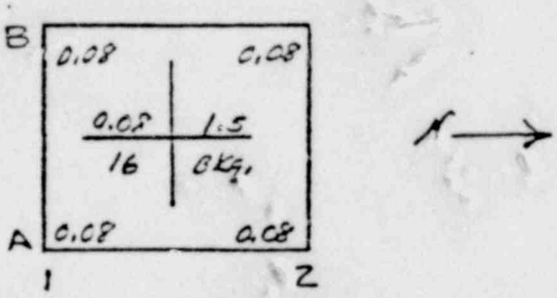
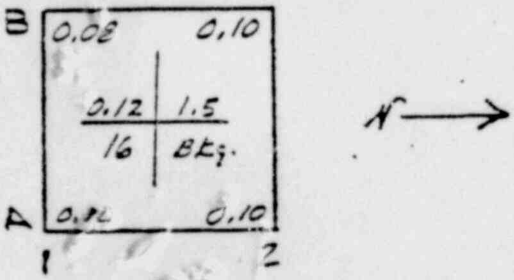
BLDG. NO. 5D SWITCH HOUSE & OFFICE



BLDG. NO. 5E SULFURIC ACID STR. HOUSE



BLDG. NO. 5F MAINT. SHOP



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RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100cm²	LOOSE BETA/GAMMA IN DPM/100cm²
BLDG. NO. 5A		
1. FLOOR CRACK A1.8	20	MDA
2. TANK TOP	40	MDA
3. WEST WALL LEDGE	140	2900
BLDG. NO. 5B		
1. SOUTH WALL LEDGE	20	MDA
2. STAIRS TO OFFICE	30	MDA
3. GRATING BOILER NO 1	20	MDA
4. GRATING BOILER NO 2	20	MDA
BLDG. NO. 5C		
1. FLOOR CRACK A1.7	180	1110
2. NORTH WALL LEDGE	40	MDA
3. EAST WALL LEDGE	20	MDA
BLDG. NO. 5D		
1. FLOOR CRACK B2.5	140	MDA
2. FLOOR CRACK B2.10	20	MDA
3. WEST WALL LEDGE	20	MDA
BLDG. NO. 5E		
1. FLOOR CRACK A1.5	20	MDA
2. TOP OF TANK	8	MDA
3. LIGHT B1.5	20	MDA
BLDG. NO. 5F		
1. SHELVES WEST WALL	100	1110
2. SHELVES CENTER	120	900
3. FLOOR CRACK A1.4	180	1400
BLDG. NO. 5G		
1. FLOOR CRACK A2.5	160	2150
2. NORTH WALL LEDGE	100	1710

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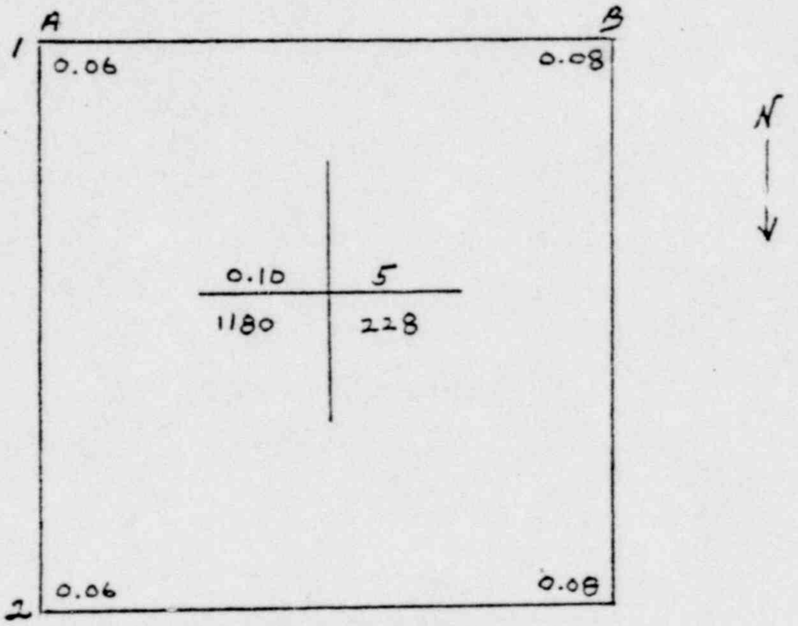
BLDG. NO. 6 PUMP HOUSE



RANDOM SMEARS

SMEAR AREA	LOOSE ALPA IN DPM/100cm²	LOOSE BETA/GAMMA IN DPM/100cm²
1. PUMP HOUSING	122	770
2. WINDOW SILL	118	820
3. Floor GRATE B2	224	1270
4. PIPING A1	78	230
5 OVER DOOR	160	1030

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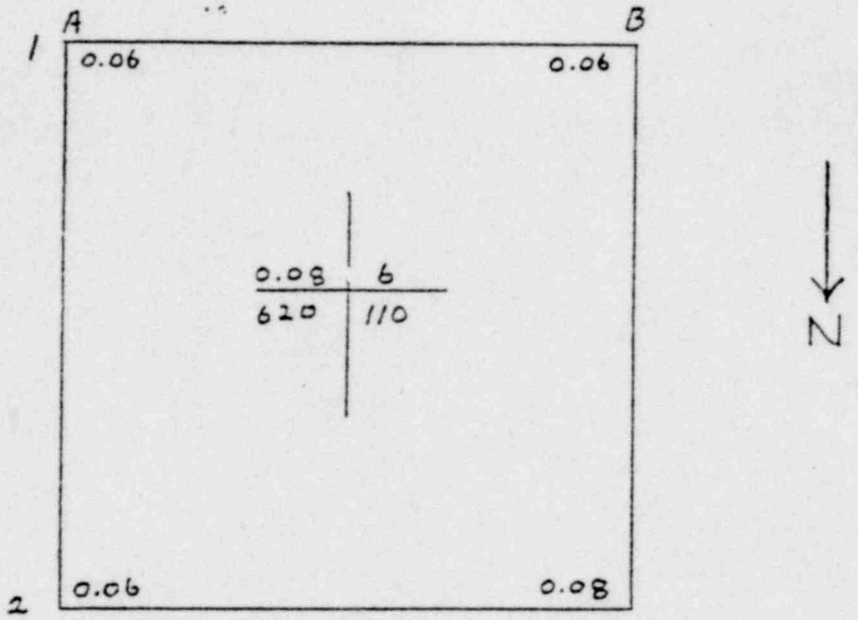
BLDG. NO. 7 WELL HOUSE



RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100cm^2	LOOSE BETA/GAMMA IN DPM/100 CM^2
1. METAL FLOOR GRATE	414	1500
2. OVER DOOR	130	840
3. WINDOW SILL	204	540
4. PUMP HOUSING	220	870

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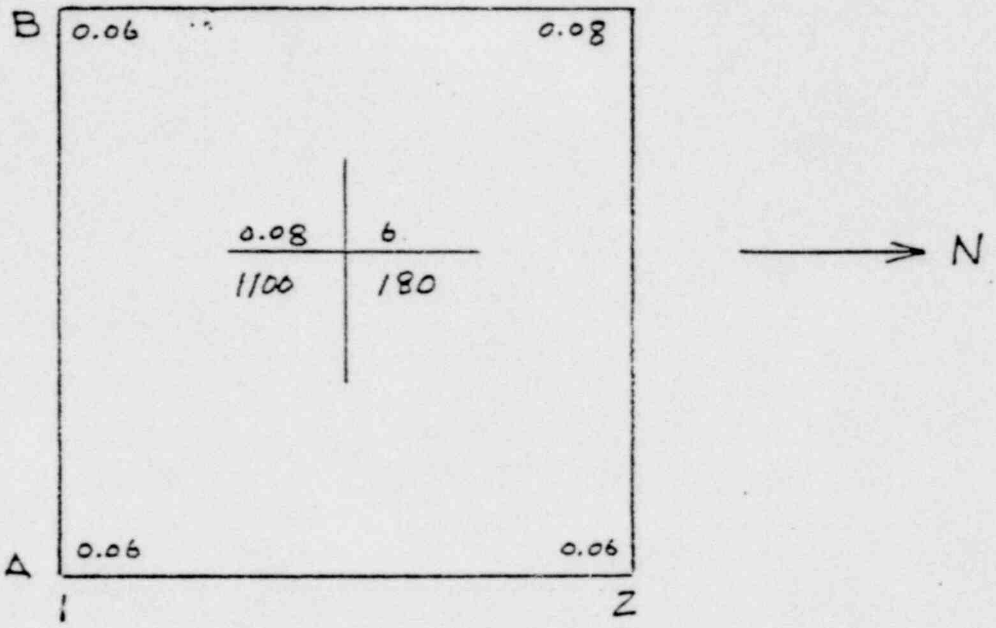
BLDG. NO. 8 INCINERATOR



RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100cm²	LOOSE BETA/GAMMA IN DPM/100 cm²
1. NORTH WALL	120	940
2. WEST WALL	184	1160
3. SOUTH WALL	154	910
4. DOOR JAM	168	1070

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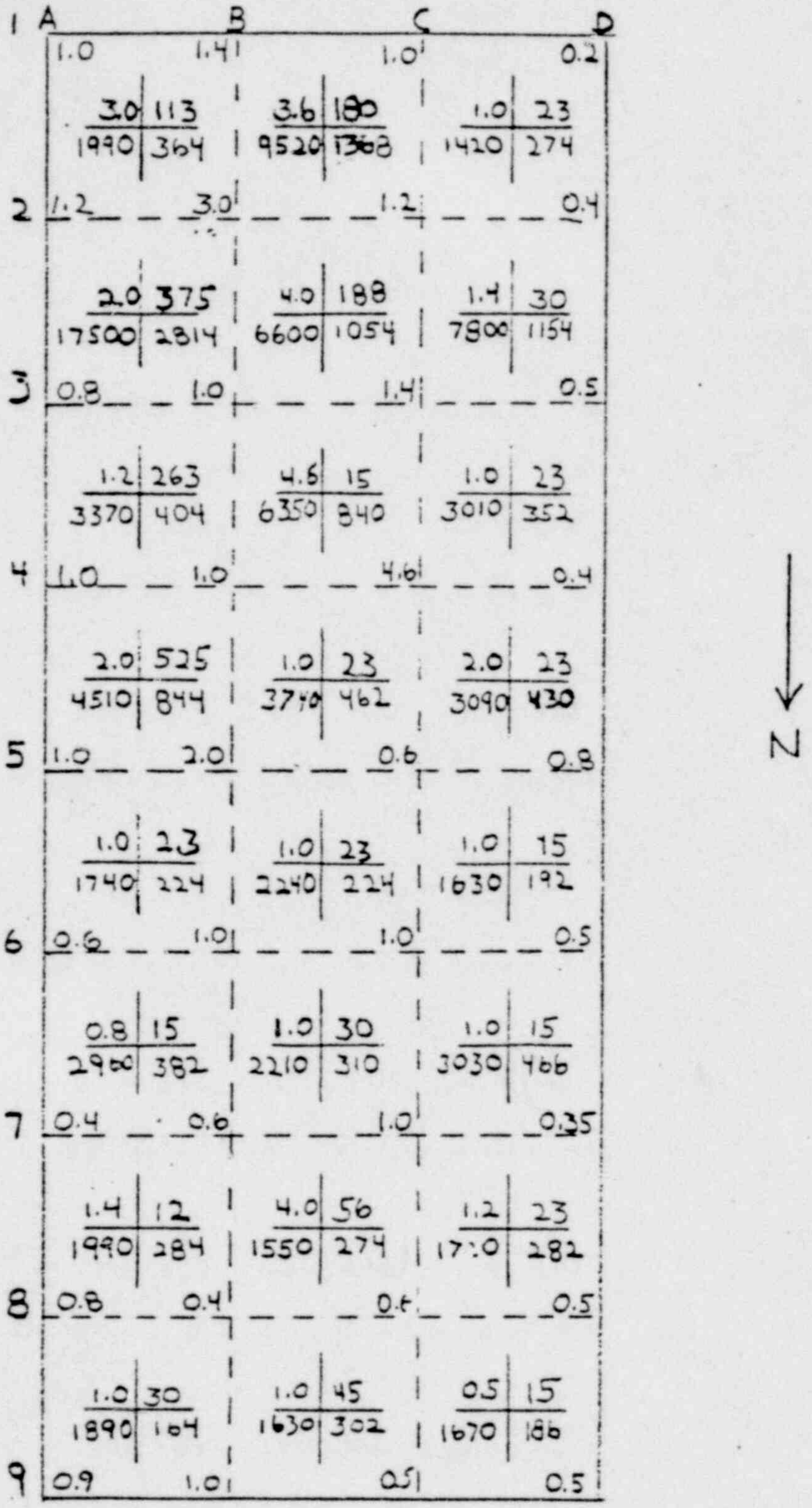
BLDG. NO. 9 1ST FLOOR



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BLDG. NO. 9 1ST FLOOR
RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100 cm^2	LOOSE BETA/GAMMA IN DPM/100 CM^2
1 ELECTRICAL SWITCH B3.1	223	810
2 FIRE EXTINGUISHER C5	180	600
3 ELECTRICAL PANEL A3/CR7	126	570
4 SIDE OF B1-F TANK	116	390
5 STAIRS TO TOP OF C2-3 TANK	196	750
6 ELEVATOR DOOR	220	900
7 SIDE OF C-1 TANK	102	370
8 NORTH SPIRAL STAIR CASE	80	850
9 TOP OF B1-F TANK	76	490
10 NO. 20 HTR SWITCH BOX	64	290
11 PAPER TWL DISPENSER	102	530
12 MIDDLE SPIRAL STAIRCASE	64	290
13 FLOOR CRACK C4.6	194	1100
14 UNDER ASPHALT A4.3	54	MDA
15 I BEAM SHELF A3.2	300	1370
16 FLOOR CRACK B1.2	722	2610
17 FLOOR CRACK C1.9	380	900
18 ELECTRICAL PANEL C3.1	22	320
19 FIRE STATION NO. 65	42	130
20 SHELF IN PAINT LOCKER	190	1000
21 SHELF IN PAINT LOCKER	344	1130
22 MOTOR SWITCH BOX NO. D4	50	240

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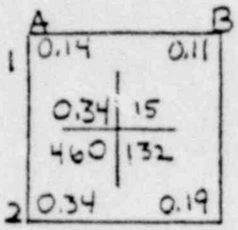
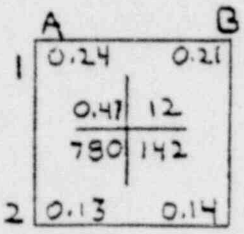
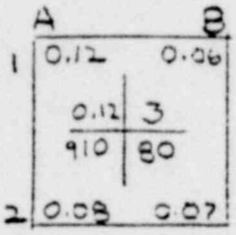
BLDG. NO. 9 1ST FLOOR



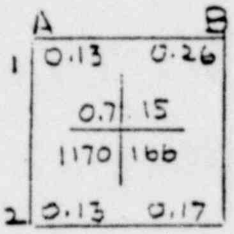
S-W OFFICE



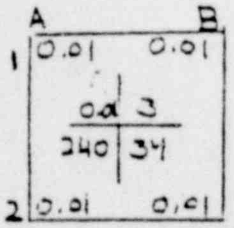
S-W WASHROOM



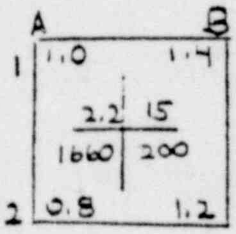
S-W RECORDS OFFICE



MACHINE SHOP

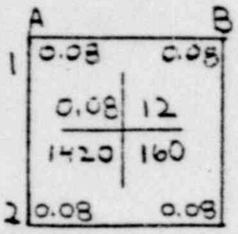


EAST ENTRANCE INCLUDING GUARD STATION
AND
PURCHASING

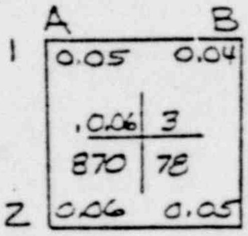


N-E ELEVATOR SHAFT BASE

BLDG. NO. 9 1½ FLOOR



N.-E. CHEMICAL LAB



N-E CHEMICAL LAB OFFICE
AND SUPPLY RM.

BY .... DATE .... SUBJECT ....

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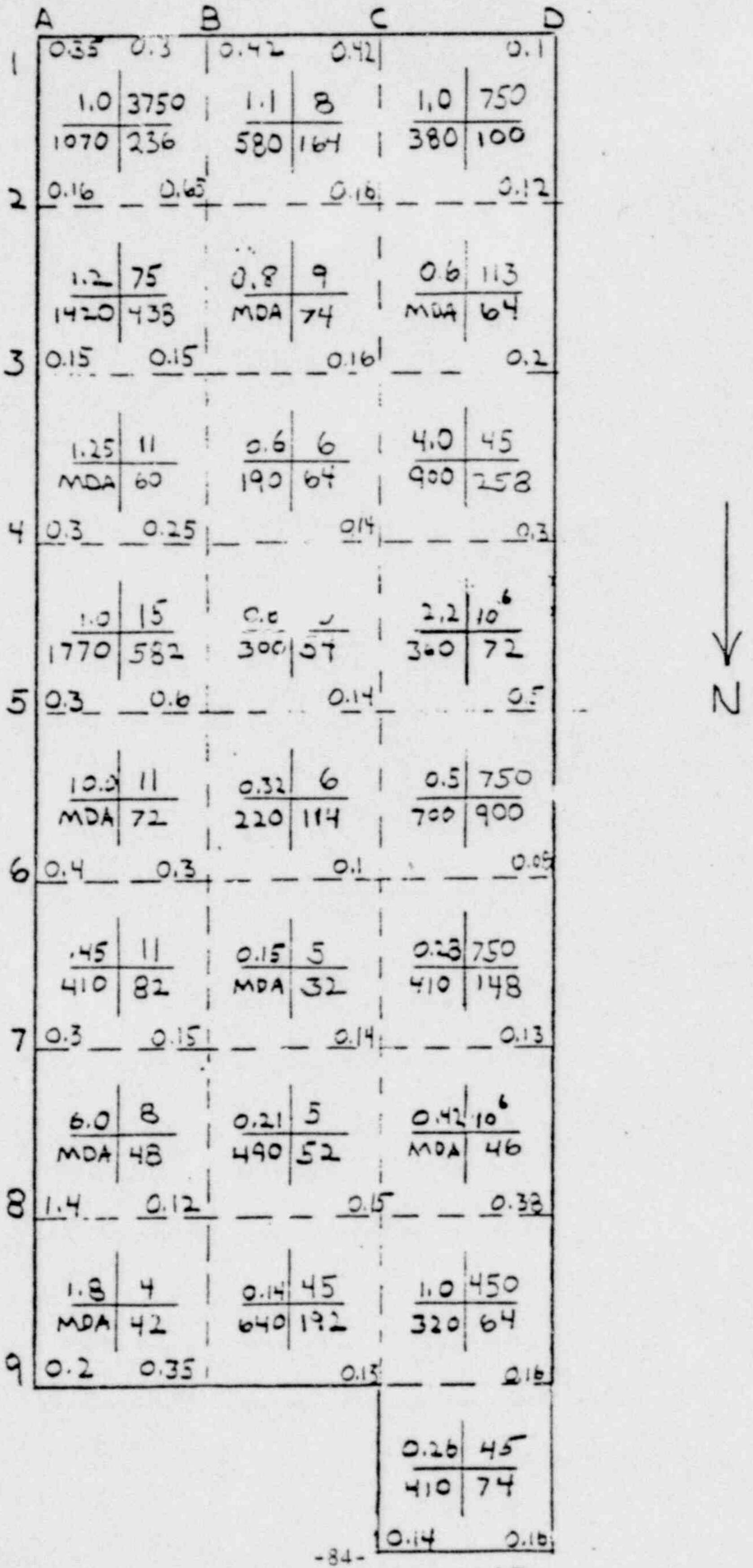
BLDG. NO. 9 2ND FLOOR



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BLDG. NO. 9 RANDOM SMEARS

2ND FLOOR

SMEAR AREA	LOOSE ALPHA IN DPM / 100 cm^2	LOOSE BETA/GAMMA IN DPM / 100 cm^2
#1 STORAGE LOCKERS B9.1	326	1700
#2 ELEC. PANEL B7.	66	210
#3 WINDOW FAN C8	122	640
#4 FLOOR DRAIN C8	82	39
#5 VERTICAL SUPPORT B7.6	10	MDA
#6 SPIRAL STAIR CASE (NORTH)	74	240
#7 FLOOR DRAIN C2.8	38	160
#8 FLOOR CRACK A1.3	198	500
#9 INSIDE WALL A1.1	52	1090
#10 INSIDE WALL A1.1	260	2650

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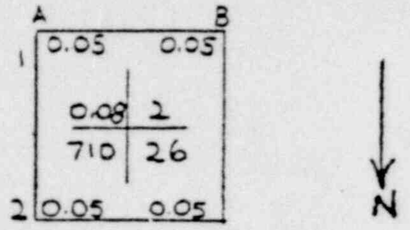
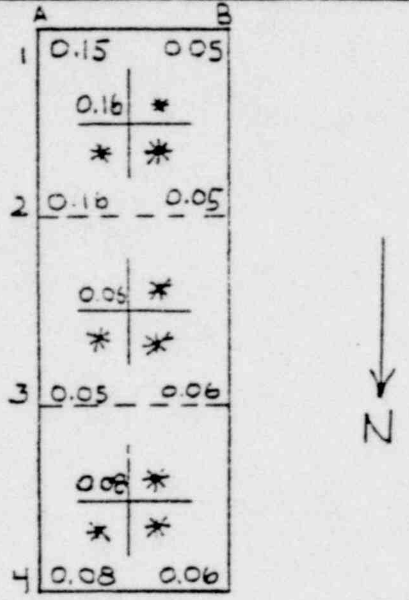
BLDG. NO. 9 2ND FLOOR ENGINEERING OFFICE



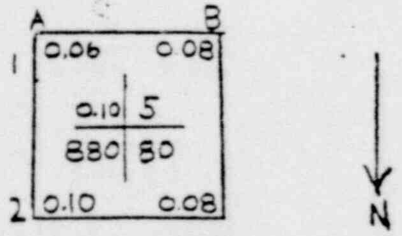
BLDG. NO. 9-WEST, ROOF OFF OF 2ND FLOOR



NOTE: * UNABLE TO MEASURE DUE TO SNOW

* INACCESSIBLE

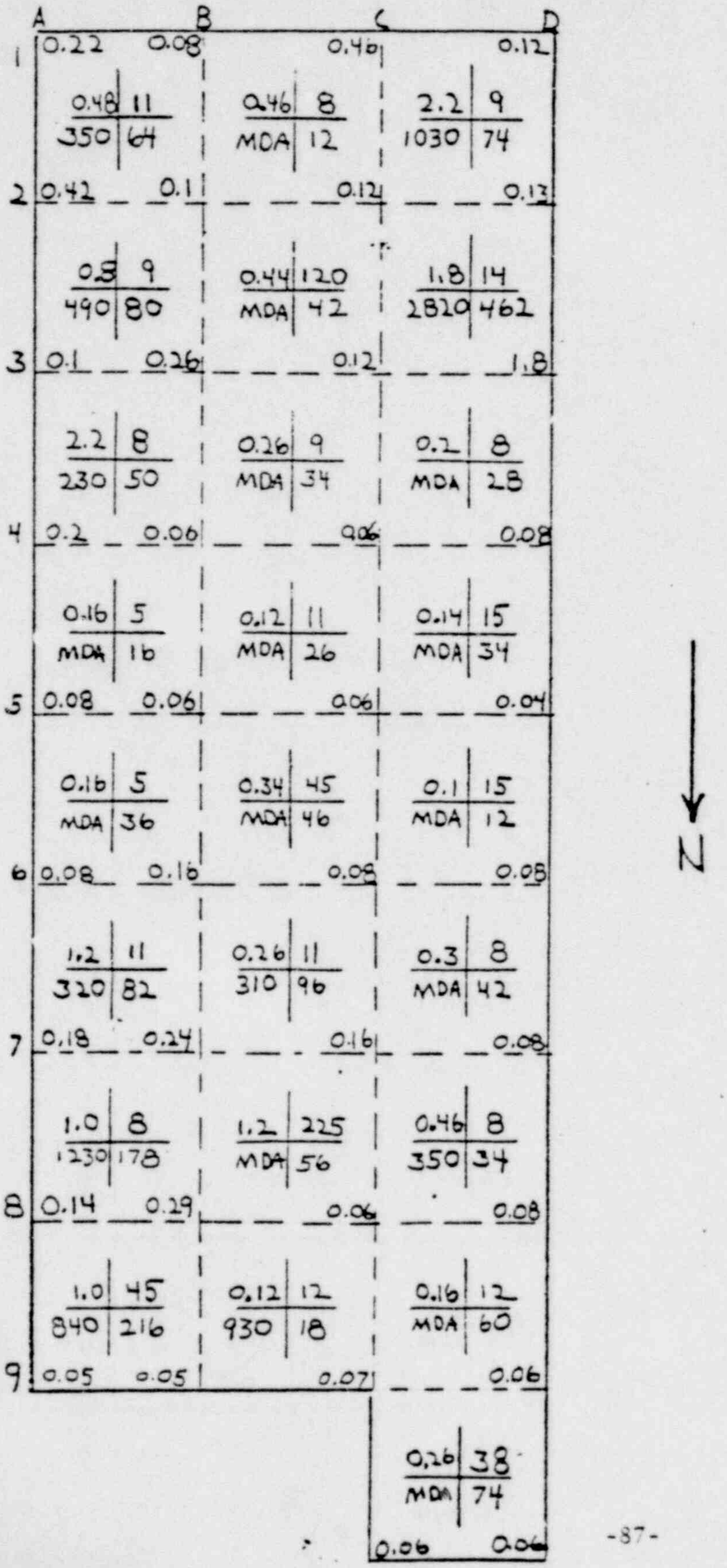
BLDG. NO. 9 2½ FLOOR, BATHROOM



BY .... DATE .... SUBJECT .... SHEET NO. .... OF ....

