OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : Files

THRU: R. S. Cleveland, Senior Radiation Specialist
Region I, Division of Compliance

DATE: November 21, 1967

FROM : N. Michael Shopenn, Radiation Specialist
Region I, Division of Compliance

SUBJECT: STEPAN CHEMICAL COMPANY
MAYWOOD DIVISION
100 WEST HUNTER AVENUE
MAYWOOD, NEW JERSEY 07607
LICENSE NUMBER: STC-130

Inspector's Evaluation

The following items of noncompliance were noted as a result of an inspection performed on October 18 and November 2, 1967: Burial on licensee's property without authorization, 10 CFR 20.301(c); Disposal of contaminated material by incineration, 10 CFR 20.305; and 10 CFR 20.401(b), records of surveys during the decontamination and burial were not kept.

These items were discussed with Mr. Swanson, who stated the conditions would not occur again. The company is not now and does not intend to return to the business of extracting source materials from rare earths and they are in the process of requesting termination of the current source materials license.

It is the opinion of the inspector that the burial of the waste slurry material was the best thing the company could have done. It keeps the material from being dispersed by the winds and rain as it is underground. Water will not dissolve the salts, as they are most insoluble in water.

DRAFT
SHOPENN:cc
11/6/67

Reviewed 11/20/67
et al
RS

BACK-UP FOR AEC-592

PARTS 20 and 40 INSPECTION

STEPAN CHEMICAL COMPANY
Maywood Division
100 West Hunter Avenue
Maywood, New Jersey 07607

Inspector: N. Michael Shopenn

Lic. No.: STC-130

Persons Accompanying Inspector

None, State notified

Persons Contacted

Mr. Ernest A. Swanson, Director of Production and Engineering
Harold Spiess, Controller and Chief Accountant
J. Alrutz, Past Director of Production and Engineering
Edson Nichols, Engineer

Noncompliance Noted

10 CFR 20.301(c) - General Requirements - burial of radioactive material.

See paragraphs 22 - 28 of report for details.

10 CFR 20.305 - Treatment or disposal by incineration. See paragraph 25 of report for details.

10 CFR 20.401(b) - Records of Surveys, radiation monitoring and disposal - See paragraphs 16 - 19 of report for details.

Dates of Inspection: November 2, 1967
October 18, 1967 (Announced Reinspection)

REPORT DETAILS

Background Information

Results of Previous Inspections

1. The following information was obtained from the prior inspection reports maintained in the licensee's folder.

2. The last inspection was made on August 30 and September 4, 1963 by Ernest P. Resner, who noted the following items of noncompliance:

   20.105 - Permissible levels of radiation in unrestricted areas (the waste slurry pile), Buildings 21, 23 and 24.

   20.203 - Caution signs and labels

   20.203(b)

   20.203(e)(2)

   20.203(f)(2)

3. Inspections made prior to the 1963 inspection were on May 24, 1957 and May 15, 1961. These inspections reported items of noncompliance.

History of Operations

4. A description of the overall history appears in the inspection report of August 30 and September 4, 1963, Items 9 - 12. Briefly, the history of the company's thorium operations as related to the inspector by Mr. Swanson, Director of Production and Engineering, is as follows: The plant started operations in the late 1800's about 1895. When World War I started, a shortage of thorium for gas mantles appeared. The company started production of this material from monzite sands separating the rare earths from it. This process continued until 1957 when the plant shut down operations . The plant then started to dispose of its stacks

of materials and equipment; the last being disposed of in 1966 by sale and burial of the slurry wastes completed in August 1967.

Organization and Administration

5. The Maywood Division of the Stepan Chemical Company is a subsidiary of the Chicago firm of Stepan Chemical Company. This division of the company employs 65 to 80 persons depending on workload demands. This information was given to the inspector by Harold Spiess, Controller and Chief Accountant.

6. The Maywood Plant is in charge of Mr. D. H. Francis, Vice President and General Manager. Mr. Ernest Swanson, Director of Production and Engineering works directly for Mr. Francis. Mr. H. Spiess is the company controller and Chief Accountant, reporting to Mr. Francis and the company's Chief Controller in Chicago. This information was supplied to the inspector by Mr. Spiess.

Products and Services

7. Mr. Swanson related the information on the Maywood Division, Stepan Chemical Company's current products. The Division now manufactures essential oils obtained from glove leather cuttings and waste shavings. This is to be used in the manufacture of washing products.

8. The company is no longer in the production of rare earths materials or thorium salts. The company does not intend to return to the production of materials from the rare earths. Mr. Swanson was most emphatic in this statement. He stated the company is in the process of filing for termination of the source materials license it now holds.