CHKD. BY JLW DATE 2-11-77 .... JOB NO. 0-2265-P

BLDG. NO. 9 3RD FLOOR



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BLDG. NO. 9 RANDOM SMEARS

3RD FLOOR

	SMEAR AREA	LOOSE ALPHA IN DPM / 100 cm^2	LOOSE BETA / GAMMA IN DPM / 100 cm^2
#1	RND. DUCT CHUTE C9.	76	500
#2	#4 VACUUM PUMP PANEL	132	900
#3	FLOOR DRAIN C8.3	42	390
#4	INSIDE WALL C1.1	178	390
#5	PIPING C1.1	16	MDA
#6	PIPING C1.1	42	MDA
#7	PIPING C1.1	26	MDA
#8	EXHAUST FAN C2.	78	MDA
#9	EXHAUST FAN	44	MDA
#10	FLOOR DRAIN C6.	22	600

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Chkd. By HW Date 2-11-77

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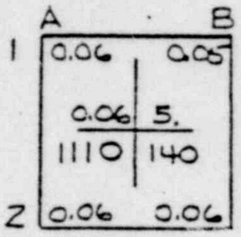
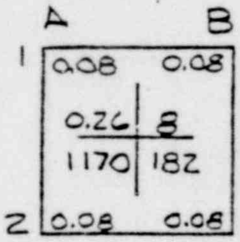
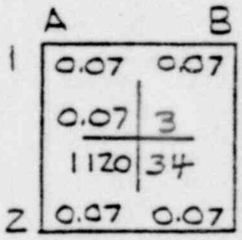
BLDG. NO. 9 3RD FLOOR



N-W LANDING, LUNCH RM.
AND OFFICE



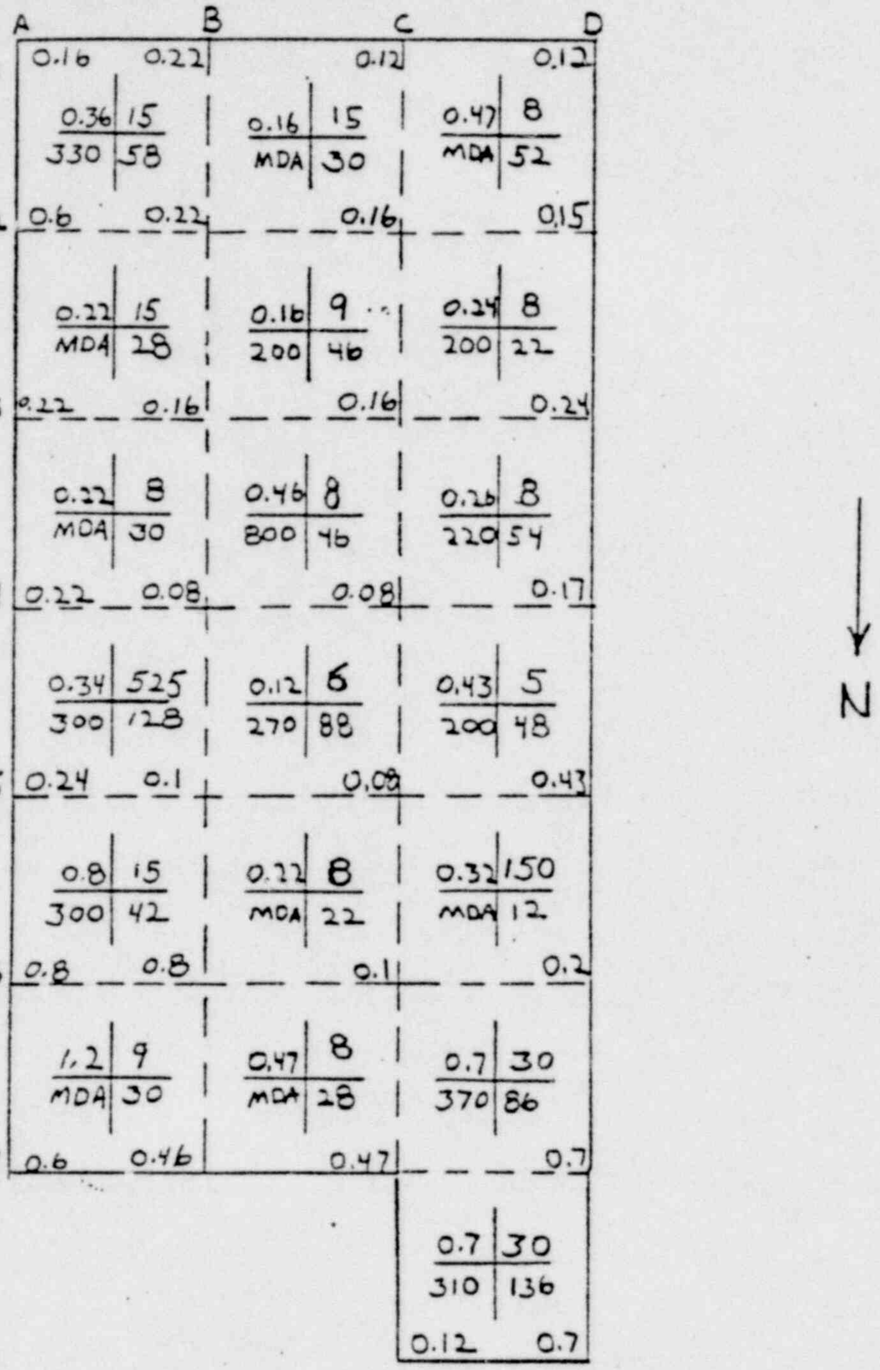
S-W. 9TH FLOOR STORAGE,
(CONVERTED ELEVATOR SHAFT)



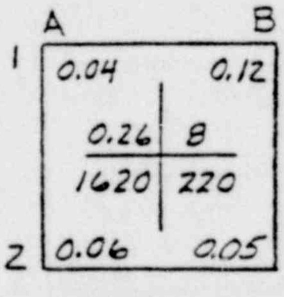
N-E 3½ FLOOR LANDING,
CHANGE RM. & SHOWERS

BY ______ DATE ______ SUBJECT ______ SHEET NO. ____ OF ____
CHKD. BY AW DATE 2-11-77 JOB NO. 0-2265-P

BLDG. NO. 9 4TH. FLOOR



4TH. FLOOR N-W. LANDING, H2O TREATMENT RM.



By ________ Date ________
Chkd. By GW Date 2-11-77

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Proj. No. 0-2265-15

BLDG. NO. 9 RANDOM SMEARS

4TH FLOOR

	SMEAR AREA	LOOSE ALPHA IN DPM / 100 cm^2	LOOSE BETA/GAMMA IN DPM / 100 cm^2
# 1	TOP OF AIRCONDITION, UNIT 3	78	350
# 2	AIR CONDITIONING DUCTS (TOP)	336	1790
# 3	CRANE (NORTH END)	32	280
# 4	CRANE (SOUTH END)	20	190
# 5	SULFURIC ACID TANKS (TOP) STL.	18	MDA
# 6	SULFURIC ACID TANKS (TOP) STL.	14	MDA
# 7	FLOOR DRAIN C1.5	82	260
# 8	DRAIN A3.1	130	520

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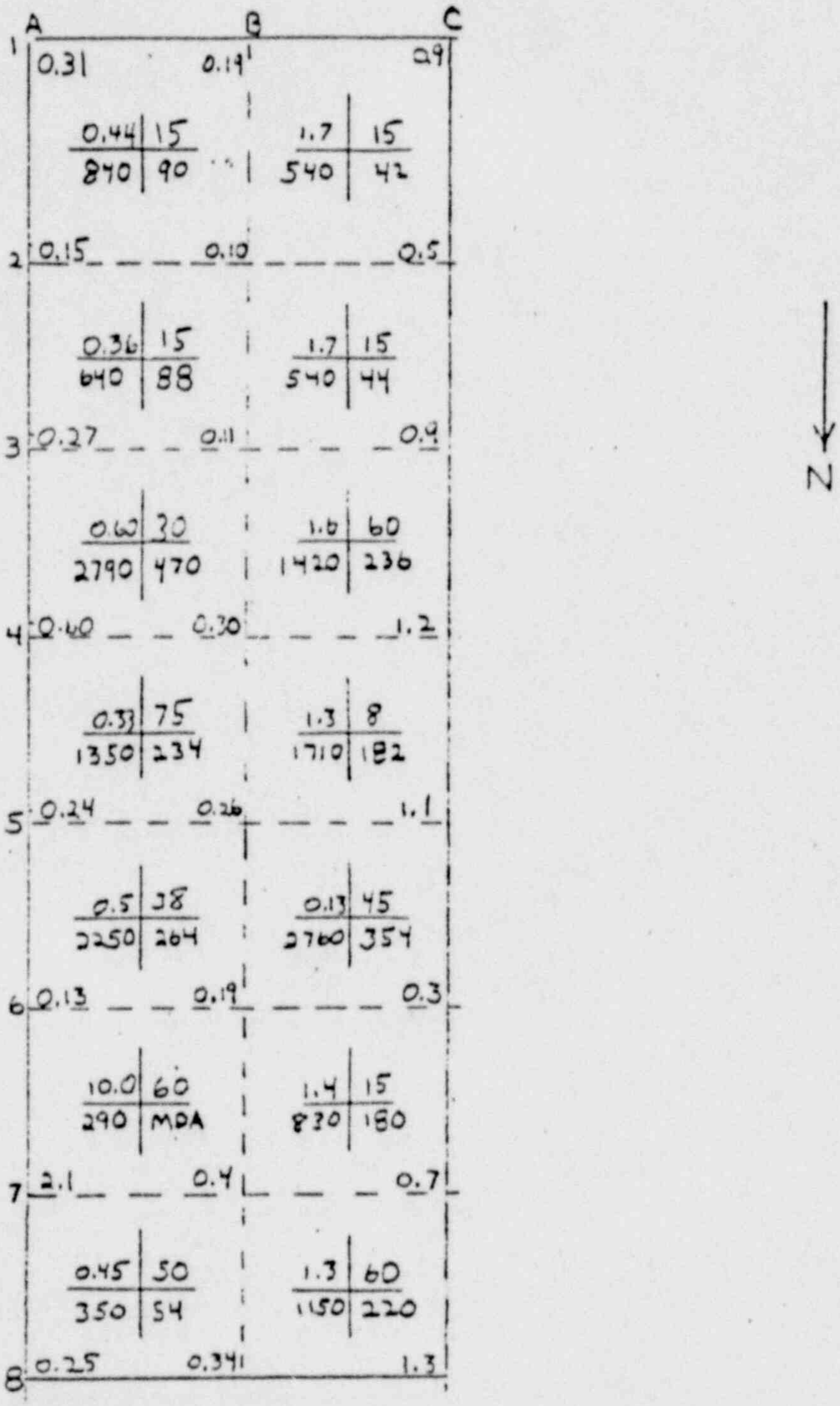
CHKD. BY MW DATE 2-11-77 .... JOB NO. 0-2265-P

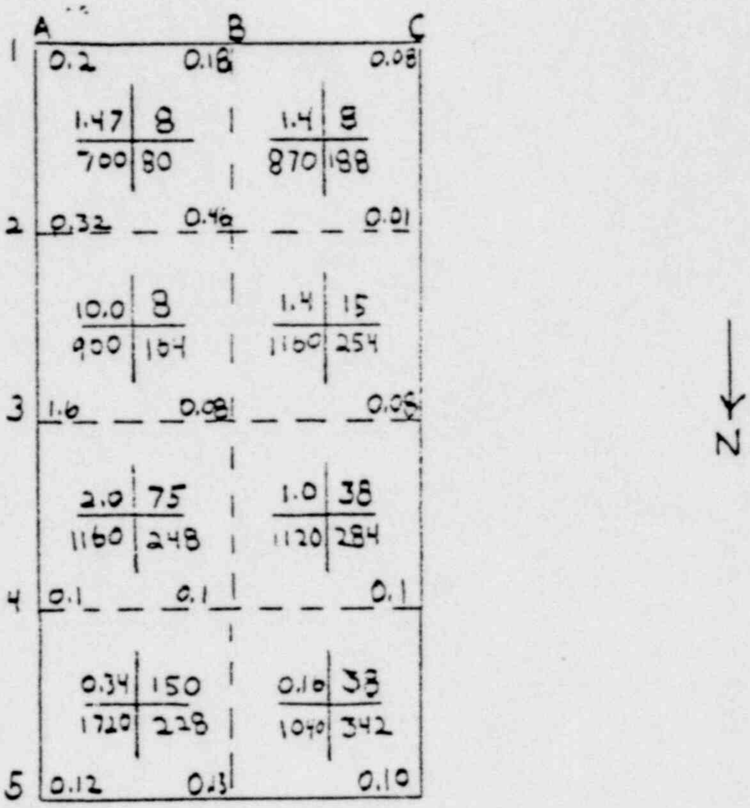
BLDG 9 BOX CAR LOAD AREA



BY ________ DATE ________ SUBJECT ______________________ SHEET NO. ______ OF ______

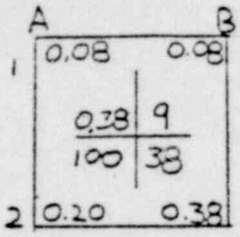
CHKD. BY YW DATE 2-11-77 JOB NO. 0-2265-P

BLDG. NO. 9 BASEMENT, ADJ. CAR LOAD AREA

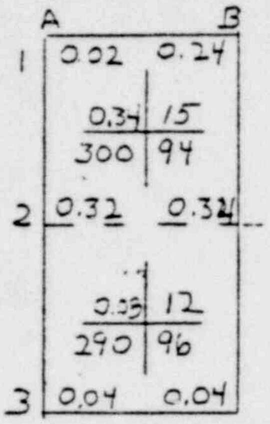


BY .... DATE .... SUBJECT .... SHEET NO. .... OF ......
CHKD. BY Hw DATE 2-11-77 JOB NO. 0-2265-P

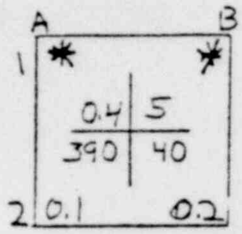
BLDG. NO. 9A SEPARATE ROOMS



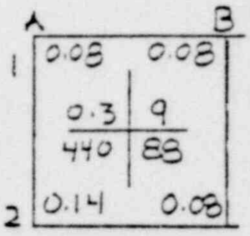
CONTROL LAB



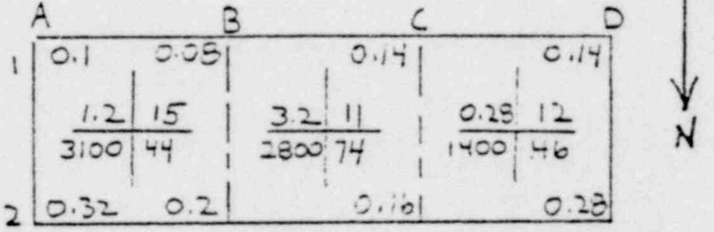
ELEVATOR LOADING AREA



OPEN BAY BIN AND DRUM STORAGE



S-W PIPE STORAGE ROOM



OPEN BAY GARAGE

* IN EXCESS OF 10.0 MR/HR

SMEAR AREA	LOOSE ALPHA IN DPM/100 CM²	LOOSE BETA/GAMMA IN DPM/100 CM²
CONTOL LAB		
1 SOUTH BRICK WALL	34	330
2 EAST WINDOW LEDGE	56	180
3 SOUTH WALL COUNTERTOP	52	300
4 WEST WALL SHELVES	116	300
5 NORTH WALL HEATING UNIT	34	250
ELEVATOR LOADING AREA		
1 TOP OF WOODEN ELEVATOR DOOR	240	1170
2 EAST WALL METAL LADDER	38	70
3 TOP OF EAST WALL LAB TABLE	156	730
4 ELECTRIC MOTOR	184	810
5 WEST FIBERGLASS WALL	52	170
6 EAST WALL WOODEN SHELVES	146	750

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BLDG. NO. 9A RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100 CM^2	LOOSE BETA/GAMMA IN DPM/100 CM^2
OPEN BAY AND DRUM STORAGE		
1 EAST WALL CRACK	24	MDA
2 SALT STORAGE BIN	10	MDA
3 METAL JUNK ON FLOOR..	98	610
4 NORTH WALL SHELVES	58	340
S-W PIPE STORAGE ROOM		
1 EAST WALL SHELVES	134	1480
2 BLOCK VALVES	30	200
3 WEST WALL PIPE RACKS	60	200
4 SOUTH WALL CONDUIT	56	140
OPEN BAY GARAGE		
1 WORKBENCH B2.1	54	290
2 OVERHEAD DOOR	128	520
3 STORAGE SHELVES A2.1	298	1120
4 WORK BENCH A2.3	374	1900
5 I BEAM 6' UP A2.4	266	1190
6 WHEELBARREL A2.6	252	1810

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BLDG. NO. 9 - ANNEX BUILDINGS

RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100 cm²	LOOSE BETA/GAMMA IN DPM./100 cm²
BLDG. 3E CAUSTIC TANK RM.		
CAUSTIC TANK A1.7 #1	86	1960
WATER FOUNTAIN A1.4 #2	44	1750
3C FRAME PRESS. RM. #3		
PRESS. BASE A1.3	62	1740
EAST WALL SUPPORT BEAM A1.6	28	1950
OFFICE I		
LIGHT FIXTURE	28	1350
OFFICE II		
SHELVES A2.0	44	1950
3D PROCESS RM.		
WORK TABLE A2.1	54	1800
METAL STAIRS A1.5	34	2010
LARGE BASIN B2.5	26	1980
WEST WINDOW SILL A2.9	14	1530
EUROPIUM PROCESS		
LAB TABLES E. A8	12	1670
LAB TABLES W. A9	40	1590
OVEN B2.4	16	1410
SUPER CEE RM.		
TABLES A1.4	60	1930
VENTS A2.1	18	1640
GRINDING MACHINE A2.8	62	1960
WAREHOUSE 3B		
WORK BENCH A1.7	22	1650
LOCKERS A2.8	22	1780
WINDOW SILL B1.7	42	1700
DIESEL PUMP B2.8	76	2260
LANTHIUM FURNACE 3A		
E-S FLOOR, CORNER A1.0	674	5430
ELECTRIC BOX A1.3	1462	8120
HEATING FURNANCE RM.		
CONCRETE PLATFORM A1.2	22	1650
TANK A1.8	30	1660

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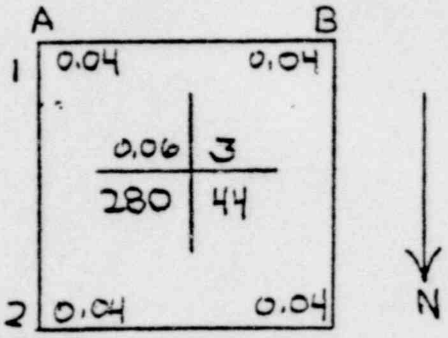
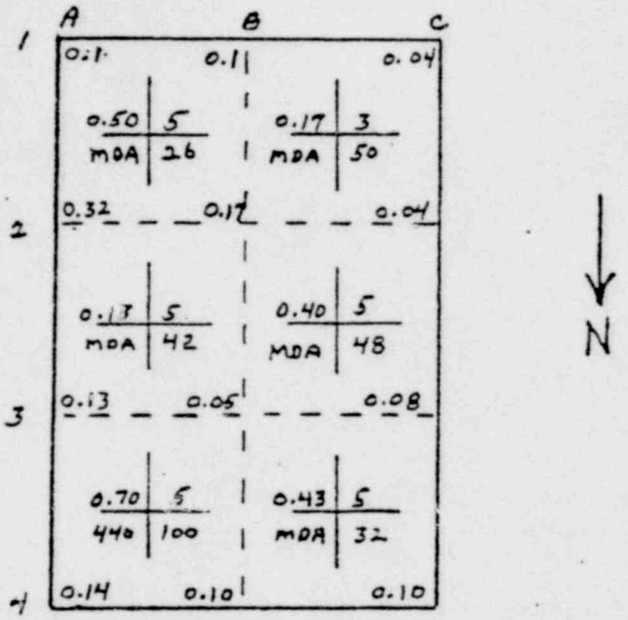
BLDG. NO. 10



RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100 cm²	LOOSE BETA/GAMMA IN DPM/100 cm²
1 WEST WALL	24	260
2 EAST WALL	32	280

BLDG. NO. 11 MISC. STORAGE



RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100cm²	LOOSE BETA/GAMMA IN DPM/100 cm²
1. TOP OF OVERHEAD DOOR	30	MDA
2. SHELVES NORTH END	52	MDA
3. " " "	116	390
4. " " "	318	590
5. SHELVES SOUTH END	66	170
6. " " "	54	MDA
7. " " "	6	MDA
8. FLOOR CRACK A1.9	26	MDA
9. FLOOR CRACK A2.7	50	MDA
10. FLOOR CRACK B3.4	112	260

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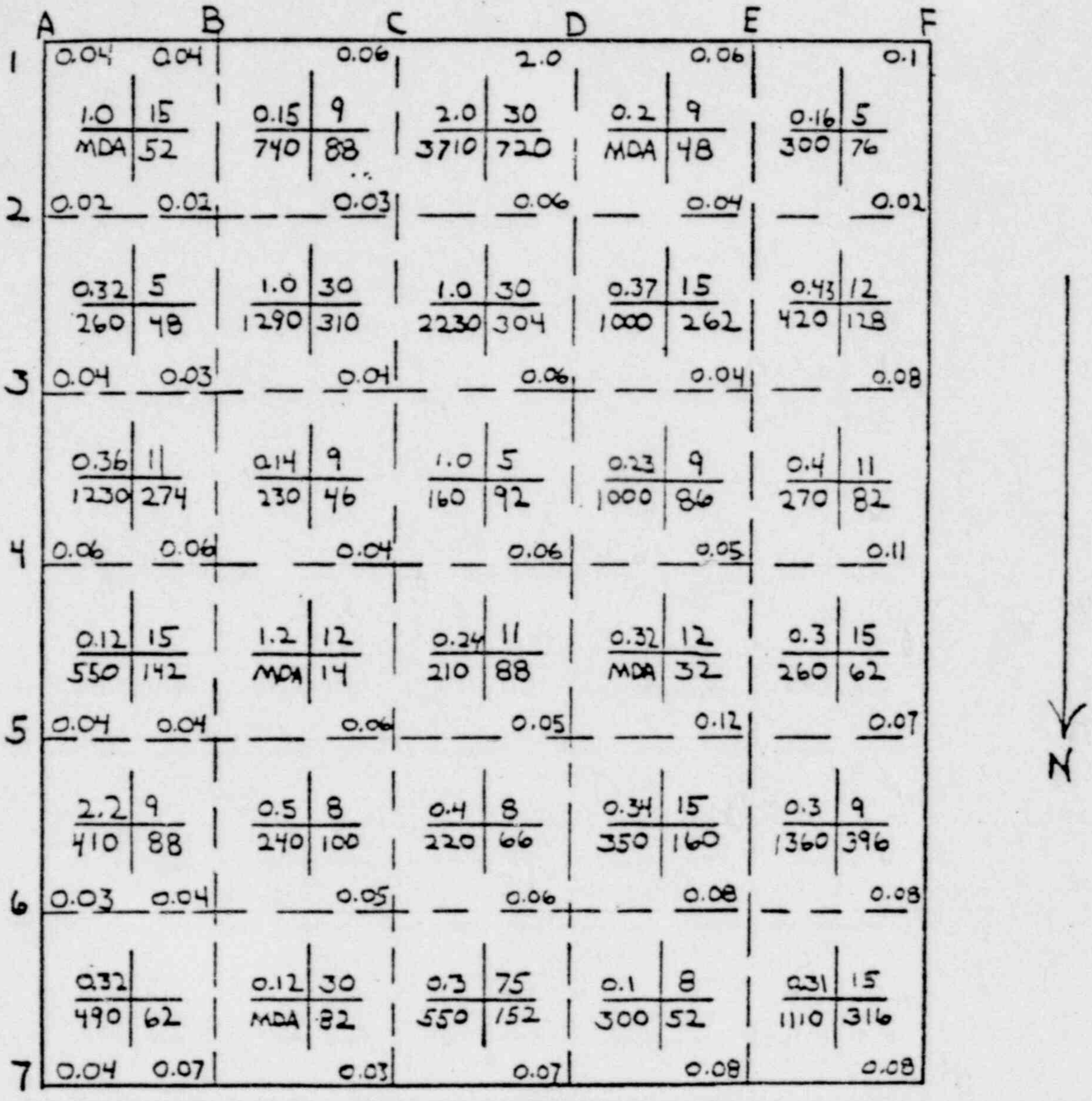
BLDG. NO. 12



	A	B	C	D	E	F
1	0.04	0.04	0.06	2.0	0.06	0.1
	1.0 15 MDA 52	0.15 9 740 88	2.0 30 3710 720	0.2 9 MDA 48	0.16 5 300 76	
2	0.02	0.02	0.03	0.06	0.04	0.02
	0.32 5 260 48	1.0 30 1290 310	1.0 30 2230 304	0.37 15 1000 262	0.43 12 420 128	
3	0.04	0.03	0.04	0.06	0.04	0.08
	0.36 11 1230 274	0.14 9 230 46	1.0 5 160 92	0.23 9 1000 86	0.4 11 270 82	
4	0.06	0.06	0.04	0.06	0.05	0.11
	0.12 15 550 142	1.2 12 MDA 14	0.24 11 210 88	0.32 12 MDA 32	0.3 15 260 62	
5	0.04	0.04	0.06	0.05	0.12	0.07
	2.2 9 410 88	0.5 8 240 100	0.4 8 220 66	0.34 15 350 160	0.3 9 1360 396	
6	0.03	0.04	0.05	0.06	0.08	0.08
	0.32 490 62	0.12 30 MDA 82	0.3 75 550 152	0.1 8 300 52	0.31 15 1110 316	
7	0.04	0.07	0.03	0.07	0.08	0.08

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BLDG. NO. 12 RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100 cm²	LOOSE BETA/GAMMA IN DPM/100 cm²
1 LKR SOUTH EAST CORNER	80	210
2 FLOOR CRACK D2.9	106	470
3 TOP OF SOUTHWEST DOOR	120	480
4 TOP OF NORTHWEST DOOR	208	1160
5 METAL SEWAGE COVER/OFFICE	40	290
6 TOP OF LIGHT FIXTURE/OFFICE	194	820
7 FLOOR CRACK D6.5	48	MDA
8 NORTHEAST STORAGE SHELVES	178	630
9 FLOOR SEAM A3.8	262	1220
10 FLOOR SEAM A5.6	186	1120
11 FLOOR SEAM C1.4	118	480
12 FLOOR SEAM D5.2	210	560
13 EAST WALL F3.5	48	MDA
14 WEST WALL A4.0	30	200
15 FLOOR SEAM F6.7	320	1210

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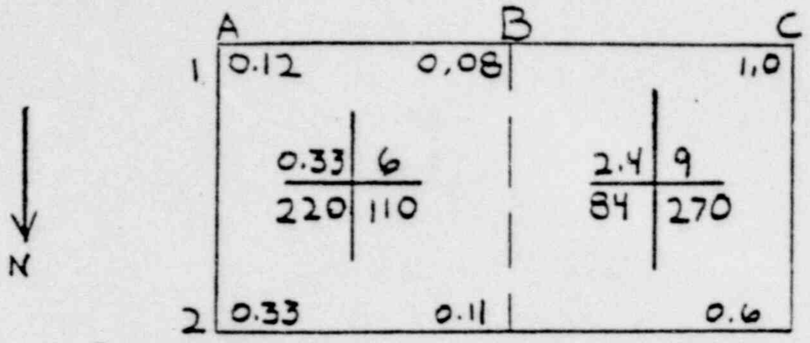
BLDG. NO. 14



RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100cm²	LOOSE BETA/GAMMA IN DPM/100cm²
1 TOP OF FILTER B1.2	20	MDA
2 FLOOR GRATING DOORWAY	182	690
3 FLOOR CRACK C1.4	74	230
4 LEVELOMETER C2 PIT	160	780
5 OPEN VALVE SUCTION PIPE	236	980
6 WALL OF SOUTH PIT B1	812	1119

ATCOR INC.
Elmsford, N. Y. 10523

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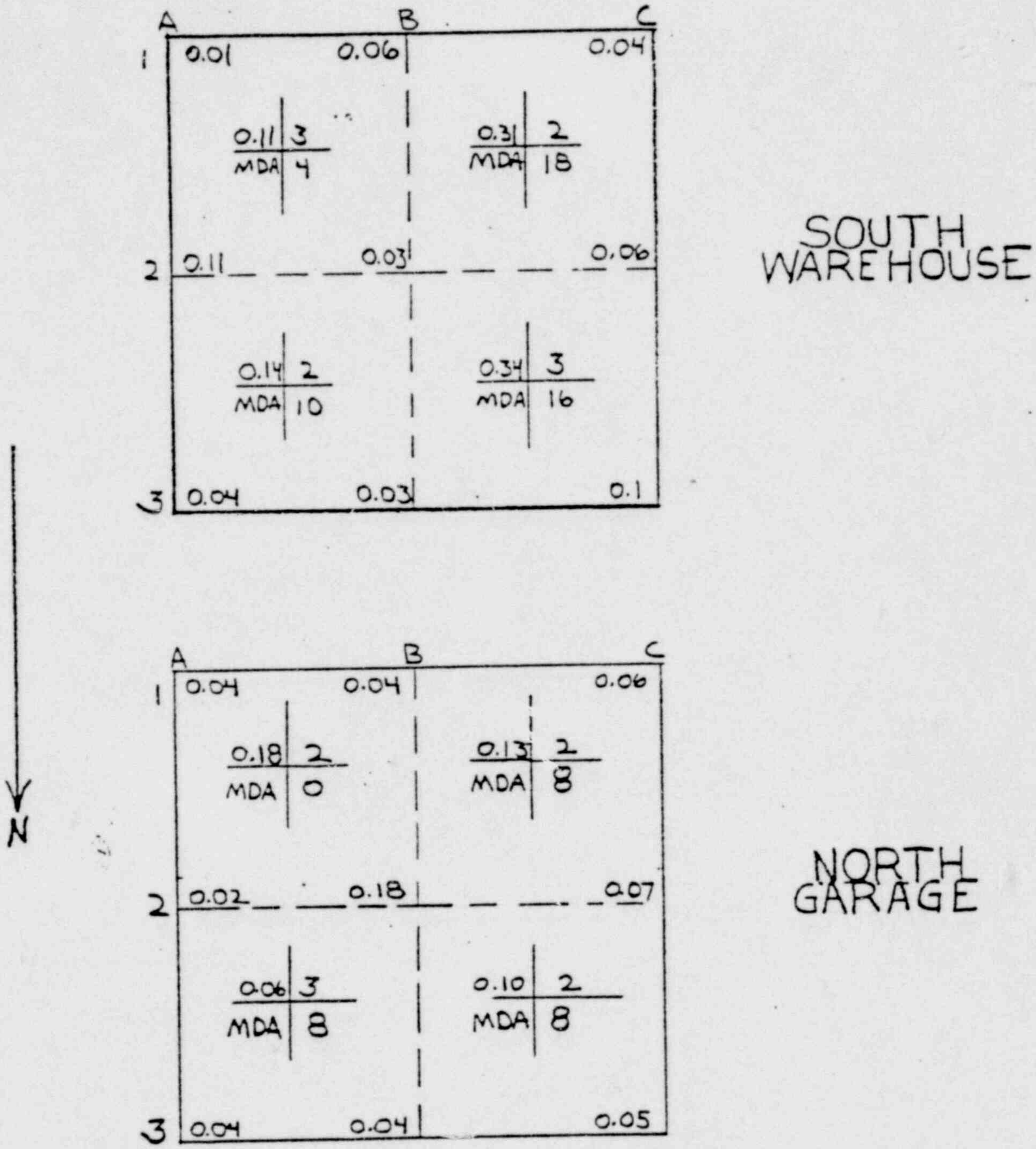
BLDG. NO. 20



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BLDG. NO. 20 RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100cm²	LOOSE BETA/GAMMA IN DPM/100 cm²
SOUTH WAREHOUSE		
1 SOUTH WALL	4	MDA
2 NORTH WOOD DOOR	6	MDA
3 EAST WALL	8	MDA
4 FLOOR CORNER S-E	4	MDA
NORTH GARAGE		
1 WEST WORK BENCH	10	MDA
2 SOUTH WOOD DOOR	6	MDA
3 EAST WALL-FLOOR SEAM	6	110
4 GREASE PIT	18	220

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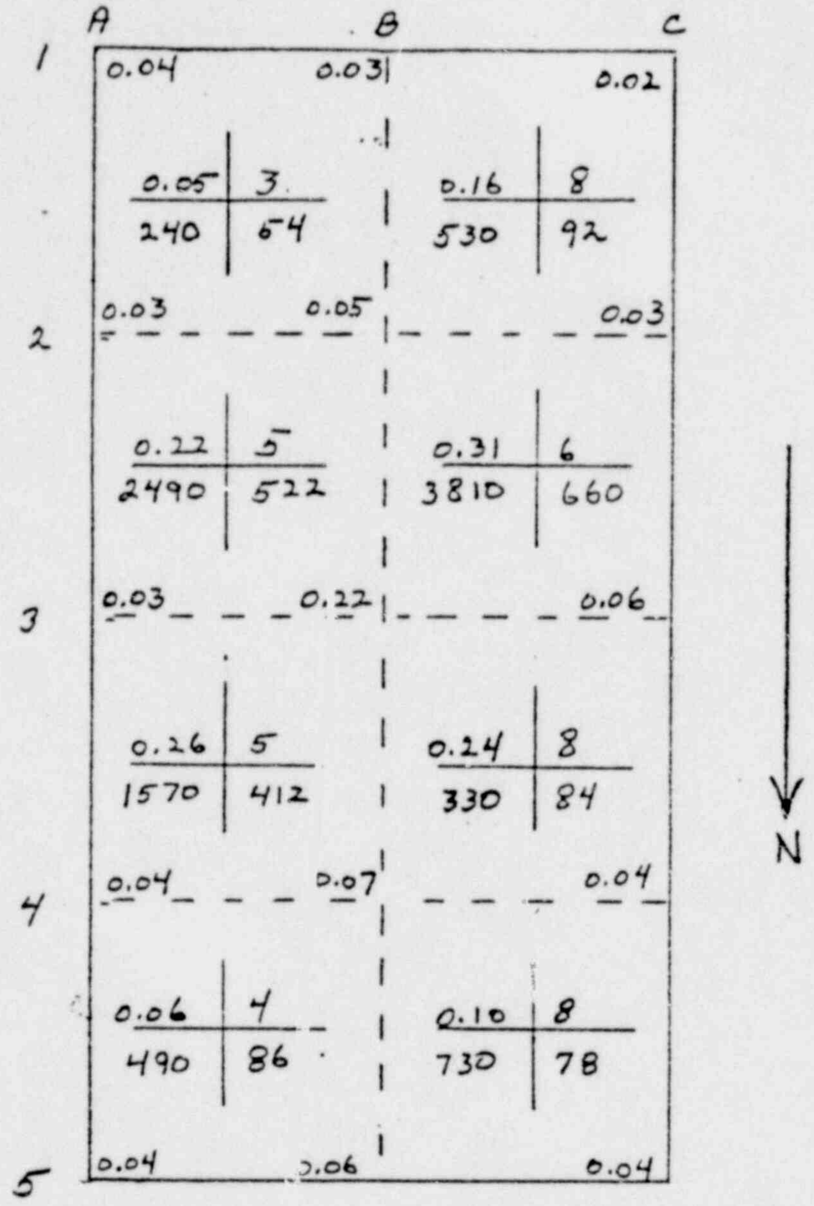
BUILDING NO. 21 - GROUND FLOOR



ATCOR INC.
Elmsford, N. Y. 10523

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BUILDING NO. 21 - GROUND FLOOR

RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100 cm²	LOOSE BETA/GAMMA IN DPM/100 cm²
1 SUMP B3.1	152	940
2 FLOOR TROUGH B1.1	226	860
3 FLOOR TROUGH B2.5	356	1110
4 FLOOR TROUGH B3.5	220	990
5 FLOOR TROUGH B4.5	232	1040
6 STAIRS TO 2ND FLOOR C1.1	164	700
7 FLOOR DRAIN A1.1	286	970
8 DOOR SILL B5.1	162	870

ATCOR INC.
Elmsford, N. Y. 10523

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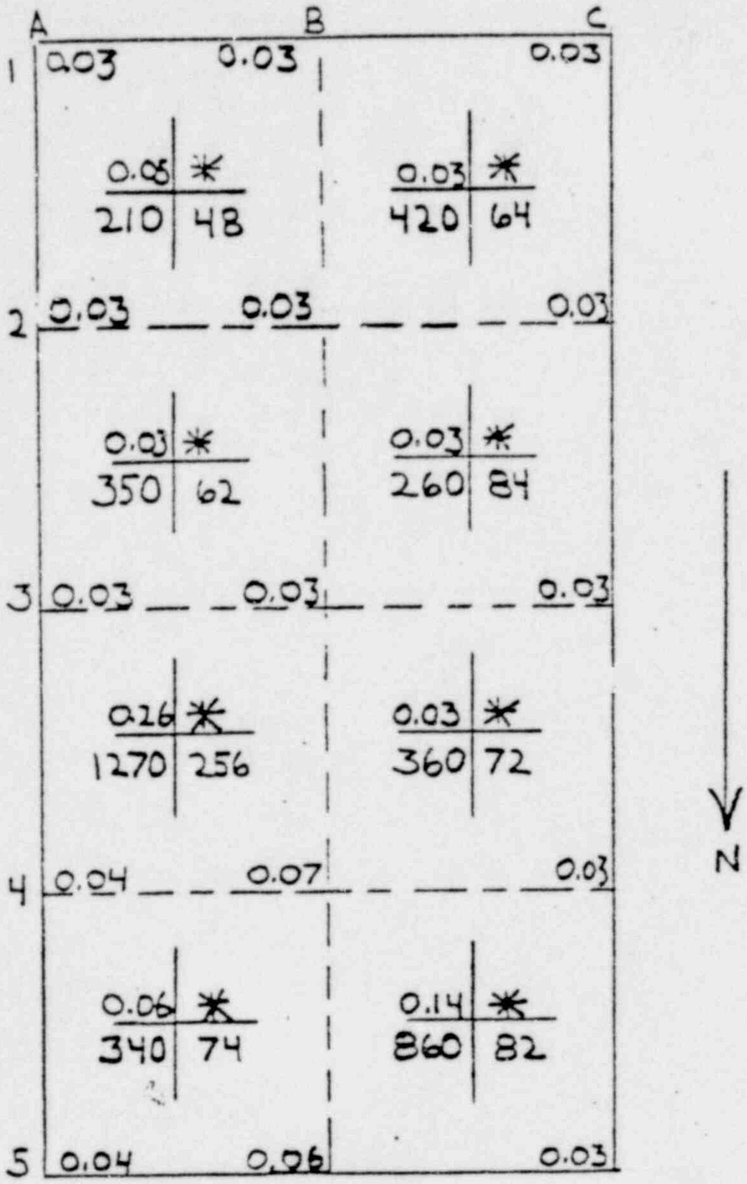
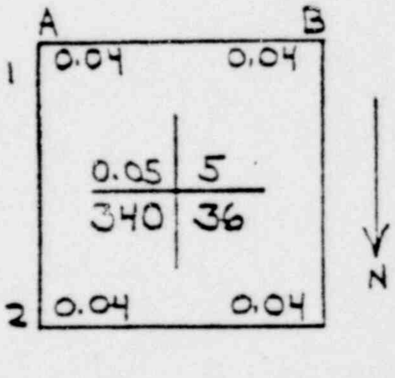
BUILDING NO. 21 - SECOND FLOOR



* NOTE OPEN GRADING FLOOR
NO FIXED ALPHA READING

X-RAY
LAB



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BUILDING NO. 21 - SECOND FLOOR

RANDOM SMEARS

SMEAR AREA	LOOSE ALPHA IN DPM/100cm²	LOOSE BETA/GAMMA IN DPM/100cm²
1 A1.3 FLOOR DRAIN	156	430
2 A2.4 GRADING	218	390
3 WEST WALL A 4.4	244	370
4 A4.3 FLOOR DRAIN	176	290
5 SOUTH WALL	284	510
6 NORTH WALL	244	470
7 B3.6 GRADING	252	480
8 C4.5 BATHROOM WALL	168	360
X-RAY LAB		
1 NORTH WALL	96	340
2 FLOOR A1.5	140	520

REPORT OF ANALYSIS

FEBRUARY 16, 1977

REPORT OF ANALYSIS

REVISION [illegible]/77
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WORK ORDER NUMBER	CUSTOMER P.O. NUMBER	DATE RECEIVED	DELIVERY DATE	PAGE
3-2419		02/04/77	02/16/77	1

ATCOR INC
PARK HALL
PEEKSKILL N Y 10566

S O I L

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	COLLECTION-DATE START TIME	COLLECTION-DATE STOP DATE	COLLECTION-DATE STOP TIME	NUCLIDE	ACTIVITY (pCi/gm DRY)	NUCL-UNIT-% ASH-WGHT-% * U/M **	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS	LAB.
32248	S THORIUM ORE		02/08				BE-7	L.T. 1. E 01		02/09			4
	(Monazite Ore)						K-40	2.44+-0.24E 02		02/09			4
							MN-54	L.T. 1. E 00		02/09			4
							CO-58	L.T. 1. E 00		02/09			4
							CO-60	L.T. 1. E 00		02/09			4
							ZR-95	L.T. 3. E 00		02/09			4
							RU-103	L.T. 2. E 00		02/09			4
							RU-106	L.T. 1. E 01		02/09			4
							I-131	L.T. 3. E 00		02/09			4
							CS-134	L.T. 2. E 00		02/09			4
							CS-137	L.T. 2. E 00		02/09			4
							BA-140	L.T. 6. E 00		02/09			4
							CE-141	L.T. 2. E 00		02/09			4
							CE-144	L.T. 7. E 00		02/09			4
							RA-226	1.64+-0.16E 02		02/09			4
							AC-228	5.10+-0.51E 03		02/09			4
							PB-212	4.26+-0.43E 03		02/09			4
							TL-208	4.50+-0.45E 03		02/09			4
							PB-214	2.39+-0.24E 02		02/09			4
							BI-214	2.66+-0.27E 02		02/09			4
32249	S AFRICAN ORE		02/08				BE-7	L.T. 8. E 00		02/09			4
							K-40	3.17+-0.32E 02		02/09			4
							MN-54	L.T. 1. E 00		02/09			4
							CO-58	L.T. 8. E-01		02/09			4
							CO-60	L.T. 7. E-01		02/09			4
							ZR-95	L.T. 2. E 00		02/09			4
							RU-103	L.T. 1. E 00		02/09			4
							RU-106	L.T. 9. E 00		02/09			4
							I-131	L.T. 2. E 00		02/09			4
							CS-134	L.T. 1. E 00		02/09			4
							CS-137	L.T. 1. E 00		02/09			4
							BA-140	L.T. 3. E 00		02/09			4
							CE-141	L.T. 1. E 00		02/09			4
							CE-144	L.T. 4. E 00		02/09			4
							RA-226	1.19+-0.12E 02		02/09			4