Facilities

9. Currently, there are no facilities for storage, use or preparation of the

thorium. Mr. Swanson stated the remaining chemical processing facilities are being reworked and updated to handle the products now being manufactured. All thorium facilities have been dismantled. See Attachment 1 for the decision to demolish in paragraph 2.

10. Prior to and during the dismantling of the buildings, the State of New Jersey, Department of Health, Radiological Unit, checked out the buildings. (Attachment 1, Pages 3 - 5, and Attachment 2, drawing locating the buildings on the property.)

Radiation Safety Officer and Radiation Safety Committee

11. The plant does not have any need for a Radiation Safety Officer nor a Radiation Safety Committee, at this time. Mr. Alrutz who was the RSO during the last sales of the material and during the dismantling of the buildings, left the company's employ in July 1966. Mr. Swanson stated he assumed the responsibilities of RSO. Mr. Swanson has a B.S. in Chemistry and is an experienced Chemical Engineer with five years of radiological safety experience, under Mr. Alrutz.

Personnel Monitoring

12. Dosimeters were worn by personnel working on the decontamination and dismantling process buildings. This was stated to the inspector by Mr. Swanson and Mr. Alrutz, who made the statement during a phone conversation at the plant on November 2, 1967. Data from the records kept on the film badge results showed 317 mrem for G. Finly and 170 mrem for Mr. Buscen in 1963. This was received during the transfer of material, decontamination and dismantling of the buildings in October through December 1963. Mr. Finly received 85 mrem during January through March 1964 as decontamination and dismantling continued. There were no film badges worn after completion of the dismantling

and disposing of the building scrap as stated by Mr. Swanson.

13. Film badges are issued monthly, collected and sent to Tracerlab Division, Laboratory for Electronics under contract.

14. Personnel did not wear film badges during the waste slurry burial as stated by Mr. Swanson. Mr. Swanson stated he performed the surveys and the maximum reading found was 5 mr/hr at contact (1cm.) as ~~with~~ isolated hot spots in ~~this~~ the slurry pile. It was his decision that exposures would not be in excess of 20.202 provisions. Discussion of this monitoring will be discussed in detail in the section on surveys.

Surveys and Survey Instruments

16. Surveys were performed by the Tracerlab Company in January 1964 (Attachment 3, Tracerlab Report and J. Alrutz memo) prior to decontamination and by the State of New Jersey, Department of Health, Radiation Safety Section. The State Health Department personnel covered all the decontamination work and contained surveys with the RSO and company personnel assisting. This has been stated by Alrutz and Swanson with a confirming report from Mr. Russo of the State agency. The only survey available from the state at this time is the one attached to a memo from Alrutz (Attachment 1, pages 3 - 5.)

17. ~~Alrutz~~ Mr Swanson stated he performed the surveys on the loads during the removal of the waste slurry pile to the burial site. He stated he checked the loads

and found contact readings of 0.1 mr/hr to 2 mr/hr on the average with an occasional report reading 5 mr/hr at contact. Mr. Swanson ~~xxxxxx~~ went on to state that he was the only person to be within a meter of the 5 mr/hr readings, all the operators by the design of the equipment and the truck cabs were at least a meter away.

18. The survey instruments used by the state are described in Paragraph 1 of the Attachment 1. The Tracerlab survey was performed with an Eberline PAC-3G alpha detector and a Tracerlab SU-1H Cutie Pie (Attachment 3, page 4). The survey meters can be assumed to be calibrated properly as the agencies involved are reputable and normally have well calibrated equipment available for use. The survey meter used by Mr. Swanson was a CDV-700, serial number 90308 (0-50 mr/hr) Victoreen, manufactured geiger tube probe meter with capability for open and closed window reading. Mr. Swanson stated the ~~information~~ instrument was sent back to the manufacturer in 1966 for overhaul and calibration. Mr. Swanson stated he checked and calibrated the instrument against the known standard, and sent with the instrument on a daily basis. He also stated he changed the "D" cells in the instrument daily to ensure against battery failure in the field during the day. The instrument was shown to the inspector.

19. The inspector conducted a dose rate survey in the area of the old buildings, then the general waste burial area, and the area where the slurry waste and decontamination wastes are buried. The general background reading was .025 mr/hr on an NC Model GS-2, #5588 end window GM tube survey meter. All areas surveyed read background. Six spot ~~xxx~~ samples were collected. The following table gives the locations and results of the samples. Samples read background on the portable survey meter, when held to the open end window.