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REPORT OF ANALYSIS

WORK ORDER NUMBER	CUSTOMER P.O. NUMBER	DATE RECEIVED	DELIVERY DATE	PAGE 2
3-2419		02/04/77	02/16/77	

ATCOR INC
PARK HALL
PEEKSKILL N Y 10566

SOIL

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (pCi/gm DRY)	NUCL-UNIT-% ASH-WGHT-% * U/M **	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS	LAB.
32249	S AFRICAN ORE		02/08				AC-228	5.33+-0.53E 03		02/09			4
							PB-212	2.73+-0.27E 03		02/09			4
							TL-208	3.98+-0.40E 03		02/09			4
							PB-214	1.83+-0.18E 02		02/09			4
							BI-214	2.18+-0.22E 02		02/09			4
32250	S BLDG 2 DRAIN SYST.		02/08				BE-7	L.T. 4. E 00		02/09			4
							K-40	4.56+-0.46E 01		02/09			4
							MN-54	L.T. 5. E-01		02/09			4
							CO-58	L.T. 4. E-01		02/09			4
							CO-60	L.T. 4. E-01		02/09			4
							ZR-95	L.T. 9. E-01		02/09			4
							RU-103	L.T. 4. E-01		02/09			4
							RU-106	L.T. 4. E 00		02/09			4
							I-131	L.T. 7. E-01		02/09			4
							CS-134	L.T. 7. E-01		02/09			4
							CS-137	L.T. 5. E-01		02/09			4
							BA-140	L.T. 2. E 00		02/09			4
							CE-141	L.T. 5. E-01		02/09			4
							CE-144	L.T. 2. E 00		02/09			4
							RA-226	1.87+-0.19E 01		02/09			4
							AC-228	6.76+-0.68E 02		02/09			4
							PB-212	5.29+-0.53E 02		02/09			4
							TL-208	5.77+-0.58E 02		02/09			4
							PB-214	1.84+-0.18E 01		02/09			4
							BI-214	1.51+-0.15E 01		02/09			4

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RUN DATE 02/15/77

REPORT OF ANALYSIS

PAGE 3

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3-2419		02/04/77	02/16/77

ATCOR INC
PARK HALL
PEEKSKILL N Y 10566

SOIL

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	TIME	STOP DATE	TIME	NUCLIDE	ACTIVITY (pCi/gm DRY)	NUCL-UNIT-% ASH-WGHT-% * G/M **	MID-COUNT TIME DATE	TIME	VOLUME - UNITS	LAB.
32251	S BLDG 9B FIN P RR T (Finished Products Area Sampled at Railroad Tracks)		02/08				BE-7	L.T. 1. E 01		02/09			4
							K-40	1.92+-0.19E 02		02/09			4
							MN-54	L.T. 1. E 00		02/09			4
							CO-58	L.T. 1. E 00		02/09			4
							CO-60	L.T. 1. E 00		02/09			4
							ZR-95	L.T. 2. E 00		02/09			4
							RU-103	L.T. 1. E 00		02/09			4
							RU-106	L.T. 1. E 01		02/09			4
							I-131	L.T. 2. E 00		02/09			4
							CS-134	L.T. 2. E 00		02/09			4
							CS-137	L.T. 1. E 00		02/09			4
							BA-140	L.T. 4. E 00		02/09			4
							CE-141	L.T. 1. E 00		02/09			4
							CE-144	L.T. 4. E 00		02/09			4
							RA-226	4.61+-0.46E 02		02/09			4
							AC-228	2.88+-0.29E 03		02/09			4
							PB-212	2.04+-0.20E 03		02/09			4
							TL-208	2.36+-0.24E 03		02/09			4
							PB-214	4.74+-0.47E 02		02/09			4
							BI-214	4.18+-0.42E 02		02/09			4
32252	S BLDG 5 MEZAN INE (Mezzanine Sample taken in Grid A-5, pg 24, Section 3.1)		02/08				BE-7	L.T. 7. E 01		02/14			4
							K-40	2.40+-0.24E 02		02/14			4
							MN-54	L.T. 7. E 00		02/14			4
							CO-58	L.T. 6. E 00		02/14			4
							CO-60	L.T. 5. E 00		02/14			4
							ZR-95	L.T. 1. E 01		02/14			4
							RU-103	L.T. 9. E 00		02/14			4
							RU-106	L.T. 6. E 01		02/14			4
							I-131	L.T. 2. E 01		02/14			4
							CS-134	L.T. 8. E 00		02/14			4
							CS-137	L.T. 8. E 00		02/14			4
							BA-140	L.T. 3. E 01		02/14			4
							CE-141	L.T. [illegible]		02/14			4
							CE-144	L.T. 4. E 01		02/14			4
							RA-226	2.43+-0.24E 03		02/14			4
							AC-228	5.05+-0.51E 03		02/14			4
							PB-212	4.62+-0.46E 03		02/14			4
							TL-208	5.35+-0.54E 03		02/14			4
							PB-214	2.95+-0.30E 03		02/14			4
							BI-214	2.54+-0.25E 03		02/14			4

REVISION [illegible]
RUN DATE 02/15/77

REPORT OF ANALYSIS

WORK ORDER NUMBER	CUSTOMER P.O. NUMBER	DATE RECEIVED	DELIVERY DATE	PAGE 4
3-2419		02/04/77	02/16/77	

ATCOR INC
PARK MALL
PEEKSKILL N Y 10566

SOIL

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (pCi/gm DRY)	NUCL-UNIT-% ASH-WGHT-% * U/M **	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS	LAB.
													4
32253	S BLDG 3 DRAIN SYST.		02/08				BE-7	L.T. 3. E 00		02/14			4
							K-40	L.T. 3. E 00		02/14			4
							MN-54	L.T. 4. E-01		02/14			4
							CO-58	L.T. 3. E-01		02/14			4
							CO-60	L.T. 3. E-01		02/14			4
							ZR-95	L.T. 8. E-01		02/14			4
							RU-103	L.T. 4. E-01		02/14			4
							RU-106	L.T. 3. E 00		02/14			4
							I-131	L.T. 1. E 00		02/14			4
							CS-134	L.T. 5. E-01		02/14			4
							CS-137	L.T. 4. E-01		02/14			4
							BA-140	L.T. 2. E 00		02/14			4
							CE-141	L.T. 5. E-01		02/14			4
							CE-144	L.T. 2. E 00		02/14			4
							RA-226	1.04+-0.11E 01		02/14			4
							AC-228	9.71+-0.97E 01		02/14			4
							PB-212	6.07+-0.61E 01		02/14			4
							TL-208	8.08+-0.81E 01		02/14			4
							PB-214	1.59+-0.16E 01		02/14			4
							BI-214	8.38+-0.84E 00		02/14			4

LAST PAGE OF REPORT

APPROVED BY K. ROACH 02/15/77
K Roach

SEND 1 COPIES TO AT100S

2 - GAS LAB. 3 - RADIO CHEMISTRY LAB. 4 - Ge(Li) GAMMA SPEC LAB. 5 - TRITIUM GAS/L.S. LAB.

All activities are referenced to mid-count-time."

EVALUATIONS AND RECOMMENDATIONS RELATING TO REPORTS ON THE CURRENT RADIOLOGICAL SITUATION AND DECOMMISSIONING OPTIONS FOR THE KERR-MC GEE RARE EARTH FACILITY IN WEST CHICAGO

by

Kenneth W. Skrable

February 9, 1978

INTRODUCTION

Following a briefing on the Kerr-McGee Rare Earth facility that I received from Mr. Levesque of ATCOR on February 4, 1978, I reviewed the Argonne(1) and the ATCOR(2) reports on the current radiological situation and the ATCOR(3) report on decommissioning options. After reviewing these reports, I discussed with Mr. Levesque specific sections of the reports including the decommissioning options. In addition, I reviewed applicable sections of various references (4-18) in formulating my recommendations.

My recommendations take into consideration the current and future radiological situations possible under the various decommissioning options, the cost effectiveness of the various decommissioning options within the framework of applicable regulations and what is deemed to be as low as is reasonably achievable (ALARA), and the current social/political climate surrounding the Kerr-McGee facility.

DISCUSSION

1. Radiological Hazards

The mining and milling of uranium and thorium pose many of the same types of internal and external radiological hazards both during and post operation. Analyses of ores and samples of contamination at the Kerr-McGee facility indicate the presence of considerable uranium as well as thorium waste products (p. 62-65 of reference 2). In addition, there appears to be considerable ^{40}K activity. However, activity associated with thorium waste products is about a factor of 5 to 20 times that for uranium or ^{40}K, and the major hazards would appear to be due to thorium and its daughters. Both uranium and thorium support a whole host of radioactive daughter products that emit alpha or beta radiation often accompanied by gamma radiation. Waste products contain most of all the daughter products as well as some unseparated uranium and thorium. The long term hazards of uranium and thorium wastes, if completely depleted of the long lived uranium and thorium parents, differ greatly. In the case of uranium, two long lived radionuclides, 8 x 10^4y ^{230}Th from the ^{238}U series and 3.25 x 10^4y ^{231}Pa from the ^{235}U series, will continue to support most of the radioactivity originally present in the ore. For thorium, the gross radioactivity will decay relatively rapidly with the 6.7y half-life of ^{228}Ra, the daughter of ^{232}Th. Of course, ores not completely depleted of the long lived 1.41 x 10^{10}y ^{232}Th will finally present a relatively constant hazard associated with the concentration of ^{232}Th. Tables of the applicable radioactive series have been reproduced from reference 19 and are enclosed with this report.

Current and future internal and external radiological health hazards associated with contaminated soil depend not so much on the total quantity of radioactivity present, but more on the activity concentrations and types of radionuclides present. The greater the concentrations, the greater will be the hazards. Hazards associated with contaminated surfaces will also decrease with the specific activity of the contaminant, more so for internal hazards than for external hazards, which will depend also on the total activity present on contaminated surfaces.

Waste products of uranium and thorium milling operations lead to the emanation and release to the air of inert radiogases comprising the naturally occurring radon isotopes: actinon or 3.96 s ^{219}Rn from the actinium series (^{235}U), radon or 3.82 d ^{222}Rn from the uranium series (^{238}U), and thoron or 55 s ^{220}Rn from the thorium series (^{232}Th). Each radiogas decays to a number of short lived radioactive products which pose a hazard to the bronchial epithelium of the respiratory tract, due principally to the alpha radiation emitted by the deposited short lived daughter products. Alpha radiation emitted by the radon isotope itself or any immediate short lived daughter which may be present in the air adjacent to the surface of the bronchi also contribute to the dose, but normally to a lesser extent.

The emanation rate of these gases from a given mass of material depends on many factors including the size of the emanating particles of the material, the volume to surface ratio of the bulk of the emanating material, the absolute pressure, the relative humidity and moisture content of the material, and the half-life of the radon isotope. Because of the long ^{222}Rn half-life, which provides for a long time for it to diffuse through the internal structure of a body of emanting material to its outer surface, the emanation rate of ^{222}Rn is orders of magnitude higher than that of ^{219}Rn and ^{220}Rn, all other factors being equal. In addition, because of the lower abundance of ^{235}U (0.72%) in comparison to ^{238}U (99.27%), the emanation rate of ^{219}Rn from uranium bearing ores is negligible in comparison to that of ^{222}Rn. The emanation rate of ^{222}Rn from a given surface of contaminated soil may be reduced by covering the surface with compacted uncontaminated soil. Six feet of soil is estimated to reduce the emanation rate by 97%. Ten inches of clay is estimated to reduce the emanation rate of ^{222}Rn by a factor of approximately 100 (p. 10-3 of reference 6). The emanation rate of the other much shorter lived radon isotopes for these same coverings would be reduced by many orders of magnitude.

A concentration of 3×10^{-9}µCi cm^{-3} of ^{222}Rn in equilibrium with its short lived daughter products has been estimated to cause a dose to the bronchial epithelium of the lungs of chronically exposed persons of 12 rem y^{-1} (p. 17 of reference 16 and p. 17 of reference 17). It is interesting to note that this same concentration is the regulatory limit given in Table II, Column 1, Appendix B of 10 CFR 20 for effluent to unrestricted areas. This corresponds to about 1/30 of a working level (WL), which standard arises from the excess lung cancer deaths observed in uranium miners (p. 138 reference 5). One working level equals 1.3×10^5MeV/liter of potential alpha emission by the short lived ^{222}Rn daughter atoms and corresponds to a concentration of 10^{-7}µCi cm^{-3} of ^{222}Rn when it is in equilibrium with its short lived daughter products. This concentration of 10^{-7}µCi cm^{-3} was the previous concentration limit given for occupational exposure (10 CFR 20, Table I, Column 1, Appendix B as of January 1, 1975). The current occupational MPC value has been reduced to 3×10^{-8}µCi cm^{-3} for ^{222}Rn. The factor 1/30 is the approximation factor used in converting from an occupational MPC value to one for unrestricted areas (i.e., non-occupational MPC value); however, it has not been applied in the recent listing in Appendix B of 10 CFR 20 for the non-occupational MPC. Only a factor of 10 has been applied. The limiting concentration for unrestricted areas may be obtained from the continuous <u>occupational</u> maximum permissible concentration of 10^{-8}µCi cm^{-3} given by ICRP (p. 77 for reference 15) by dividing this value by 10. This yields an MPC value for unrestricted areas of $10^{-9}\mu\ cm^{-3}$, which is 3 times lower than the regulatory value cited above in 10 CFR 20. This value obtained from ICRP would presumably yield a dose of 1.5 rem y^{-1} to the bronchial epithelium due principally to the alpha radiation from the free atoms of ^{218}Po (p. 23 of reference 15). Thus, it would appear that the current non-occupational MPC value listed in Appendix B of 10 CFR 20 is a factor of 3 too high. Footnote 3 in Appendix B of 10 CFR 20 appears to contradict the current non-occupational MPC value listed in Appendix B. The historical development of radon and thoron MPC values has been reviewed by Albert (p. 138 of reference 5). The discrepancies noted here appear to be related to the relaxation of the occupational MPC value for the uranium mining industry:

> "During the early 1950's, the MPC in air of 10^{-11} Ci/liter was found to be excessively restrictive from a technical and economic standpoint in the Colorado Plateau uranium mines. Because of the need for uranium, there was strong pressure to relax the MPC for radon. It was discovered at this time that radon daughters were much more hazardous than radon gas, and the U.S. Public Health Service adopted a "working level" for radon of 10^{-10} Ci/liter of the alpha-emitting daughters, radium A and radium C."

Although the occupational MPC value has since been reduced, the non-occupational MPC value has remained at the same value of $3 \times 10^{-9}\mu Ci\ cm^{-3}$, which possibly reflects the fact that elevated concentrations of radon corresponding to this concentration have been observed in the environment of uranium mines and mills (See reference 5, 16 and 17).

The natural concentration of ^{226}Ra in various soils and rocks averages about 0.7 pCi/g (p. 171 of reference 20). It has been estimated that ^{222}Rn born from the decay of ^{226}Ra emanates from soil at an average rate of 1.4 ± 0.73 pCi/m^2/sec·(p. 179 of reference 20). The concentration of ^{222}Rn in the outdoor atmosphere depends on its emanation rate from the soil and meteorological factors as well. Concentrations have been shown to vary by factors of 100 from one location to another and from one time to another at the same location (p. 179 of reference 20). The concentration of ^{222}Rn has been reported to be 50 to 100 times greater than the ^{220}Rn concentration in the outdoor atmosphere. The ^{222}Rn concentration averages from 0.1 to 0.5 pCi/liter (1 to 5 x 10^{-10}μCi cm^{-3}) throughout the world (p. 180 of reference 20). The ^{222}Rn concentration inside buildings is somewhat higher and in round numbers may be taken as 0.5 pCi/liter on the average (5 x 10^{-10}μCi cm^{-3}); the corresponding figure for ^{220}Rn may be taken as 0.02 pCi/liter (2 x 10^{-11}μCi cm^{-3}) (p. 179 of reference 20).

Concentrations of ^{222}Rn in the Grants mineral belt of New Mexico have been measured at various locations (See reference 17). The highest radon concentrations in ambient air were measured in the Ambrosia Lake area where there is an active mill, numerous active mines, and an inactive mill and associated tailings pile. The highest radon concentration measured at any of the sampling locations was 6.6 pCi/liter (6.6 x 10^{-9}μCi cm^{-3}), with a monthly average of 3.6 pCi/liter (3.6 x 10^{-9}μCi cm^{-3}) (p. 15 of reference 17). These levels were concluded to be in excess of typical background levels (p. 1 of reference 17).

The estimated average radiation dose to the bronchial epithelium of the lungs of persons from radon emission is about 8 rem per year at 50 meters from the edge of a uranium mill tailings pile, 0.3 rem per year at 1 km, and about 0.1 rem per year at 2.2 km (p. 25 of reference 16). Average incremental ^{222}Rn exposure concentrations due to the tailings pile emanation at these same distances would be respectively 2 x 10^{-9}μCi cm^{-3}, 7.5 x 10^{-11}μCi cm^{-3}, and 2.5 x 10^{-11}μCi cm^{-3}, all of which are below the regulatory limit of 3 x 10^{-9}μCi cm^{-3}.

Thoron (^{220}Rn) normally does not present a problem in mining and milling operations provided reasonable care is taken. The highest thoron concentrations (about 1.8 x 10^{-6}μCi cm^{-3}) are found near the stores of finished thorium nitrate (p. 155 of reference 5). The regulatory occupational MPC value for thoron is 3 x 10^{-7}μCi cm^{-3} and the MPC value for unrestricted areas is 1 x 10^{-8}μCi cm^{-3} (10 CFR 20, Appendix B). The same values may be obtained from the ICRP report (p. 77 of reference 15). In most cases, the thoron decay products, 10.6 h ^{212}Pb and its daughters will not be in equilibrium with thoron because of its short half-life of 55 seconds. In a room of volume "V", which is ventilated at a flow rate "F", the activity concentration of ^{212}Pb will be reduced below that of ^{220}Rn. If ventilation and radioactive decay are assumed to be the only removal mechanisms, and if it is further assumed that there is uniform mixing in the volume, then the relationship in the steady state activity concentrations may be represented by:

$$\frac{C_{^{212}\mathrm{Pb}}}{C_{^{220}\mathrm{Rn}}} = \frac{\lambda_{^{212}\mathrm{Pb}}}{F/V} = \frac{6.51 \times 10^{-2}\mathrm{h}^{-1}}{F/V}$$

For a ventilation of 5 air changes per hour so that F/V is 5 h^{-1}, the activity concentration of ^{212}Pb would be only 1.30% of that for 55 s ^{220}Rn. In contrast to this relationship, at some point downwind from a point source of 55 s ^{220}Rn, the activity concentration of ^{220}Rn may rapidly approach zero so that its activity concentration may be much less than that for ^{212}Pb. In either situation cited above, it may be difficult if not impossible to relate a measured ^{212}Pb concentration to that of ^{220}Rn. In the first case cited, if one were to assume secular equilibrium then the ^{220}Rn concentration would be underestimated by the factor 76.8. Secular equilibrium in this case must be understood with respect to a constant emanation rate of ^{220}Rn into the confined space. The assumption of secular equilibrium would yield an underestimate of the hazard to the lung, since the MPC value for ^{220}Rn is based upon the dose due to ^{212}Pb and its daughters in equilibrium with ^{220}Rn plus the dose due to alpha radiation from ^{220}Rn itself and its vary short lived daughter, 0.15 s ^{216}Po (P. 97 and p. 138-140 of reference 5). Thus, if filter samples are used to estimate the ^{212}Pb concentration, then it would be more conservative to apply the most restrictive MPC values for ^{212}Pb: 2×10^{-8}µCi cm^{-3} for occupational and 6×10^{-10}µCi cm^{-3} for unrestricted areas (10 CFR 20, Appendix B). The same values may be obtained from the ICRP report (P. 75 of reference 15) for which the kidney is the critical organ. Furthermore, there would be no need to consider the inhalation and contribution of ^{212}Pb daughter products since their MPC values for the kidney as the critical organ are much less than that for ^{212}Pb itself. However, the ICRP MPC values for ^{212}Pb based upon the lung as the critical organ are not much different than those when the kidney is assumed to be the critical organ. The lung MPC values for air given by ICRP (p. 76 of reference 15) for ^{212}Pb and ^{212}Bi for insoluble material are the same values listed in Appendix B 10 CFR 20 and are given and compared to values for ^{220}Rn:

	Restricted Areas (Occupational) (μCi cm^{-3})	Non-restricted Areas (Non-occupational) (μCi cm^{-3})
^{212}Pb	2×10^{-8}	7×10^{-10}
^{212}Bi	2×10^{-7}	7×10^{-9}
^{220}Rn	3×10^{-7}	$i \times 10^{-8}$

These MPC values determined by ICRP are based upon an averaging of the dose over the entire 1000 gram mass of the lung as opposed to averaging the dose over the bronchial epithelium from thoron and its daughters. Thus, the use of thoron (^{220}Rn) MPC values is moot regardless of the critical organ. I recommend that the more restrictive MPC values for ^{212}Pb be used to evaluate measured concentrations of thoron and its daughters.

Preliminary experimental measurements and estimates of concentrations of ^{222}Rn and ^{220}Rn and its daughters at the Kerr-McGee site in West Chicago indicate that ^{222}Rn and ^{220}Rn are present at comparable levels of about $4 \times 10^{-9}\mu$Ci cm^{-3}. This would indicate that current levels exceed the non-restricted area MPC values for ^{222}Rn and ^{212}Pb. I recommended that a comprehensive program to evaluate current levels of radon and thoron and its daughters be intiated as soon as possible. The recommended decommissioning option discussed below should reduce concentrations considerably below the MPC values.

In addition to the internal radiation hazards associated with airborne concentrations of radon and thoron, the ores, waste products, tailings, and surfaces contaminated with thorium, uranium and their daughter species pose potential internal radiation hazards through inhalation, ingestion, and other possible pathways. Evaluations of ambient out-door concentrations at the Kerr-McGee site and similar facilities show that levels of uranium, thorium and their longer lived decay products very seldom exceed applicable limits. Contaminated soil and surfaces may pose both an external and internal radiation hazard. The external radiation hazard potential may be evaluated with appropriate instruments without much difficulty. The internal radiation hazard potential, however, is much more difficult to predict and depends upon the nature of the contaminated surface, the characteristics of the contaminant, the kinds of activities of personnel working in contaminated areas, the ventilation of contaminated spaces, and in the case of contaminated soils, the meteorological conditions and weather at the time (e.g. gustiness, precipitation, etc.). With regard to contaminated surfaces, there is considerable variation in the recommended safe levels (see references 5, 7, 8, 9, 10 and 12). Regulatory Guide 1.86 gives limits of surface contamination for the unrestricted use of facilities. These limits presumably would limit doses to 1/10 the occupational limits under continuous exposure conditions. Thus, contamination levels approximately 30 to 40 times the limits of Regulatory Guide 1.86 would seem to be reasonable levels for occupational exposure conditions. Although there are some areas in buildings at the Kerr-McGee site that may exceed these limits, current levels in most cases would not pose any significant internal or external hazards relative to the occupational limits.

2. Recommended Decommissioning Option

I have considered the potential hazards to occupationally exposed personnel and the general public for the proposed decommissioning options and dismantlement outlines as well as their cost effectiveness in relation to ALARA guidelines. I essentially agree with all of the recommendations of ATCOR (page 23 of reference 3) and I recommend option 2 for the decommissioning of the manufacturing site and option 3 for the Acres. I recommend that procedures in the dismantlement outline number 5 (page 20 of reference 3) be followed with exceptions and additions:

a. Chipping or scarifying of floors and other surfaces is not recommended since such procedures would add unnecessarily to the cost and the exposure of personnel to internal and external hazards. Since the rubble is to be buried in the Acres or disposed of as waste anyway, this procedure is not necessary.

b. Highly contaminated surfaces should be vacuumed if material is not firmly fixed to the surface. Equipment or areas with high levels of fixed contamination should be sprayed with paint or some other appropriate material to prevent the contamination of personnel and the spread of material in the process of dismantlement.

c. Health physics procedures should be established and evaluated by a health physicist during the dismantlement of the Acres and should include appropriate contamination control procedures, air sampling and analysis, personnel dosimetry, respiratory protection, and internal radiation dose assessment. Survey and counting equipment should be evaluated and calibrated for the radionuclides and radiations of interest.

I have evaluated the proposal for isolation of the rubble generated from the decommissiong of the Acres and the burial of the tailings under a layer of 6 inches of clay and 6 feet of soil. This covering will be more than adequate for reducing external radiation levels and airborne concentrations of radon and thoron below applicable limits and within the framework of the ALARA guidelines. It should also provide some margin for erosion and other losses of protection in the future; however, re-vegetation of the area will be very important for maintaining the same level of protection in the future. Deep rooting vegetation should be avoided to prevent penetration into the clay barrier and the subsequent escape of radon and thoron.

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16. "Potential Radiological Impact of Airborne Releases and Direct Gamma Radiation to Individuals Living Near Inactive Uranium Mill Tailings Piles," EPA-520/1-76-001, U.S. Environmental Protection Agency, January, 1976.

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19. "Radiological Health Handbook," U.S. Department of Health, Education and Welfare, 1970.

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Actinium Series (4n + 3)*

Nuclide	Historical name	Half-life	Major radiation energies (MeV) and intensities†		
			α	β	γ
$^{235}_{92}U$	Actinouranium	7.1×10^{8}y	4.37 (18%) 4.40 (57%) 4.58c‡ (8%)	---	0.143 (11%) 0.185 (54%) 0.204 (5%)
$^{231}_{90}Th$	Uranium Y	25.5h	---	0.140 (45%) 0.220 (15%) 0.305 (40%)	0.026 (2%) 0.084c (10%)
$^{231}_{91}Pa$	Protoactinium	3.25×10^{4}y	4.95 (22%) 5.01 (24%) 5.02 (23%)	---	0.027 (6%) 0.29c (6%)
$^{227}_{89}Ac$ 98.6% 1.4%	Actinium	21.6y	4.86c (0.18%) 4.95c (1.2%)	0.043 (-99%)	0.070 (0.08%)
$^{227}_{90}Th$	Radioactinium	18.2d	5.76 (21%) 5.98 (24%) 6.04 (23%)	---	0.050 (8%) 0.237c (15%) 0.31c (8%)
$^{223}_{87}Fr$	Actinium K	22m	5.44 (-0.005%)	1.15 (-100%)	0.050 (40%) 0.080 (13%) 0.234 (4%)
$^{223}_{88}Ra$	Actinium X	11.43d	5.61 (26%) 5.71 (54%) 5.75 (9%)	---	0.149c (10%) 0.270 (10%) 0.33c (6%)
$^{219}_{86}Rn$	Emanation Actinon (An)	4.0s	6.42 (8%) 6.55 (11%) 6.82 (81%)	---	0.272 (9%) 0.401 (5%)
$^{215}_{84}Po$ -100% .00023%	Actinium A	1.78ms	7.38 (-100%)	0.74 (-.00023%)	---
$^{211}_{82}Pb$	Actinium B	36.1m	---	0.29 (1.4%) 0.56 (9.4%) 1.39 (87.5%)	0.405 (3.4%) 0.427 (1.8%) 0.832 (3.4%)
$^{215}_{85}At$	Astatine	-0.1ms	8.01 (-100%)	---	---
$^{211}_{83}Bi$ 0.28% 99.7%	Actinium C	2.15m	6.28 (16%) 6.62 (84%)	0.66 (0.28%)	0.351 (14%)
$^{211}_{84}Po$	Actinium C'	0.52s	7.45 (99%)	---	0.570 (0.5%) 0.90 (0.5%)
$^{207}_{81}Tl$	Actinium C"	4.79m	---	1.44 (99.8%)	0.897 (0.16%)
$^{207}_{82}Pb$	Actinium D	Stable	---	---	---

*This expression describes the mass number of any member in this series, where n is an integer.
Example: $^{207}_{82}Pb$ (4n + 3)......4(51) + 3 = 207

†Intensities refer to percentage of disintegrations of the nuclide itself, not to original parent of series.

‡Complex energy peak which would be incompletely resolved by instruments of moderately low resolving power such as scintillators.

Data taken from: Table of Isotopes and USNRDL-TR-802.

Uranium Series (4n + 2)*

Nuclide	Historical name	Half-life	Major radiation energies (MeV) and intensities†		
			α	β	γ
$^{238}_{92}U$	Uranium I	4.51x10⁹y	4.15 (25%) 4.20 (75%)	---	---
$^{234}_{90}Th$	Uranium X₁	24.1d	---	0.103 (21%) 0.193 (79%)	0.063c‡ (3.5%) 0.093c (4%)
$^{234}_{91}Pa^*$ 99.87% 0.13%	Uranium X₂	1.17m	---	2.29 (98%)	0.765 (0.30%) 1.001 (0.60%)
$^{234}_{91}Pa$	Uranium Z	6.75h	---	0.53 (66%) 1.13 (13%)	0.100 (50%) 0.70 (24%) 0.90 (70%)
$^{234}_{92}U$	Uranium II	2.47x10⁵y	4.72 (28%) 4.77 (72%)	---	0.053 (0.2%)
$^{230}_{90}Th$	Ionium	8.0 x10⁴y	4.62 (24%) 4.68 (76%)	---	0.068 (0.6%) 0.142 (0.07%)
$^{226}_{88}Ra$	Radium	1602y	4.60 (6%) 4.78 (95%)	---	0.186 (4%)
$^{222}_{86}Rn$	Emanation Radon (Rn)	3.823d	5.49 (100%)	---	0.510 (0.07%)
$^{218}_{84}Po$ 99.98% 0.02%	Radium A	3.05m	6.00 (~100%)	0.33 (~0.019%)	---
$^{214}_{82}Pb$	Radium B	26.8m	---	0.65 (50%) 0.71 (40%) 0.98 (6%)	0.295 (19%) 0.352 (36%)
$^{218}_{85}At$	Astatine	~2s	6.65 (6%) 6.70 (94%)	? (~0.1%)	---
$^{214}_{83}Bi$ 99.98% 0.02%	Radium C	19.7m	5.45 (0.012%) 5.51 (0.008%)	1.0 (23%) 1.51 (40%) 3.26 (19%)	0.609 (47%) 1.120 (17%) 1.764 (17%)
$^{214}_{84}Po$	Radium C'	164μs	7.69 (100%)	---	0.799 (0.014%)
$^{210}_{81}Tl$	Radium C"	1.3m	---	1.3 (25%) 1.9 (56%) 2.3 (19%)	0.296 (80%) 0.795 (100%) 1.31 (21%)
$^{210}_{82}Pb$	Radium D	21y	3.72 (.000002%)	0.016 (85%) 0.061 (15%)	0.047 (4%)
$^{210}_{83}Bi$ ~100% .00013%	Radium E	5.01d	4.65 (.00007%) 4.69 (.00005%)	1.161 (~100%)	---
$^{210}_{84}Po$	Radium F	138.4d	5.305 (100%)	---	0.803 (0.0011%)
$^{206}_{81}Tl$	Radium E"	4.19m	---	1.571 (100%)	---
$^{206}_{82}Pb$	Radium G	Stable	---	---	---

---

*This expression describes the mass number of any member in this series, where n is an integer.
Example: $^{206}_{82}Pb$ (4n + 2)......4(51) + 2 = 206

†Intensities refer to percentage of disintegrations of the nuclide itself, not to original parent of series.

‡Complex energy peak which would be incompletely resolved by instruments of moderately low resolving power such as scintillators.

Data taken from: Table of Isotopes and USNRDL-TR-802.

Thorium Series (4n)*

Nuclide	Historical name	Half-life	Major radiation energies (MeV) and intensities†		
			α	β	γ
$^{232}_{90}$Th	Thorium	1.41×10^{10}y	3.95 (24%) 4.01 (76%)	---	---
$^{228}_{88}$Ra	Mesothorium I	5.7y	---	0.055 (100%)	---
$^{228}_{89}$Ac	Mesothorium II	6.13h	---	1.18 (35%) 1.75 (12%) 2.09 (12%)	0.34c‡ (15%) 0.908 (25%) 0.96c (20%)
$^{228}_{90}$Th	Radiothorium	1.910y	5.34 (28%) 5.43 (71%)	---	0.084 (1.6%) 0.214 (0.3%)
$^{224}_{88}$Ra	Thorium X	3.64d	5.45 (6%) 5.68 (94%)	---	0.241 (3.7%)
$^{220}_{86}$Rn	Emanation Thoron (Tn)	55s	6.29 (100%)	---	0.55 (0.07%)
$^{216}_{84}$Po	Thorium A	0.15s	6.78 (100%)	---	---
$^{212}_{82}$Pb	Thorium B	10.64h	---	0.346 (81%) 0.586 (14%)	0.239 (47%) 0.300 (3.2%)
$^{212}_{83}$Bi 64.0% 36.0%	Thorium C	60.6m	6.05 (25%) 6.09 (10%)	1.55 (5%) 2.26 (55%)	0.040 (2%) 0.727 (7%) 1.620 (1.8%)
$^{212}_{84}$Po	Thorium C'	304ns	8.78 (100%)	---	---
$^{208}_{81}$Tl	Thorium C"	3.10m	---	1.28 (25%) 1.52 (21%) 1.80 (50%)	0.511 (2[illegible]) 0.583 (86%) 0.860 (12%) 2.614 (100%)
$^{208}_{82}$Pb	Thorium D	Stable	---	---	---

*This expression describes the mass number of any member in this series, where n is an integer.
Example: $^{232}_{90}$Th (4n)......4(58) = 232

†Intensities refer to percentage of disintegrations of the nuclide itself, not to original parent of series.

‡Complex energy peak which would be incompletely resolved by instruments of moderately low resolving power such as scintillators.

Data taken from: Lederer, C. M., Hollander, J. M., and Perlman, I., Table of Isotopes (6th ed.; New York: John Wiley & Sons, Inc., 1967) and Hogan, O. H., Zigman, P. E., and Mackin, J. L., Beta Spectra (USNRDL-TR-802 [Washington, D.C.: U.S. Atomic Energy Commission, 1964]).

Appendix 3. Ore Residue, and Lagoon Sediment Analysis

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INTER-OFFICE CORRESPONDENCE

Location West Chicago, Illinois Date July 28, 1964

Copy to: O. L. DAIGLE
G. T. DECK
R. P. MACLEAN
W. D. MUNSON

To: B. J. BENNETT

From: D. W. NEWMAN

Subject: EUROPIUM POTENTIAL IN BY PRODUCTS AND WASTES - Reference PD-6407
SUMP SURVEY 12 ACRE GRAVEL PIT

INTRODUCTION:

Since 1956, all of the effluent streams from the Plant processes have been pumped into the gravel pit located on the 12 acres. The solids contained in this sewage have settled out and remained in the sump as the soluble portion of the sewage was filtered through the gravel bed. Various estimates have been made as to the amount of material present in the sump and the commercial value of these solids. A report submitted in December 22, 1961, based on three grab samples taken from the surface of the sump, gave an estimate of 6,300,000 pounds of dry solids in the sump containing 4,800 pounds of Europium oxide and 3,600 pounds of Yttrium oxide. In view of the urgent need of Europium oxide, it seemed imperative to obtain a more valid figure for the amount of contained Europium, Yttrium, and other Rare Earths present in the sump.

SURVEY AND SAMPLING OF THE SUMP

In the last part of June, the maintenance department constructed a raft supported by ten phosphoric acid drums. It had a built in railing and an A-frame super-structure to support the sampling thief as safety precautions (see photograph No. 1).

A sample thief was designed and constructed from thin wall stainless steel tubing. A valve consisting of rubber stoppers centered on a guide rod served as the valve, to keep the core sample within the thief. A sleeve valve was built into the lower end to permit removal of the core sample from the thief conveniently (see photograph No. 2). While the maintenance department was building the raft and sampler the control laboratory made a rough survey of the sump itself. Building No. 19 was used as the base line and the support beams at 20 foot centers were used to locate east and west ordinates. North and south ordinates were also laid out using 20 foot centers. This gave us a grid upon which to plot the surface area of the sump. Measurement of the shore line was made relative to the outermost ordinates north, south, east, and west.

SUMP SAMPLING

It was originally intended to take thief samples of the sump on 40 foot centers. This was found to be impossible because the solids in the sump are at, or near, surface level in the northwest corner of the sump. Samples were consequently taken at 40 foot centers with the exception of this particular area (See Figure I). The method of operation was to extend the bottom plunger (valve) on the sampling thief and lock it in the extended position. The thief was then pushed to the bottom of the sump whereupon the bottom valve was unlocked and the outer pipe casing was forced over the rubber stoppers to seal off the sample thus obtained. After the thief was lifted from the sump, the core sample was removed by sliding the sleeve valve upward and away from the now open side ports (see photograph No. 3 and 4). Depth measurements, liquid, solid, and total, were made at 40 foot centers, but these were found inadequate to give a good profile of the sump bottom. These measurements were all repeated at 20 foot centers. (see photograph No. 5 and Table No. I).

To check the homogeneity of the sump, a composite sample was made of the core samples taken on each of ordinates A C, E, G, I, and K. These were analyzed separately in addition to the single composite sample made of the entire sump (those samples taken at the intersections of the ordinance marked with a circle in Figure I).

The validity of the sample taken is about 95%, since the theoretical volume of the sample that should have been taken and the actual volume of the sample taken were practically identical (see Tabl II).

Further proof of the validity of the sample can be observed in photographs 3 and 4. The material near the bottom of the sump is quite solid (photograph 3) as compared to the material found near the surface (Photograph 4).

The sum of the depth measurements (total depth, water depth, solid depth) at the sample sites indicates that the sump now is 76.5% filled to capacity with solids. A composite sample of the sump sample obtained has been standing in the laboratory for two weeks. The settling rate has now dropped to nearly zero and the solid volume now stands at about 77%.

SUMP CAPACITY

In order to calculate the cubic feet contained in the sump the average depth of each 20 foot square was calculated by averaging the total depth at the four corners of each of the individual 20 foot squares considered (see Figure I).

The area of that considered for volume calculations is that area contained within the dotted lines. This is about 75% of the surface area of the sump. On this basis, there are 403,500 cubic feet contained in the sump. On the basis of the sample taken from the sump, there are 14,400,000 pounds of damp filter cake (35.8 pounds per cubic foot) and 7,000,000 pounds of dry solids (17.4 pounds per cubic foot).

COMPOSITION OF DRY SOLIDS - A.N. 641413

Total Oxides (R.E. + Th)	50 %
F	28 %
SO_3	4.9%
P_2O_5	2.6%
CaO	6.6%
SiO_2	4.0%
Cl	0.2%
Alkali Sulfate	5.1%
R_2O_3 (Fe + Al)	6.2%
Reducible as C_2O_4	1.4%
L.O.I.	5 % gain

OXIDE COMPOSITION (T.O.) - A.N. 645618

CeO_2	27.3%	
Pr_6O_{11}	4.3%	
Nd_2O_3	15.1%	
Sm_2O_3	3.0%	
Dy_2O_3	2.6%	
Eu_2O_3	0.10%	(2nd .098)
Y_2O_3	12.0 %	
ThO_2	9.8 %	

HOMOGENEITY OF SUMP SOLIDS

Analysis of contained oxides from sump samples taken on ordinates A, C, E, G, I, and K.

	ThO_2	CeO_2	Y_2O_3	Eu_2O_3
A	9.7	29.8	10.0	.082
C	10.4	29.6	10.5	.082
E	8.9	26.6	11.0	.078
G	6.6	27.3	12.5	.088
I	5.4	27.3	14.5	.09
K	3.6	26.3	16.3	.09

SUMP VALUES (SALES DOLLAR)

Eu_2O_3	(3,500,000 @ 0.10%)	3,500 lbs.	@	$350	=	$ 1,225,00
Y_2O_3	(3,500,000 @ 12.0 %)	420,000 lbs.	@	45	=	18,900,00
RE_2O_3	(3,500,000 @ 78.0 %)	2,720,000 lbs.	@	0.126	=	342,00
F as HF	(7,000,000 @ 28.0 %)	1,960,000 lbs.	@	0.135/70%		378,00
ThO_2	(3,500,000 @ 9.8 %)	343,000 lbs.				No Value

RECOVERY OF SUMP SOLIDS

A rough profile of the sump bottom derived from the depth measurements taken (Figure II) indicate that there is one low spot in the sump and practically the whole sump bottom slopes in that direction. Since this is true, it may be possible to center the pumping operations in one location (20 foot depth) and wash the sump solids to this area for removal.

The depth of water above solids in the sump is shown in Figure III. The rise and fall of the level in the sump is considerable. Photograph 6 shows the appearance of the sump early Monday morning before pumping operations had hit a high value. The area of solids exposed at this time is shown enclosed with dotted lines in Figure I (northwest area of the sump).

PROCESSING CONSIDERATIONS

In view of the high fluoride content of the dry sump solids (28%) any proposed processing should consider the recovery of these values (equivalent to $378,000 sales value of 70% HF).

We could probably build a plant for recovery of the hydrofluoric acid and these values recovered might well carry the cos of capital equipment needed. However, we do lack sales outlets for the recovered acid, and we do lack experience in the operation of such a plant. Safety and air pollution undoubtedly will be major problems. If time is of the essence, it looms as a major road block. The possibility that this is a "one shot deal" also dictates that the capital expenditure should be held to a minimum.

PROCESSING PROPOSAL

In view of the above considerations, it would seem to make sense to farm out the fluoride recovery step to a hydrofluoric acid manufacturer, as for example, Blockson.

The fluoride content of dried sump solids is 28% as opposed to 50% for Fluorspar CaF_2 and 55% for Cryolite Na_3AlF_6. However, with the equivalent of 2 million pounds of HF in the offing perhaps Blockson could be sold on the idea of working the material up for us. This will probably require a feasability study or pilot operation before they would commit themselves. Perhaps the analysis of the dried solids would give them sufficient data to decide.

The process would be the same as that used for recovery of hydrofluoric acid from Fluorspar, except that the anhydrous Rare Earth sulfate would be a by product rather than gypsum. The anhydrous Rare Earth sulfate would then be returned to AP&CC for dissolution and further processing.

PROCESS STEPS

1. Pump out sump solids and filter off water.

2. Dry damp filter cake in rotary drier (available).

3. Break up lumps - Hammer Mill

 4. Ship to Blockson (?) for F removal and recovery.
 5. Receive anhydrous Rare Earth sulfate from Blockson.

6. Dissolve anhydrous Rare Earth sulfate in acidulated water.

7. Filter off $CaSO_4$ - $BaSO_4$ insolubles.

8. Neutralize solution with Rare Earth hydrate to remove Thorium.

9. Process Neutralized residue in normal manner.

9A. Process solution for Europium recovery, Pink Salts, etc.

D. W. Newman

DWN/lm

SUMP SAMPLING
DEPTH MEASUREMENTS

Ordinates		1	2	3	4	5	6	7	8	9	10	11	1
Total	T			7.25	9.00	7.50	9.00	9.00	8.50	8.00	8.00		
A Water	W			1.25	2.00	1.50	2.00	1.00	1.00	1.50	1.00		
Solids	S			6.00	7.00	6.00	7.00	8.00	7.50	6.50	7.00		
A-B	T			8.00	11.75	13.75	13.75	12.50	13.00	12.50	10.50		
Mid-Point	W			2.00	2.00	2.00	1.50	1.50	1.00	0.75	0.75		
	S			6.00	9.75	11.75	12.25	11.00	12.00	11.75	9.75		
	T			10.50	14.00	17.25	17.25	16.50	16.00	15.75	13.50		
B	W			2.50	2.50	2.00	2.00	1.75	1.25	1.00	0.50		
	S			8.00	11.50	15.25	15.25	14.75	14.75	14.75	13.00		
	T			11.50	19.00	16.50	17.50	16.00	15.50	14.75	13.00	12.00	
C	W			2.25	2.50	2.25	2.00	2.00	1.50	0.00	1.00	0.50	
	S			9.25	16.50	14.25	15.50	14.00	14.00	14.75	12.00	11.50	
	T	7.50	10.00	20.00	19.25	19.25	16.75	15.00	14.50	15.00	13.00	11.75	6
D	W	2.75	3.25	3.00	2.75	2.50	2.50	2.25	2.00	2.50	1.00	0.75	1
	S	4.75	6.75	17.00	16.50	16.75	14.25	12.75	12.50	12.50	12.00	11.00	5
	T	7.00	16.00	17.50	16.25	16.00	14.75	16.00	13.50	15.50	12.00	8.00	8
	W	2.50	3.00	3.50	3.00	3.00	2.50	2.5	2.00	2.00	2.00	1.50	1
	S	4.50	13.00	14.00	13.25	13.00	12.25	13.50	11.50	13.50	10.00	6.50	6
	T	5.00	11.50	12.00	14.00	17.00	15.00	12.25	14.00	13.25	13.00	11.00	7
F	W	4.00	3.50	3.50	3.50	3.00	2.75	2.50	2.00	2.50	2.50	2.50	2.
	S	1.00	8.00	8.50	10.50	14.00	12.25	9.75	12.00	10.75	10.50	8.50	5
	T		9.50	10.00	12.00	11.00	8.25	9.00	7.00	8.00	12.50	13.75	7.
G	W		3.25	3.50	3.25	3.50	3.25	3.25	2.50	3.00	3.00	3.25	2.
	S		6.25	6.50	8.75	7.50	5.00	5.75	4.50	5.00	9.50	10.50	4.
	T		6.75	10.75	10.50	12.25	9.00	7.0	10.00	7.00	11.5	10.0	7.
H	W		3.75	4.00	3.75	3.75	4.00	3.5	3.50	3.50	3.5	6.0	4.
	S		3.00	6.75	6.75	8.50	5.00	3.5	6.50	3.50	8.0	4.0	3.
	T		6.25	5.75	9.25	7.50	9.00	10.00	7.00	8.00	8.00	7.75	7.
I	W		3.75	4.00	3.75	3.75	3.75	4.00	3.50	4.00	4.00	4.25	4.
	S		2.50	1.75	5.50	3.75	5.25	6.00	3.50	4.00	4.00	3.50	3.
	T							4.75	5.00	9.00	7.00	7.25	10.
J	W							3.50	4.00	4.00	4.00	4.25	4.
	S							1.25	1.00	5.00	3.00	3.00	6.
	T									6.00	6.00	6.50	7.
K	W									4.00	4.00	4.00	4
	S									2.00	2.00	2.50	2.

SAMPLE THIEF - VOLUME PER FOOT

Pipe = 1.75 in. dia; A = πr^2 = π (.765) = 2.40 sq. in.

Rod = .375 in. dia; A = = π (.036) = 0.11 sq. in.

Corrected A = 2.29 sq. in.

Volume per lineal ft. = 2.29 X 12 = 27.5 cu in/ft.

THEORETICAL SAMPLE VOLUME

Depth of Sample Taken Ft.

Ord.	A	C	E	G	I	K	Total Ft.
2			16.0	9.50	6.25		34.50
4	9.00	19.00	16.25	12.00	9.25		66.75
6	9.00	17.50	14.75	8.25	9.00		81.00
8	8.50	15.50	13.50	7.00	7.00		56.25
9	8.00	14.75					46.50
10			12.00	12.50	8.00	6.0	13.00
12			8.50	7.00	7.00	7.0	
	34.50	66.75	81.00	56.25	46.50	13.0	298.00 ft.

$$\frac{(298 \text{ ft})(27.5 \text{ cu in/ft})}{231 \text{ cu in/gal}} = 35.5 \text{ gals. Theo. Sample Volume}$$

ACTUAL VOLUME TAKEN (55 GAL. DRUM)

(22.5 in. dia. X 19.5 depth)

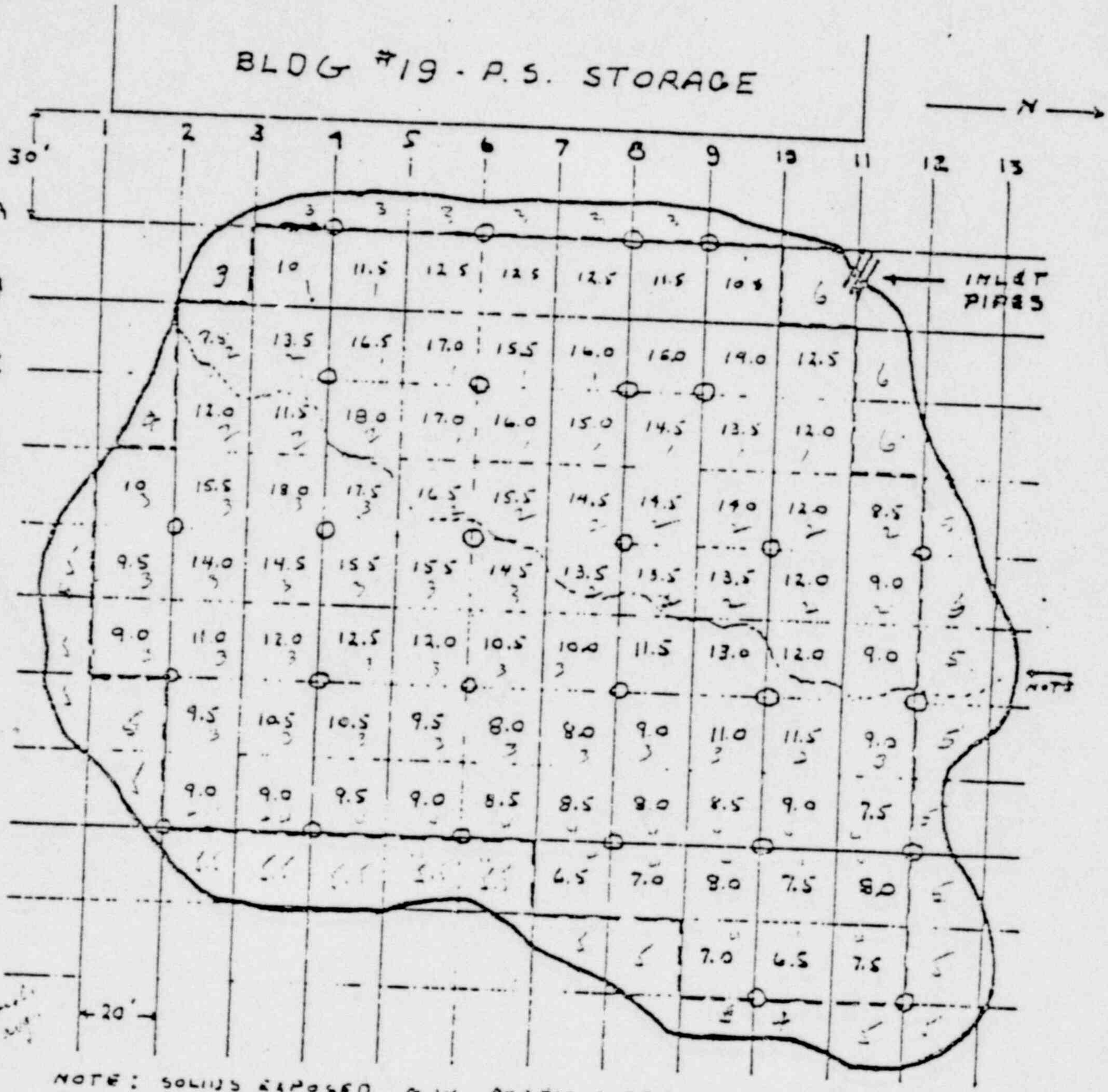
$$V = \frac{\pi r^2 D}{231 \text{ cu in/gal}} = \frac{\pi (11.25^2)\ 19.5}{231} = \frac{7750}{231} = 33.6 \text{ gal. taken}$$

VALIDITY

$$\frac{(\text{actual sample})}{(\text{theoretical sample})} \quad \frac{33.6 \text{ gal.}}{35.5 \text{ gal.}} \times 100 = 95\% \text{ Sampling efficiency}$$

SUMP SURVEY - 12A. GRAVEL PIT

JULY 1964
FIG. #1



NOTE: SOLIDS EXPOSED N.W. PORTION OF SUMP 7:00 AM. 7/13/64

MEASURED AREA OF SUMP 44,800 sq. ft. (1+ acre)

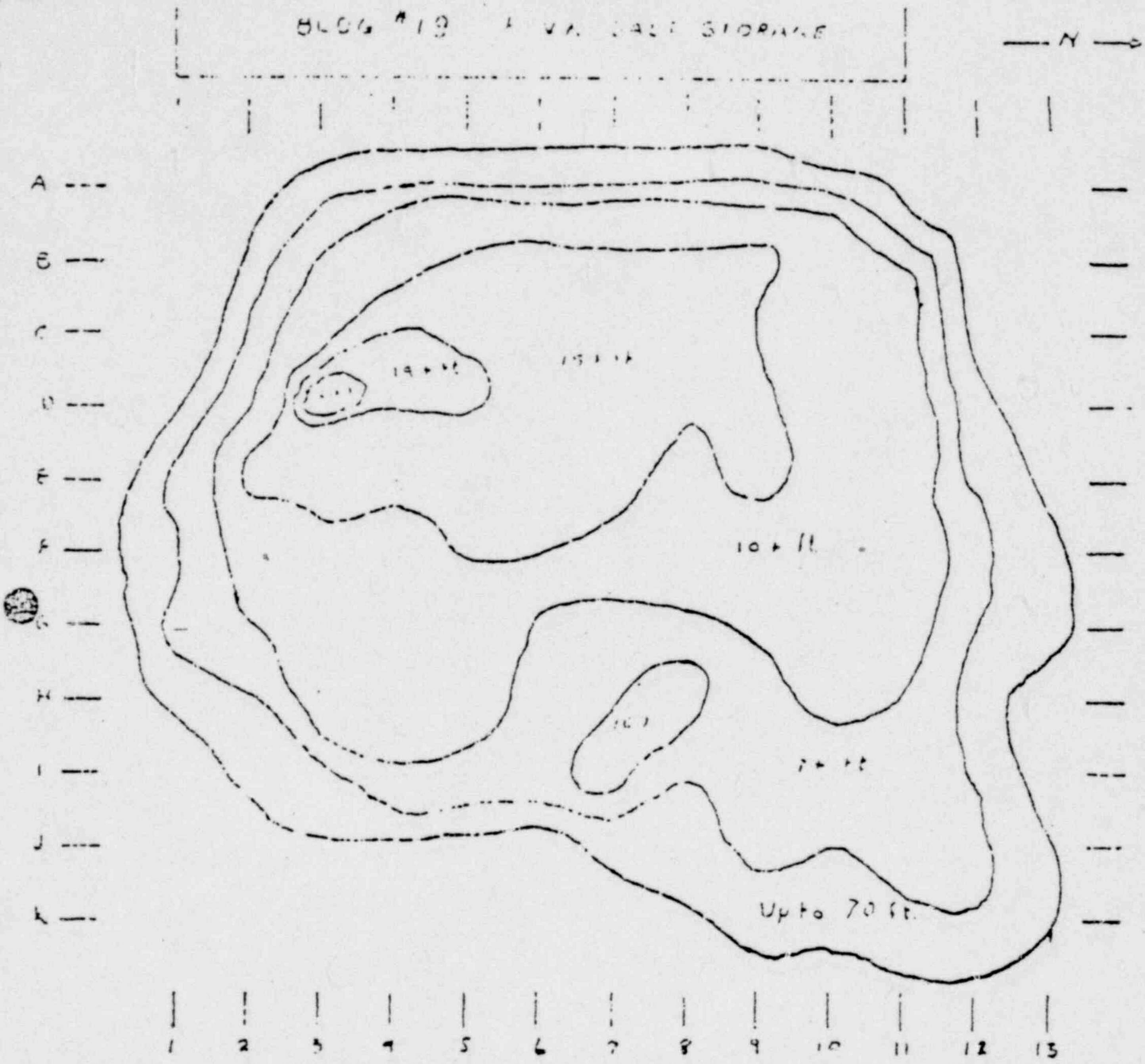
AREA USED FOR VOLUME CALCULATIONS (DOTTED LINE)
34,400 sq. ft.

DEPTHS LISTED ARE AVERAGES FOR THE FOUR CORNERS OF EACH SMALL SQUARE (20 ft. CENTERS)

SAMPLES TAKEN AT INTERSECTIONS MARKED ○

FIG. #2

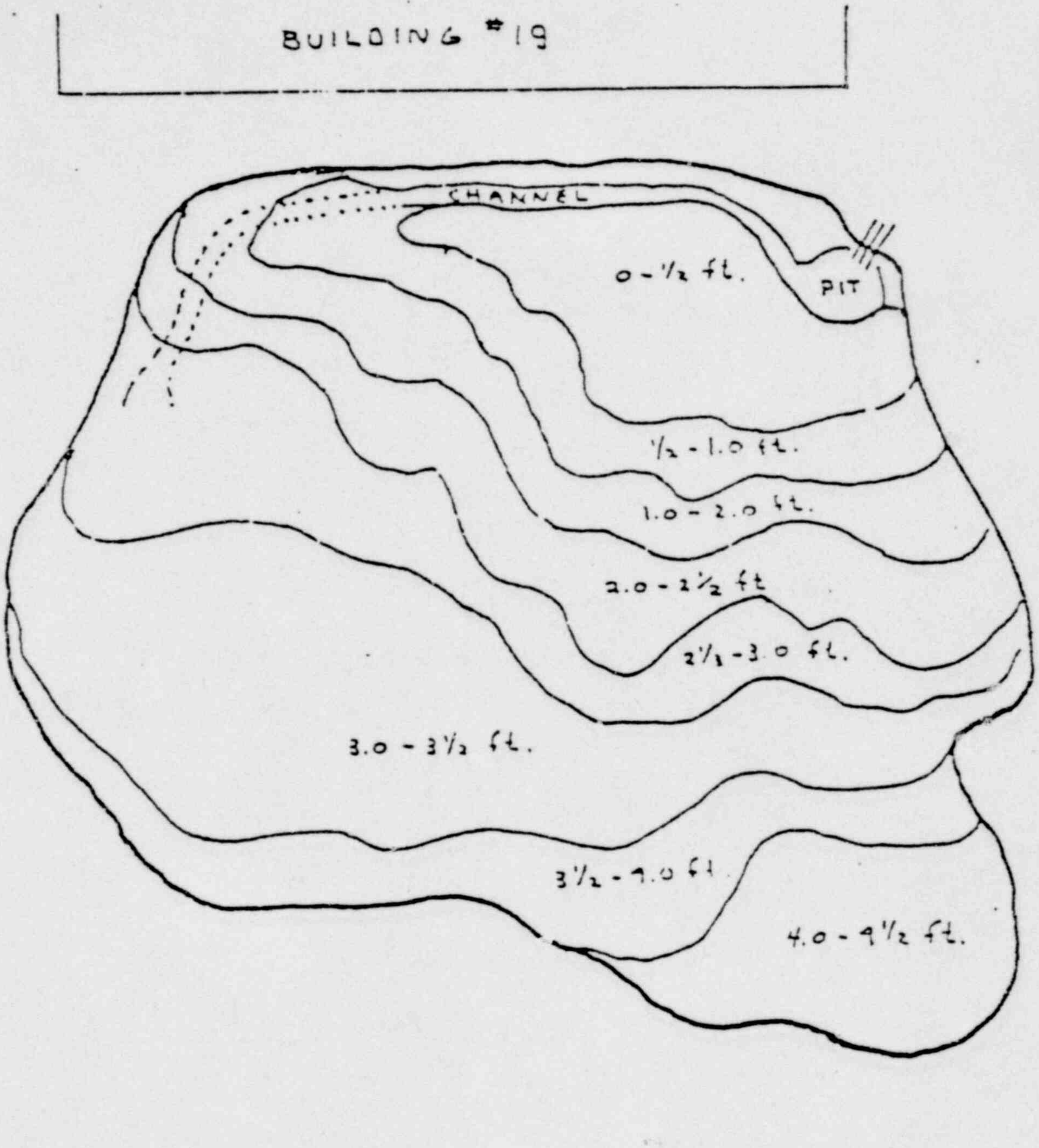
SUMP SURVEY



APPROXIMATE DEPTH OF SUMP IN FEET AS MEASURED FROM SURFACE WHEN WATER ABOVE SOLIDS IS ZERO AT C-10 ON MAP.

Fig. # 3

SUMP SURVEY



MEASURED DEPTH OF WATER ABOVE THE SETTLED SOLIDS IN (12 ACRE) SUMP.

SUMP IS AT PRESENT 76.5 % FULL OF SOLIDS.

FORM C-19;10-67 AP&CC

INTER-OFFICE CORRESPONDENCE

LOCATION Rare Earth Division

DATE April 7, 1966

Copy to: B. J. Bennett
O. L. Daigle
W. L. Silvernail
M. M. Woyski

To: R. J. Vreeland

From: D. W. Newman

Subject: Sample of Sump "Gunk" Taken by Layne Westem (composite of 20+ cores) AN 661063

The sample of sump slurry received on 3/30/66 has been analyzed and the results are given below. We have included the analyses of the two other sump samples that have been taken from this sump in the recent past for comparative purposes. Sample taken March, 1966, is the same material sent to M. M. Woyski (50 gals.) at Whittier.

	July, 1964	Dec., 1965	March, 1966
Density	1.19	?	1.29
% Damp Solids	48.5	?	58.4
% Dry Solids	23.6	16.6	31.1
% T.O. (dry solids)	50.0	53.3	46.1
% Y_2O_3/T.O.	12.0	5.4	11.5
% Eu_2O_3/T.O.	0.10	0.09	0.11
% ThO_2/T.O.	9.8	3.9	3.7

D. W. Newman
D. W. Newman

DWN/gkp

CC: J. D. Shreve, O/C ✓
O. L. Daigle, WCP

SEP 12 1973

KERR-McGEE CHEMICAL CORP.
INTERNAL CORRESPONDENCE

TO W. L. Silvernail

FROM J. P. Zapolski

DATE September 7, 1973

SUBJECT ANALYSIS OF DISSOLVING RESIDUE

Analysis of dissolving residue sampled from the large pile, 8/28/73, is as follows:

Moisture

Ave. of 3 samples by moisture balance	36.9%
Sample dried at 105°C over weekend	34.6%

Total Oxide (includes ThO_2)

Dry basis	10.8%
Wet basis (36.9% moisture)	6.8%
Wet basis (34.6% moisture)	7.1%

ThO_2/Total Oxide

X-ray analysis	4.55%
Colorimetric analysis	4.65%

ThO_2/Wet Residue Basis

4.6 x 0.071 =	0.33%

Use this
RJV

Unreacted Sand (URS)

Unreacted is the total nitric acid insoluble residue remaining after the insoluble fines are separated by flotation. It consists of unreacted monazite, xenotime, zircon, ilmenite, silica, etc.

On the wet basis the URS was 3.5%.

An X-ray scan of dried dissolving residue showed rare earths, Fe, Pb, and possibly Sr to be present. After the dissolving residue was washed and nitric washed to get unreacted sand, the X-ray scan of the dried URS showed Ti and high Zr also to be present.

A wet chemical T.O. and ThO_2 in the URS will be obtained at a later date.

J. P. Zapolski
J. P. Zapolski

JPZ/jy

Average Values from Weekly Residue Composites 8/30/7[illegible] - W.L.S.
6/1/63 to 5/31/67

Date		% TiO		% ThO_2	ThO_2/TO.		% H_2O
6/1/63 - 12/30/63	26	11.92	31	0.36	3.0	29	30.1
1/1/64 - 12/31/64	47	13.45	47	0.31	2.3	47	27.2
1/1/65 - 12/31/65	38	11.42	38	0.36	3.2	38	25.7
1/1/66 - 12/31/66	49	11.33	49	0.65	5.7	15	36.0
1/1/67 - 5/31/67	22	12.58	22	1.07	8.5	22	42.1
	182	12.13	187	0.52	4.29	151	30.4

KERR-McGEE CORPORATION
INTERNAL CORRESPONDENCE

SEP 2 5 1973

TO W. L. Silvernail

DATE September 20, 1973

FROM R. E. Harris

SUBJECT Analysis of W. Chicago Residue Pile; Proj. 2214

The analysis of the residue pile has been completed and the results are reported here. The total rare earth and thorium oxides were determined by dissolving a 10.00 g sample in acid, treating the residue with HF to remove silica, fusing the remaining residue with sodium carbonate and finally going through a double ammonia precipitation and double oxalate precipitation. The thorium was determined on the T. O. by x-ray fluorescence.

9-20-73

The ^{228}Ra value is an approximation and is the best we can do without expending a great deal of time. If a better number is needed it would be advisable to send it to a commercial laboratory that has β pulse height analysis equipment.

The results on as received basis are as follows:

Moisture loss at 115°C	35.6%
Total Rare Earth and Thorium Oxides	6.9
ThO_2	0.30
U	.0019
Unreacted Sand	3.45
^{228}Ra	.0014 μc/g ± 50%

Ray E. Harris
R. E. Harris

REH/rvb
cc: O. L. Daigle
C. H. Long
J. D. Shreve
File: W. Chicago Plant

KERR-McGEE CORPORATION
INTERNAL CORRESPONDENCE

TO Ralph Vreeland
DATE April 10, 1974
FROM R. Harris
SUBJECT Analysis of W. Chicago Pond Samples

The analyses of the samples from Ponds #2 and 3 at W. Chicago Plant have been completed and are reported here:

	Pond #2	Pond #3
Vol % Settled Solids	61%	[illegible]2%
Wt % Dry Solids in Orignal Sample	12.2	19.8
Wt % Rare Earth Oxides + ThO_2 on Dry Basis	52.6	43.9
Wt % ThO_2 on Dry Basis	5.7	2.5

Roy Harris
R. Harris

REH/nvb
cc: C. H. Long

File: W. Chicago Plant

KERR-McGEE CORPORATION
INTERNAL CORRESPONDENCE

TO R. J. Vreeland

FROM W. J. Robertson

DATE May 13, 1975

SUBJECT Analysis of West Chicago Residues

At your request, the samples received from West Chicago on March 19, 1975, have been further analyzed for thorium content.

	% ThO_2 (dry basis)
No. 1 Pond Sludge	3.2
Residue from No. 1 Pond Piled West of Sand Shed	2.4
Residue Pile South of Pond No. 1	5.4

USE 3.9 AVG. FOR PILES
RJV

Let us know if any additional work is required.

W. J. Robertson
W. J. Robertson
Chemical Extraction

WJR/jc

Distribution:

T. W. Clapper
R. E. Davis
C. H. Long
J. D. Hale
TIC

1/333

KERR-McGEE CORPORATION
TECHNOLOGY DIVISION
Proprietary information of the Company
TO BE KEPT CONFIDENTIAL

TECHNICAL D ON

KERR-McGEE CHEMICAL CORP.
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

July 8, 1975

Mr. J. E. Rothfleisch
Nuclear Regulatory Commission
Washington, D.C. 20545

Dear Mr. Rothfleisch:

I am enclosing a photo-map of our West Chicago, Ill. property which we discussed on the telephone today. This map shows the most recent radiation survey of our waste storage area made on April 22, 1975.

This survey was made as the starting point of an engineering survey to develop details for grading and covering portions of the area containing the radioactive wastes. These plans were completed June 25. We have taken no action on these plans pending the disposition of the entire property. We would expect to provide a detailed description of the waste contents, together with these plans, to any potential purchaser of this property.

I have the following limited information on the uranium and radium content of the wastes.

A composite sample of the ore residue pile showed the following assay:

ThO_2	0.30%
U	0.0019%
^{228}Ra	0.0014 uc/g ± 50%

The uranium content of No. 1 Pond sludge and of old pond dredgings were analyzed on grab samples as follows:

No. 1 Pond	0.143% U_3O_8 (dry basis)
Dredging Piles	0.025-.062% U_3O_8 (dry basis)

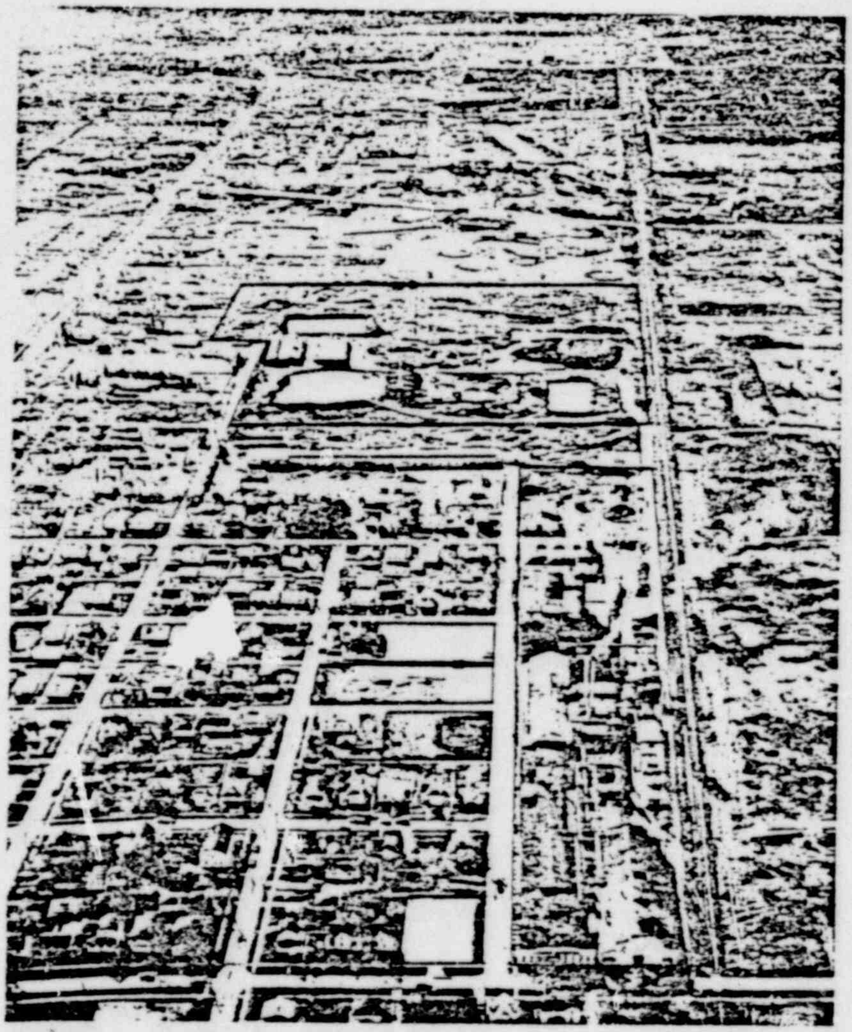
I hope this information will be useful to you. If you have any further questions please call me again.

Sincerely,

Ralph J Vreeland

RALPH J. VREELAND
Senior Project Engineer

RJV/so
Enclosure



KERR-McGEE CHEMICAL CORP.
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

December 18, 1975

Mr. William Crow
Fuel Fabrication & Reprocessing Branch
Directorate of Licensing
Nuclear Regulatory Commission
Washington, D. C. 20545

RE: Docket No. 40-2061
License STA 583

Dear Mr. Crow:

Enclosed are the results of the leaching and ground water tests of materials in the waste storage area at our West Chicago, Illinois facility.

The samples were taken at the following locations as measured on the grid of the area maps in your possession.

Sample No. 1 - Standing Water in No. 2 Pond, 10.5N x 2.0E
Sample No. 2 - Standing Water in No. 3 Pond, 5.25N x 8.75E
Sample No. 3 - Ground Water 9 Ft. Below Surface, 5.5N x 0.5E
Sample No. 4 - Solids from No. 1 Pond, 10.75N x 6.75E
Sample No. 5 - Solids from No. 2 Pond, 11.5N x 2.0E
Sample No. 6 - Solids from No. 3 Pond, 5.75N x 6.5E
Sample No. 7 - Solids from Residual Pile, 7.5N x 2.0E
Sample No. 8 - Solids Between No. 3 & No. 4 Ponds, 5.5N x 6.25E
Sample No. 9 - Thorium Hydrate Solids in Bldg. 19, 11.0N x 5.5E

The report indicates that there is considerably more leachable radioactivity in the sample No. 9. This material is described as "Process Intermediates", Item No. 6, Table I of Plan submitted with my letter of October 3, 1975. This material is considerably richer in thorium than the other waste solids (14% vs. 0.3-2.5%) and may contain a small amount of water soluble chloride.

The report further indicates that the solid materials could be rendered less water-soluble by raising the pH of the environment. This could be accomplished by spreading hydrated lime over the area before covering it with soil. In the case of the material represented by Sample No. 9 this relatively small pile could be covered by an impervious film before covering with soil.

In connection with the above procedures it has been our experience that elevating the pH of the materials in question will greatly decrease their permeability. In view of the proposed contour of the areas after the materials are covered, it would be expected that rain water would be largely carried away from these areas and little or no percolation would result in the future.

The report also indicates that further radiological examination of these samples has been requested by your office. I have been advised that this phase of our analytical work is greatly over-loaded largely by other programs in part associated with your office. I will try to expedite this work. We are most anxious to resolve the matter of our license amendment and subsquent transfer. We would appreciate your early attention to this.

Very truly yours,

R. J. Vreeland

R. J. Vreeland
Senior Project Engineer

RJV:ph
Attachment

KERR-McGEE CHEMICAL CORP.
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

March 29, 1976

Mr. William Crow
Fuel Fabrication and Reprocessing Branch
Directorate of Licensing
Nuclear Regulatory Commission
Washington, D. C. 20545

RE: License No. STA-583
Docket No. 40-2061

Dear Mr. Crow:

Please refer to my letter to you of December 18, 1975 which described samples of waste materials at our West Chicago facility. Attached is a report from our Technical Division which gives additional analytical results on the samples.

We trust this added information will allow you to complete your evaluation of our plan for the modification of the storage facilities at West Chicago.

Very truly yours,

R J Vreeland

R. J. Vreeland
Senior Project Engineer

RJV:ph
Attachment

cc: R. MacLean
M & H Corp.
J. V. Connell

KERR-McGEE CORPORATION

INTERNAL CORRESPONDENCE

TO R. J. Vreeland

DATE March 24, 1976

FROM G. E. Van De Steeg

SUBJECT West Chicago Residue Samples; Project 4556

Nine samples from West Chicago were submitted for isotopic analysis and leach testing. The initial results were reported in my memo of December 16, 1975.

The attached three Tables summarize the results of isotopic analysis on the nine original samples plus a composite made from the pH 7 leach-test solutions.

This now completes our anticipated work on these samples. We will retain these samples for 3 months in the eventuality more work is requested.

I hope this will now satisfy the NRC requirements for the sale of the West Chicago Facility.

G. E. Van De Steeg

GEV/nvb
Attachments
cc: C. H. Long

File: West Chicago Facility

ISOTOPIC ANALYSIS BY ALPHA SPECTROMETRY

URANIUM

Sample Identification		U-238	U-235	U-234
#1	Standing Water in No. 2 Pond, pCi/l	25	2.1	25
#2	Standing Water in No. 3 Pond, pCi/l	.89	.034	.89
#3	Ground Water 9 ft. Below Surface, pCi/l	.18	.016	.22
#4	Solids from No. 1 Pond, pCi/g	270	13	240
#5	Solids from No. 2 Pond, pCi/g	340	14	310
#6	Solids from No. 3 Pond, pCi/g	65	3	65
#7	Solids from Residue Pile, pCi/g	9	.5	9
#8	Solids Between No. 3 and No. 4 Ponds, pCi/g	410	20	450
#9	Thorium Hydrate Solids in Building, pCi/g	1900	100	1800
#10	Composite of pH 7 Leach Solution	6.1	.16	5.7

ISOTOPIC ANALYSIS BY ALPHA SPECTROMETRY

THORIUM

Sample Identification		Th-232	Th-230
#1	Standing Water in No. 2 Pond, pCi/l	0.023	0.031
#2	Standing Water in No. 3 Pond, pCi/l	0.003	0.009
#3	Ground Water 9 ft. Below Surface, pCi/l	<0.003	0.014
#4	Solids from No. 1 Pond, pCi/g	75	25
#5	Solids from No. 2 Pond, pCi/g	660	240
#6	Solids from No. 3 Pond, pCi/g	1530	320
#7	Solids from Residue Pile, pCi/g	550	140
#8	Solids Between No. 3 and No. 4 Ponds, pCi/g	660	500
#9	Thorium Hydrate Solids in Building, pCi/g	9300 *	6400 *
#10	Composite of pH 7 Leach Solution, pCi/l	No thorium detected (<0.002)	

* These results appear to be low for Thorium Hydrate. Chemical ThO_2 was not performed on original sample. Recovery based upon Th-228 internal standard.

ISOTOPIC ANALYSIS FOR RADIUM *

Sample Identification	Ra-223	Ra-224	Ra-226	Ra-228
#1 Standing Water in No. 2 Pond, pCi/l	<.1	32	32	<.1
#2 Standing Water in No. 3 Pond, pCi/l	<.1	11	17	99
#3 Ground Water 9 ft. Below Surface, pCi/l	<.1	6.7	6.7	1.5
#4 Solids from No. 1 Pond, pCi/g	9.3	7.2	<.1	410
#5 Solids from No. 2 Pond, pCi/g	1.4	<.1	<.1	160
#6 Solids from No. 3 Pond, pCi/g	7.1	<.1	<.1	1100
#7 Solids from Residue Pile, pCi/g	14	<.1	<.1	1800
#8 Solids Between No. 3 and No. 4 Ponds, pCi/g	.6	<.1	<.1	150
#9				
#9 Thorium Hydrate Solids in Building, pCi/g	2.8	<.1	<.1	270
#10 Composite of pH 7 Leach Solution	<1	20	20	<1

* Multiple regression analysis of alpha/beta growth curves for samples carried through chemical radium separation.

OPS-1283
JOB-2329 ✓

ALCOR

PARK MALL, PEEKSKILL, NEW YORK 10566 TEL: 914-739-9000 TELEX: 969535

June 21, 1978

Kerr-McGee Chemical Corporation
Kerr-McGee Center
P.O. Box 25861
Oklahoma City, Oklahoma 73125

Attention: Mr. R. J. Vreeland

Subject: Chemical Analysis of Soil and Water Samples Taken in April, 1978 in the 27 Acre Site of Kerr-McGee's West Chicago Facility

Gentlemen:

In order to present the data transmitted to R.G. Levesque from C. H. Long, K-M Technical Center, dated June 8, 1978, I rearranged the data and referenced the location of the samples on a diagram. Enclosure 1 contains this information in the revised format.

Please review this enclosure, and if you do not have any questions, please forward a copy to Mr. Luis Saguinsin at Argonne National Laboratory.

Very truly yours,

Robert G. Levesque

Robert G. Levesque
Radiation Safety Officer

RGL:pr

Enclosure 1 (4 copies)

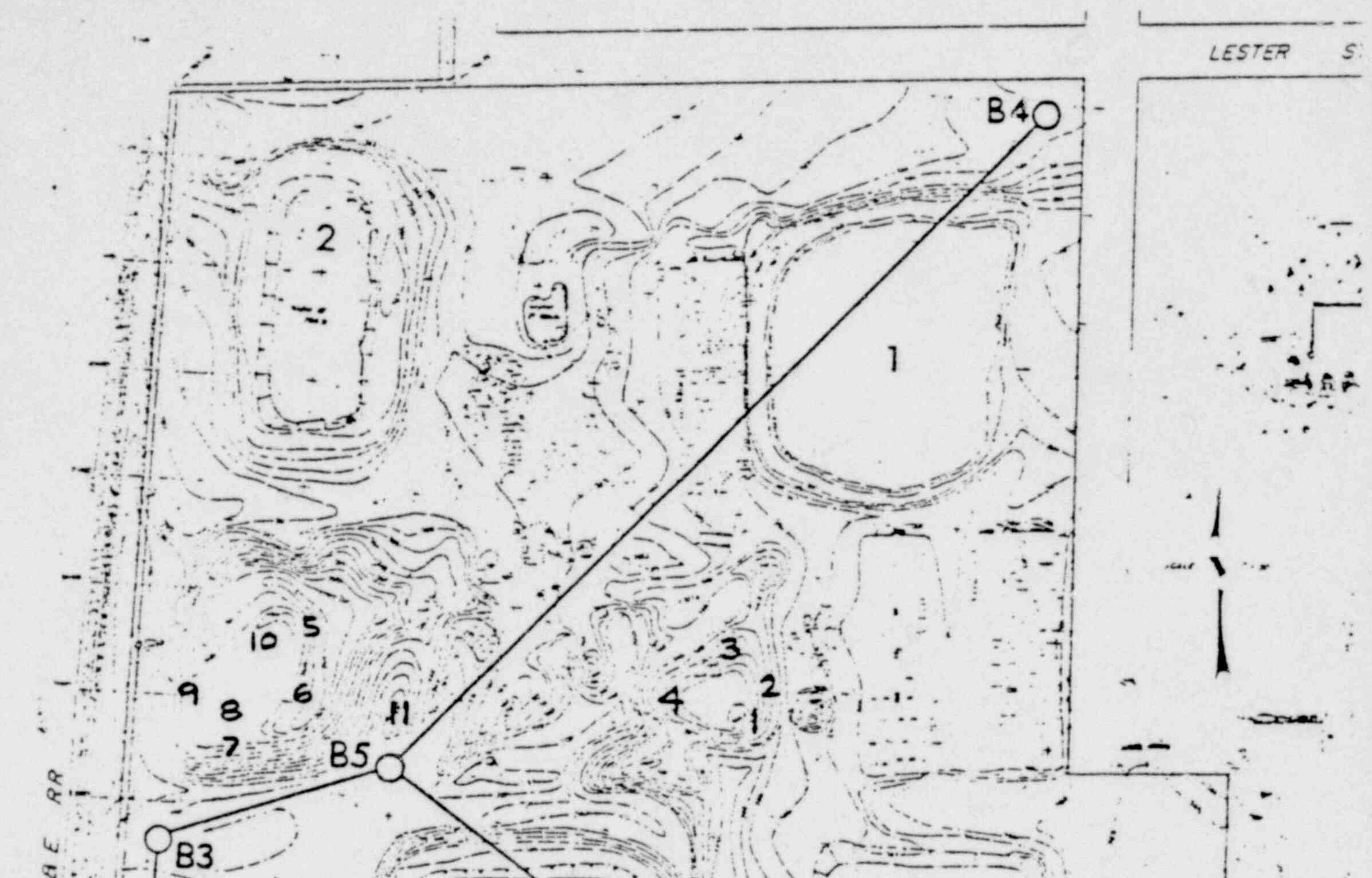


Fig. 1. Site Layout of Kerr-McGee West Chicago Waste Storage Area Showing Locations of Boreholes B1-B5, Waste Ponds 1-5, and Residue Pile Samples 1-11.

TABLE I

WEST CHICAGO FACILITY

(Well Water, April 25, 1978)

		mg/l			
I.D.	pH	$SO_4^=$	Cl^-	TDS	F
Well No. 1	6.70	570	96	1420	13
Well No. 2	6.96	1370	430	3400	1.8
Well No. 3	6.54	1420	360	3400	18
Well No. 4	6.64	590	70	1380	22
Well No. 5	6.67	1850	310	4380	22

Methods: EPA Complaince

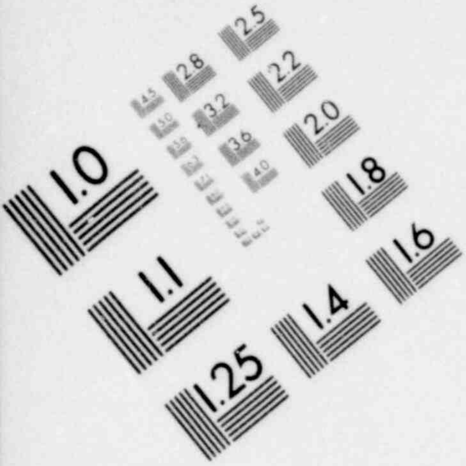
Reference: Letter dated April 26, 1978, J. E. Rempe to Ralph Vreeland;
Memo dated May 5, 1978, R. J. Vreeland to C. H. Long;
Memo dated March 22, 1978, R. J. Vreeland to C. H. Long.

TABLE II

WEST CHICAGO ORE TAILINGS PILES
TOTAL LEACHABLE

(By Appendix A Method, Illinois EPA Division of Land/Noise Pollution Control)

I.D.			ppm (µg/g Dried Powder, -100 Mesh)								
Location	Depth (In)	% Moisture	As	Cd	Cr	Cu	Fe	Ni	Pb	Se	Zn
1	18	38.8	94	1.6	37	100	4700	120	490	110	130
1	36	38.8	82	1.6	25	97	4400	32	730	120	110
1	72	37.5	54	2.0	24	73	4700	32	400	48	54
2	18	44.5	94	2.3	17	74	4900	38	1800	54	89
2	36	44.0	78	2.0	24	58	4600	30	1900	68	68
2	84	45.0	120	1.3	21	60	4700	20	2100	99	74
3	18	38.9	79	1.7	26	93	4500	25	380	69	840
3	36	39.3	75	2.2	23	84	4500	17	360	47	1000
3	72	40.5	74	1.5	25	84	4600	36	330	49	190
4	18	42.4	64	1.5	19	44	4800	28	830	30	88
4	36	40.8	44	1.2	15	49	4700	26	890	46	120
4	90	45.4	60	2.4	21	40	4800	24	900	23	80
5	4	40.8	18	1.3	14	19	1800	24	4800	23	11
5	36	39.8	20	1.4	7.5	30	1400	12	3600	26	5.0
6	4	29.7	14	2.2	8.4	15	2600	24	5400	30	5.9
6	48	30.4	22	1.5	12	24	4400	23	[illegible]00	20	9.6
7	4	39.9	15	0.99	7.1	16	1200	9.9	4400	33	5.2
7	36	39.3	18	0.44	12	24	1900	11	3600	25	5.8
8	4	44.9	24	1.4	17	24	2600	31	5500	20	8.4
8	36	35.7	31	0.97	11	27	1200	25	3000	24	5.3
9	4	38.0	9.3	0.54	4.9	14	880	8.3	4900	14	5.4
9	36	27.7	29	1.0	12	18	990	28	4900	18	11
10	4	33.1	21	1.5	10	25	2500	24	4500	31	9.5
10	36	32.2	22	2.4	9.8	27	3000	27	4900	64	5.9
11	4	37.0	17	2.1	12	16	3000	21	4700	14	6.5
11	36	32.6	33	2.2	16	48	4700	50	3000	40	9.3



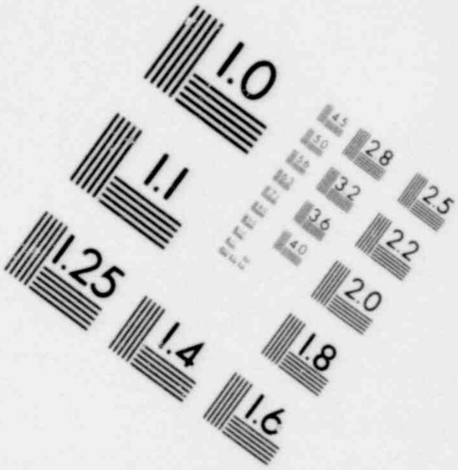
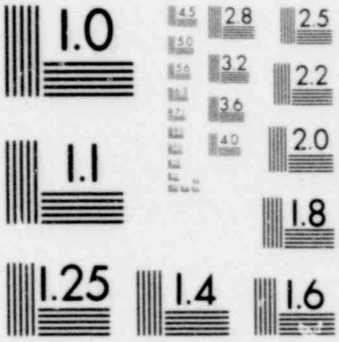
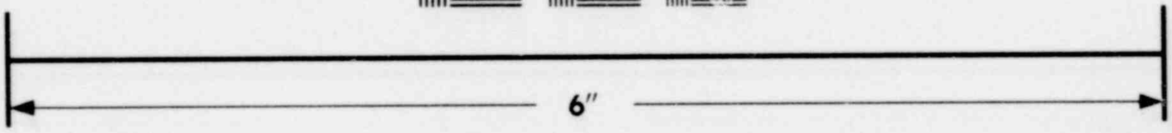
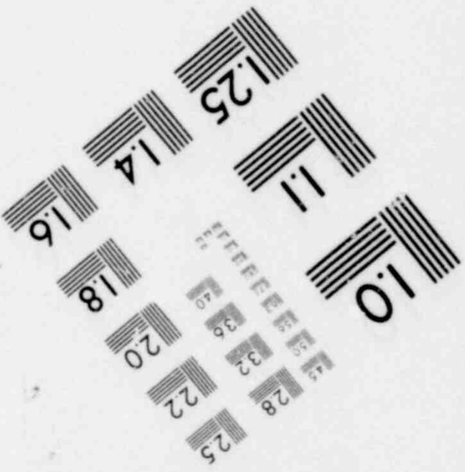
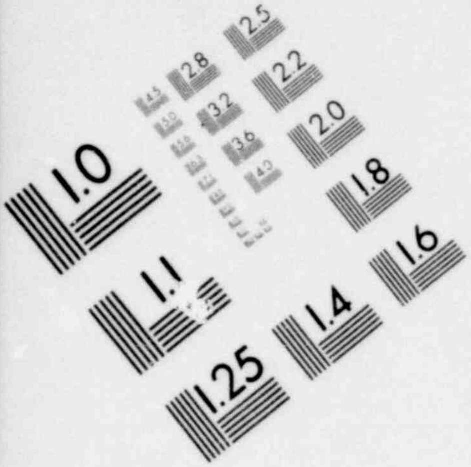


IMAGE EVALUATION TEST TARGET (MT-3)









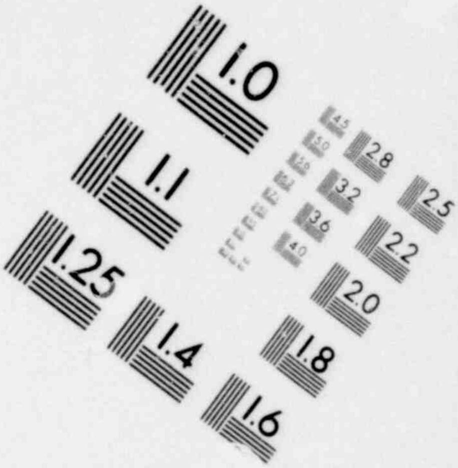
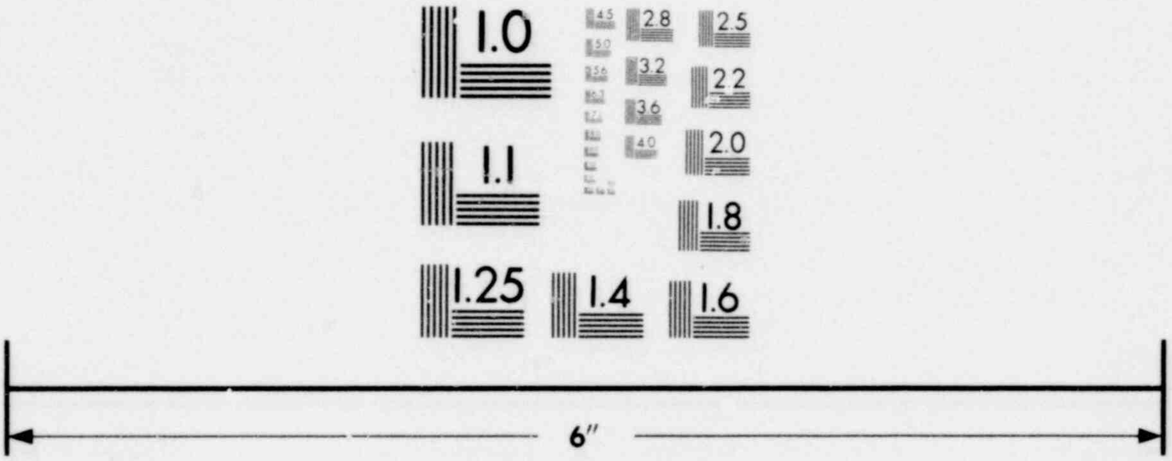
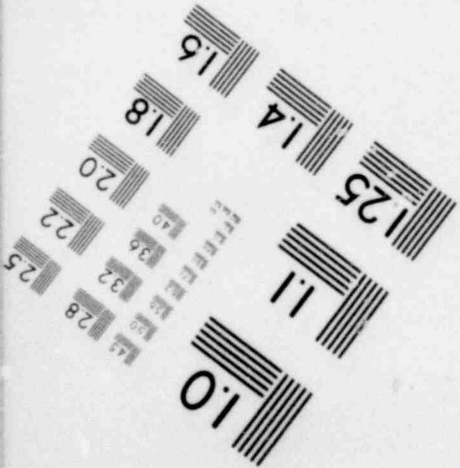


IMAGE EVALUATION
TEST TARGET (MT-3)





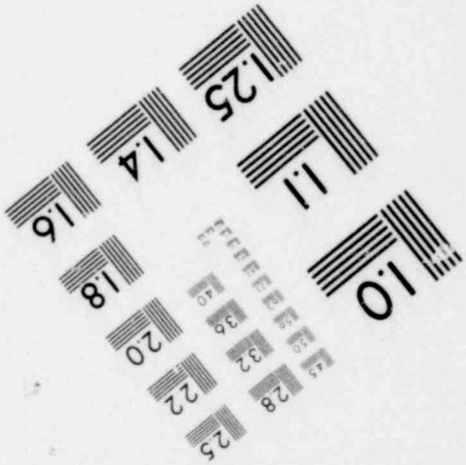


TABLE III

WEST CHICAGO ORE TAILINGS PILES
WATER LEACHABLE @ pH5

(By Appendix B Method, Illinois EPA Division of Land/Noise Pollution Control)

I.D.		% Moisture	Milligrams/Liter*								
Location	Depth (In)		As	Cd	Cr	Cu	Fe	Ni	Pb	Se	Zn
1	18	38.8	0.059	0.002	0.082	0.056	0.25	0.057	0.010	0.069	0.31
1	36	38.8	0.082	<0.001	0.061	0.069	0.24	0.044	0.023	0.074	0.37
1	72	37.5	0.088	0.002	0.033	0.062	0.21	0.28	0.013	0.067	0.24
2	18	44.5	0.097	0.004	0.029	0.083	0.25	0.059	0.031	0.071	0.096
2	36	44.0	0.072	0.003	0.059	0.074	0.20	0.041	0.034	0.057	0.11
2	84	45.0	0.075	<0.001	0.034	0.044	0.25	0.023	0.046	0.059	0.15
3	18	38.9	0.083	0.003	0.043	0.071	0.20	0.026	0.004	0.062	9.1
3	36	39.3	0.089	<0.001	0.051	0.049	0.19	0.028	0.008	0.062	16
3	72	40.5	0.059	<0.001	0.041	0.064	0.20	0.039	0.008	0.047	2.1
4	18	42.4	0.095	<0.001	0.034	0.083	0.25	0.036	0.011	0.043	0.40
4	36	40.8	0.046	<0.001	0.020	0.057	0.22	0.035	0.032	0.048	0.62
4	90	45.4	0.072	0.002	0.021	0.045	0.21	0.026	0.020	0.059	0.37
5	4	40.8	0.021	<0.001	0.036	0.021	0.13	0.020	0.10	0.034	0.048
5	36	39.8	0.040	<0.001	0.017	0.036	0.094	0.009	0.052	0.030	0.059
6	4	29.7	0.011	<0.001	0.009	0.021	0.23	0.023	0.23	0.031	0.043
6	48	30.4	0.034	0.002	0.018	0.032	0.21	0.019	0.18	0.022	0.091
7	4	39.9	0.018	<0.001	0.024	0.014	0.093	0.029	0.12	0.034	0.037
7	36	39.3	0.024	<0.001	0.016	0.021	0.16	0.017	0.076	0.038	0.037
8	4	44.9	0.041	<0.001	0.047	0.034	0.20	0.034	0.17	0.030	0.053
8	36	35.7	0.051	<0.001	0.030	0.034	0.16	0.021	0.083	0.037	0.075
9	4	38.0	0.016	<0.001	0.008	0.020	0.077	0.037	0.091	0. 17	0.067
9	36	27.7	0.047	<0.001	0.032	0.027	0.13	0.023	0.11	0.023	0.091
10	4	33.1	0.034	<0.001	0.030	0.030	0.17	0.014	0.13	0.048	0.043
10	36	32.2	0.041	<0.001	0.021	0.025	0.22	0.041	0.071	0.086	0.070
11	4	37.0	0.026	<0.001	0.024	0.017	0.18	0.027	0.15	0.021	0.016
11	36	32.6	0.037	0.003	0.027	0.043	0.23	0.034	0.072	0.049	0.12

*Note concentration units are in mg/L as prescribed by Appendix B method for 1 liter of water extract from 100 g of "As Is" sample; to compare with the results in Table II multiply above result by $\frac{1000}{\%\ \text{moisture}}$.

TABLE III-A

WEST CHICAGO ORE TAILINGS PILES
WET PILE MATERIAL*

I.D.		Water Leachable @ pH 5 on "As Is" Basis		Water Leachable @ pH 5 Calc'd to Dry Basis	
Location	Depth (In)	SO_4, %	F, %	SO_4, %	F, %
1	18	0.63	.027	1.03	.044
7	4	2.71	.0014	4.51	.0023

*Analysis conducted on Illinois EPA Appendix B Water Leachates where caustic and/or HCl was used to control pH @ 5.

TABLE III-B

WEST CHICAGO FACILITY
WET PILE MATERIAL*

I.D.		Water Leachable @ Uncontrolled pH*	
Location	Depth (In)	Cl^-, %	TDS, %
1	18	0.16	1.10
7	4	.01	4.44

*Analysis conducted on Special Leachate using 10 g wet cake in 100 ml water for 4 hours and calc. to dry solids basis.

Note to Table III-B:

The sample of the ore residue (sample point number 7) when placed in demineralized water lowered the pH to 3.69 as measured four (4) hours after immersion.

TABLE IV

WEST CHICAGO ORE TAILINGS PILES COMPOSITION

I.D.			Composition (By X-ray Diffraction)	
Location	Depth (In)	% Moisture	Major = > 20%	Minor to Intermediate = < 20%
1	18	38.8	A	Q (D & CP, tentative)
1	36	38.8	A, AMP	Q, UP, (D & CP, tentative)
1	72	37.5	A, AMP	Q, CP
2	18	44.5	A, AMP	Q, UP, CeP
2	36	44.0	A, AMP	Q, UP, CeP
2	84	45.0	A, AMP, CeP	Q, CeP, (D, tentative)
3	18	38.9	A, AMP	Q, CP, UP
3	36	39.3	A, AMP	Q, CP, UP
3	72	40.5	A, AMP	Q, CP
4	18	42.6	A, AMP	Q, UP
4	36	40.8	A, AMP	Q, CP, D, UP
4	90	45.6	A, AMP	Q, UP
5	4	40.8	G	Q, CR, C
5	36	39.8	G	Q, CR, C
6	4	29.7	G	Q, CR, C
6	48	30.4	G, C	Q, CR
7	4	39.9	G	Q, CR, C
7	36	39.3	G	Q, CR, C
8	4	44.9	G	Q, CR, C
8	36	35.7	G, C	Q, CR
9	4	38.0	G	Q, CR, C
9	36	27.7	G, C	Q, CR
10	4	33.1	G	Q, CR, C
10	36	32.2	G	Q, CR, C
11	4	37.0	G	Q, CR, C; UP
11	36	32.6	G, C	Q, CR

A = C_eF_3
AMF = Amorphous
C_eP = C_ePO_4 (Hex)
C = $C_{e2}(SO_4)_3$
CP = C_ePO_4 (mono)

G = Gypsum ($C_aSO_4 \cdot 2H_2O$)
CR = Christobalite (S_iO_2)
Q = Quartz (S_iO_2)
D = Dolomite
UP = Unidentified Phase

Appendix 4. Perched Water Data and Related Information

Contents — Page

4.1 Letter with enclosures to Mr. R. Cooperstein dated 12/29/76 from Mr. R. J. Vreeland — 163-171

KERR-McGEE CHEMICAL CORP.
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

December 29, 1976

Mr. R. Cooperstein
Fuel Processing & Fabrication Brands
Division of Fuel Cycle & Material Supply
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

RE: License STA 583
Docket No. 40-2061

I am enclosing additional analytical data of ground water and soil taken at test well B-2 at the southwest corner of the West Chicago waste disposal area.

The ground water in the well was resampled on 12/1/76. Two water samples were taken, the first marked 719.96 and the second about a half hour later marked 719.26. The surface soil was also sampled in the vicinity of the well (first six soil samples). The core samples taken at the time of well drilling were also analyzed (last five samples). The purpose of these samples was to verify that the high Radium-228 shown in the original water sample (report of November 24, 1976) could be in error.

I am also enclosing the results of the cation exchange capacity determination of the clay layer from wells B-1, B-3, B-4, and B-5.

Sincerely,

RJ Vreeland

R. J. Vreeland
Sr. Project Engineer

gaj

cc: Dr. Ron Zussman w/enclosures
Argonne National Laboratory
7900 S. Cass Avenue
Argonne, Illinois 60439

Enclosures

subject copy

KERR-McGEE CORPORATION
INTERNAL CORRESPONDENCE

TO R. J. Vreeland
DATE December 21, 1976
FROM G. E. Van De Steeg
SUBJECT West Chicago Samples; Project 4556

Thirteen samples (2 water, 6 soil and 5 core - subsoil) were received on December 8 and 9 for isotopic radium analysis. The results of these analyses are reported on the attached Table.

This isotopic radium analysis involves multiple alpha and beta counting of each sample over one week. Then, multiple-least-squares analysis of the data is used to resolve the four curves (one each for Ra-223, Ra-224, Ra-226 and Ra-228). Because of the nature of this analysis, the Ra-228 assay is subject to the greatest error (± 1 pCi at 2 pCi/l of Ra-228).

The procedure used has not been published as an approved procedure by any of the agencies usually associated with this activity (ASTM, EPA, ERDA, etc.). However, we feel this procedure provides a quality assay commensurate with our existing equipment and the time required for sample turnaround. (To the best of my knowledge, there is no published procedure for isotopic radium analysis - although there is a published procedure for Ra-228 assay. This procedure used should be as good or better than the published Ra-228 assay method.)

G. E. Van De Steeg

GEV/nvb
Attachment
cc: C. H. Long
W. J. Shelley

File: West Chicago Plant

WEST CHICAGO SAMPLES

Sample Identification	Ra-223	Ra-224	Ra-226	Ra-228
Water, B-2, WL 12/1/76 - 719.26, pCi/l	<.10	.24	<.10	3.2
Water, B-2, WL 12/1/76 - 719.96, pCi/l	<.10	.12	<.10	.57
Soil, B-2, 60' North, pCi/g	<.05	3.3	.79	13
Soil, B-2, 45' North, pCi/g	<.05	3.5	.65	13
Soil, B-2, 30' North, pCi/g	<.05	3.2	.40	11
Soil, B-2, 15' North, pCi/g	<.05	3.9	.65	17
Soil, B-2, 15' West, pCi/g	<.05	.66	.07	.88
Soil, B-2, 10' South, pCi/g	<.05	.18	.30	.86
Subsoil, B-2, S-2, 18943/1.5'-3', pCi/g	<.05	.16	.46	2.6
Subsoil, B-2, S-6, 18943/7.5'-9', pCi/g	<.05	<.05	.52	2.4
Subsoil, B-2, S-7, 18943/9'-10.5', pCi/g	<.05	.19	.51	2.5
Subsoil, B-2, S-9, 18943/12'-13.5', pCi/g	<.05	.64	.88	6.9
Subsoil, B-2, S-13, 18943/18'-19.5', pCi/g	<.05	<.05	.44	1.4

STS Job No. 18943

Page 1 of 1 Date 4 Dec 76 mul

RESULTS OF CATION EXCHANGE CAPACITY MEASUREMENTS ON SOIL SAMPLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Soil Sample					Water Content* %		CEC in Meq/100g of Dry Soil**						
B-1, S-14 21.0 22.5'					14.63		4.35						
B-3, S-12, 16.5-18.0'					17.51		4.16						
B-4, S-34 51.0-52.5'					11.03		3.52						
B-5, S-18, 25.5-27.0'					18.44		5.14						

*Water Content = (Weight of Water Removed @ 105°C./Weight of Dry Sample) x 100%

**The cation exchange capacity (CEC) was determined using Method 57-2, Methods of Soil Analysis, American Society of Agronomy (1965). In this procedure, the soil sample is saturated with one (1) normal ammonium acetate at a pH = 7.0±0.1. The ammonium ions, which are bound into the cation sites by this exposure, are subsequently removed and their numbers determined quantitatively. The CEC is given in units of milliequivalents per 100 grams of dry soil.

STS Job No. 18943

Page 1 of 1 Date 14 Dec 96 mul

RESULTS OF CATION EXCHANGE CAPACITY MEASUREMENTS ON SOIL SAMPLES

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Soil Sample					Water Content* %		CEC in Meq/100g of Dry Soil**						
B-1, S-14 21.0-22.5'					14.63		4.35						
B-3, S-12, 16.5-18.0'					17.51		4.16						
B-4, S-34, 51.0-52.5'					11.03		3.52						
B-5, S-18, 25.5-27.0'					18.44		5.14						

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STS Job No. 18943

Page 1 of 1 Date 4 Dec 96 mul

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*Water Content ≡ (Weight of Water Removed @ 105°C./Weight of Dry Sample) x 100%

**The cation exchange capacity (CEC) was determined using Method 57-2, Methods of Soil Analysis, American Society of Agronomy (1965). In this procedure, the soil sample is saturated with one (1) normal ammonium acetate at a pH = 7.0±0.1. The ammonium ions, which are bound into the cation sites by this exposure, are subsequently removed and their numbers determined quantitatively. The CEC is given in units of milliequivalents per 100 grams of dry soil.

KERR-McGEE CORPORATION
INTERNAL CORRESPONDENCE

TO R. J. Vreeland

DATE November 24, 1976

FROM G. E. Van De Steeg

SUBJECT West Chicago Water Samples;
Project 4556

The attached two Tables summarize the results of analyses on the five West Chicago water samples submitted on October 11, 1976. The results do not give any indication of appreciable materials entering the ground water at the center (Sple B-5) and reporting to the southwest (Sple B-2) corner sample.

G. E. Van De Steeg

G. E. Van De Steeg

GEV/nvb
Attachments
cc: J. M. Carver
W. J. Ganus
C. H. Long
W. J. Shelley

File: West Chicago Plant

WEST CHICAGO WATER SAMPLES

Sample I.D.	TDS mg/l	SO_4 mg/l	Cl mg/l	Se mg/l	pH	Ra-223 pCi/l	Ra-224 pCi/l	Ra-226 pCi/l	Ra-228 pCi/l
B-1, S. E. Corner	1300	490	120	.012	6.4	<.05	.34	.47	.25
B-2, S. W. Corner	2970	1200	370	.018	6.8	≤.14	20.	2.7	153
B-3, W. Corner	3250	1600	395	.018	6.3	<.05	.11	≤.50	.36
B-4, N. E. Corner	871	270	65	.012	6.4	<.05	.31	≤.05	1.6
B-5, Center	2370	980	200	.023	6.5	<.05	1.7	≤.10	8.8

Sample I. D.	Th-228* pCi/l	Th-230* pCi/l	Th-232* pCi/l
B-1, S. E. Corner	.056 ± .010	.002 ± .002	.002 ± .002
B-2, S. W. Corner	.153 ± .016	.002 ± .002	.002 ± .002
B-3, W. Corner	.137 ± .015	.002 ± .002	.002 ± .002
B-4, N. E. Corner	.182 ± .017	.002 ± .002	.002 ± .002
B-5, Center	.152 ± .016	.002 ± .002	.002 ± .002

* ± one standard deviation (σ) of the counting rate.

WEST CHICAGO WATER SAMPLES

Sample I. D.	Ag mg/l	Al mg/l	B mg/l	Ca mg/l	Co mg/l	Cr mg/l	Cu mg/l	Fe mg/l	La mg/l
B-1, S. E. Corner	.004	.4	.3	100	.01	.06	.1	.04	<.04
B-2, S. W. Corner	.06	.6	.3	210	<.03	<.03	.09	3	<.1
B-3, W. Corner	<.01	1	.6	320	.03	.06	.06	1	<.1
B-4, N. E. Corner	.03	.3	.3	90	<.009	.009	.09	.3	.03
B-5, Center	<.007	.7	.7	170	.02	.7	.2	5	<.07

Sample I. D.	Mg mg/l	Mn mg/l	Mo mg/l	Na mg/l	Ni mg/l	P mg/l	Si mg/l	Ti mg/l	V mg/l	Y mg/l	Zn mg/l
B-1, S. E. Corner	100	.4	.01	>130	.1	1	10	.3	<.01	<.01	.6
B-2, S. W. Corner	210	.6	.09	>300	.2	<3	9	.06	<.03	<.03	<.3
B-3, W. Corner	160	1	.03	>320	.2	<3	30	.03	.03	<.03	1
B-4, N. E. Corner	40	.2	.03	90	<.009	<.9	30	.02	.03	.09	.3
B-5, Center	70	.7	.02	>240	.2	<2	20	.05	<.02	<.02	.7

These results are from emission spectrographic analysis on the total dissolved solids and, as such, have a variance of +300% to -50%.

Appendix 5. Supporting Documents and Correspondence

Contents Page

5.1 Minutes of meeting of 10/6/76 at ANL 173-179

Exhibit A Location of Washes-Map

Exhibit B Radioactive Survey-Map

R Vreeland

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

DOCKET NO.: 40-2061

APPLICANT: Kerr-McGee Chemical Corp.

FACILITY: West Chicago, Illinois Thorium/Rare Earth Processing Plant; Solid Waste Storage Area Modification Plan Amendment

SUBJECT: REPORT OF A MEETING ON OCTOBER 6, 1976

The NRC staff, Argonne National Laboratory (ANL) consultants, and representatives of the applicant and of concerned State agencies met to discuss the hydrogeologic information needed to perform the comprehensive environmental assessment for the applicant's proposed plan to modify their solid waste storage area at the West Chicago, Illinois site. The participants concurred both in this approach and the conclusions of the discussion.

Background

The meeting was held on October 6, 1976 at ANL; the attendees are listed in Attachment 1. The meeting was held because staff reviewers and Illinois state agency representatives had expressed concerns about deficiencies in environmental information in the proposal's accompanying information submittal. This limits NRC's capability to assess the environmental impact of the applicant's request. These findings were also expressed by representatives of Illinois State agencies at an earlier meeting held at ANL (September 14, 1976) at which the applicant's representatives were not present.

Discussion

R. J. Vreeland, Kerr McGee Chemical Corporation (K-M) reviewed the applicant's proposal which is summarized as follows:

1. The solid wastes storage area, approximately 27 acres, contains a large pile of ore processing residues, pond residues and dredgings from ponds which were accumulated from processing operations over a 40 year period of plant operation.

2. The plant discontinued operations at the end of 1973.

3. Additional wastes in the storage area consist of miscellaneous discarded equipment and debris derived from dismantling, decontamination and decommissioning operations from associated plant buildings.

NOV 1 5 1976

4. The waste piles contain mainly rare-earth compounds and thorium tailings; the miscellaneous debris - defunct equipment and piping - is similarly contaminated with these materials.

5. The aims of the K-M proposed waste storage area plan are:

   - to make the property more useful;
   - to improve the appearance of the site; and
   - to minimize the potential hazard to the public and the environment that might accrue from the existing storage conditions.

6. The plan involves filling in existing percolation ponds by overgrading with earth from the southern end of the property and from some building areas. Thereby, approximately the southern half of the waste storage area (about 13 acres) could be released from the license conditions and returned to unrestricted use. The remaining waste storage area would be retained under the license by K-M or a buyer of the property.

7. According to K-M radiation survey indications, some small, shallow areas in the southern sections would have to be transferred to the proposed constricted storage area before the southern portion of the property could be released from the license for unrestricted use.

8. Representatives of various Illinois state agencies expressed the following concerns to the K-M representatives:

   - Soils do not have good attenuating characteristics re-leachants and would permit influx to groundwater according to data indications. How would this be addressed by K-M?

   - There is a lack of knowledge about sand lenses in the site's geology since no on-site geological data exists. Illinois State Geologic Survey (ISGS) data indicates the presence of a moraine in the vicinity of the site.

   - The state agencies are apprehensive about using permeable soil as ground cover for the wastes and are concerned about the pollution potential due to leaching of the waste piles and other buried materials. For example, during operations in the past, homeowners south of the site were told they could not use their well water on occasions, because they had contained higher than acceptable levels of non-radiological chemicals.

- State representatives believe the use of local clay fill rather than (permeable) soil for the ground cover would be preferable.

- Would the planned storge conditions meet the Illinois State geologic requirements of an ordinary solid waste disposal site for issuance of a permit? (IEPA raised the question as an interested party.)

9. K-M representatives' responses and comments to the above were as follows:

   - Pond #1 is on a clay base; some lateral water movement would be expected as there is a perched water table due to fault areas at a depth of about 9 feet from the surface.

   - Clay was encountered in digging sewers about 1958 in the southwest region of the site, which was going in a northwesterly direction for about 500 feet from the site boundary.

   - The general drainage slope of the site is planned to run from the northeast to the southwest (towards sewers). Operating experience already indicates that this is the direction of flow. In addition, existing data can show that groundwater quality (re: pond #5) is very close to original water quality values going in a southwesterly direction.

   - It is K-M's contention that there is "no more" leachable material in the stored wastes that would cause any environmental concern. Trash would not be leachable either. However, there is essentially no data in hand to support this."

10. ANL consultants expressed the fact that they do not have enough hard data to do a comprehensive environmental assessment for NRC with the existing information.

11. W. Shelley of K-M summarized the discussion as follows: (a) it would be desirable to establish the geology under the site to increase the certitude of the safety in the storage plan with regards to the public's health and the environment; (b)It would be desirable to increase the security of the wastes contained in the constricted storage area by resorting to "encapsulation" (intermittent soil and clay layers) in producing the ground cover.

12. The additional efforts to be performed by K-M and the other participants were discussed in terms of shirt-sleeve English. These efforts were mutually agreed upon by the representatives of the various Illinois state agencies, ANL consultants and the applicant. The items of agreement are listed in Attachment 2.

13. NRC staff encouraged the performance of these actions to permit expenditious assessment of the applicant's request and continuing timely action on the matter by the Nuclear Regulatory Commission.

14. While not discussed in detail, Illinois Department of Public Health (IDPH), raised other questions about the proposed plan which the applicant was expected to address in the future. These included the financial ability of a license to do monitoring into perpetuity and the need of a health physicist at the site on a continuing basis.

/s/

R. Cooperstein
Fuel Processing & Fabrication Branch
Division of Fuel Cycle and
Material Safety

Enclosures:
As stated.

OCT 2 6 1976

ATTACHMENT 1

Meeting at ANL - October 6, 1976 - to discuss Hydrogeologic information requirements to assess Kerr-McGee West Chicago amendment request.

Participants:

R. Cooperstein	NRC
Bill Child	IEPA - Aurora
Joe Petrilli	IEPA - Springfield
Tom Cavanagh	IEPA - Springfield
Tom Johnson	ISGS
Jesse A. Pagliaro	NRC - IE:III
Chuck Grigalanski	IEPA - Aurora
Jim Daugherty	IEPA - Chicago
Nick Beskid	ANL
Ron Zussman	ANL
Thor Oberg	NRC - IE:III
Dave Ed	IDPH
Mike Auer	Kerr-McGee
Roy MacLean	Kerr-McGee
Joseph E. Rempe	Rempe Sharpg Inc.
W. J. Shelley	Kerr-McGee
R. J. Vreeland	Kerr-McGee
W. J. Ganus	Kerr-McGee
N. Frigerio	ANL

ATTACHMENT 2

OCT 2 6 1976

Conclusions of Meeting, October 6, 1976, concerning Kerr-McGee Chemical Corporation's West Chicago, Illinois Solid Waste Storage Amendment

The participants agreed that the following would be done to enhance the information available for the environmental assessment:

I Borings

1. As ANL suggested, five borings will be made by K-M; the locations of the borings will be at the NE, SE, SW corner sections of the site, adjacent to the main pile on the SW side (down-gradient side) and at the center of the site area.

2. Continuous boring samples, in jars, will be analyzed for grain size, permeability and for relevant chemical and radiological constituents.

3. Borings will be made to below the top of a clay layer or to the bottom of a sand lens; plastic screen will be used on bottom of sand lens, if found.

4. The boring at the center of the site will be to bedrock (~80-105 feet).

5. If water is encountered during drilling, it will be sampled then and 24 hours later.

II Analysis

1. A field log will be kept during the drillings.

2. ANL will handle one-half of the samples and the distribution of the balance of the samples will be among the other participating parties (K-M and Illinois state agencies).

3. ANL will perform spectrographic, chemical and radiological analyses of soil samples. The number of samples will depend upon the findings of drillings from the upper layers. Later water samples will be taken in duplicate for analysis by participants. Background sample(s) will be taken from off-site. Samples from Northeast (an unrelated open site) will be supplied by J. Rempe.

4. IEPA, ISGS, ANL and NRC:IE:III representatives will be present at time of drilling.

5. KM will do independent analyses to compare with ANL and Illinois state agencies.

6. State agencies will collect sewer samples concurrently with drillings and for about 1 month thereafter.

7. The drillings and the bulk of the sampling can be done within two weeks after approval by respective managements of the participants.