Sample	Type	Location	Results
1	vegetation maple, sumac, poplar, leaves,	adjacent to the Burial Site II	
2	vegetation weeds	Use and Storage Site	
3	Water	Puddle, old Use & Storage site	36 ∓ 18 pCi/l (α) 35 ∓ 5 pCi/l (β)
4	Water	Storm Drain	59 ∓ 18 pCi/l (α) 77 ∓ 5 pCi/l (β)
5	Soil	old Use & Storage area	20 ∓ 3 pCi/g (α) 20 ∓ 1 pCi/g (β)
6	Soil	Storm Drain at side of ditch	11 ∓ 3 pCi/g (α) 23 ∓ 1 pCi/g (β)

<u>Materials Procurement, Transfers and Disposal</u>

20. Mr. Swanson stated, and his records reflect, that there had not been any purchases since the last inspection.

21. The inventory of materials, Item 31 of the inspection made on August 30 and September 4, 1963, were transferred and shipped by truck to Davidson Chemical, Attention: Mr. Richard Mandell, P. O. Box 188, Pompton Plains, New Jersey. This was noted in a letter dated October 11, 1963 to Mr. Mandell, signed by J. P. Alrutz. Information on this transfer was noted by the inspector from the actual letter.

22. The waste slurry pile was disposed of along with surrounding earth into two burial pits, Attachments 4 and 5. Pit I has 170,250 ft^3 and Pit II has 84,480 ft^3 of material buried in it. The material was removed from the storage site to the burial pits by 10 cubic yard dump trucks in six cubic yard amounts. Mr. Swanson stated the waste material was removed was a slime (thixotropic) material.

23. The first pit was filled and covered with a 4' cover of clean soil, 2" of turf and seeded with grass. The second pit was covered with 4' of clean fill and 2" of stone and an additional 2" of stone and 2" of slphalt will be added when the area is settled.

24. The burial of the waste material took place in November and December 1966 for Burial Pit I and July and August 1967 for Burial Pit II , as stated by Mr. Swanson and confirmed by the inspectors' review of the records.

25. Scrap lumber & timbers were burned during the dismantling operations Mr. Swanson stated they did this with the low level contaminated material after ~~they were~~ it was decontaminated. Mr. Alrutz confirmed this information when the inspector talked to him on Nov. 2. 1967. Burning contaminated material with out a license specifically to do so was pointed out to Mr. Swanson as an item of noncompliance. Levels were assumed to be no more than indicated in the survey attachment 1 pages 3, 4 & 5. The incineration occured during the dismantling of the buildings in 1964 as stated to the inspector by Mr. Alrutz.

<u>Composition of the Waste Material Buried</u>

26. The waste material is the remainder of undissolved insoluble thorium phosphate

in a very alkaline media. This is due to the additional of lime after the fourth or fifth washing and processing off the original monzite sand as described to the inspector by Mr. Edson Nichols, Engineer of the company who was directly involved with the process. Additional material was buried in the form of drums of vacuum cleaner waste during decontamination, possibly contamination and incinerated and wooden scrop from contaminated buildings.

27. The total amount of waste material is described in the license as 2000 cubic yards (54,000 cubic feet) weighing an estimated 2,160,000 lbs. Mr. Alrutz stated the AEC operations office in the late 40's or early 50's analyzed a composite sample of the waste slurry with the resultant figure of 1.5% thorium content as an insoluble phosphate of the slurry. The specific activity of thorium is 1 curie/9 x 10^6 grams. The total activity calculated using the ratio of the size of the holes to the total amount of activity buried in each hole was 509.605 mCi in the 90' x 225' x 13' pit, and 179 mCi in the 66' x 90' x 13' pit. This gives a 7.03 x 10^{-4}uCi/gm of waste material based on 2000 cubic yards of material and the calculated amount of thorium buried in the barrels filled during the decontamination and demolition operation. Attachments 6 and 7 give the calculation for the amount of material buried. These calculations are conservative as Mr. Swanson stated they removed additional volumes of material around and beneath the ~~incinerated~~ slurry pile to ensure all the material was moved. This actually diluted the estimated amount of material by four.

28. The phosphate of thorium remaining in the waste does not consitute a hazard to the general public for several reasons, according to NAS-NS Pamphlet #3004, the radiochemistry of thorium, by E. K. Hyde, published in 1960, the phosphate of thorium are insoluble in water and are dissolved with extreme difficulty in concentrated acids (Page 4, Table 1,

Insoluble Compounds of Thorium). The material is buried in an area of sedimentary material as indicated by the large area of shale encountered in the digging of the burial pits. In Robert E. Liggetts, Geology and Engineering, shale is defined as consolidated fine sediments usually hardened clay or mud.

29. The inspector observed the area was mostly fine sediment and clay with broken red shale on the surface, thus giving credence to the statement made by Mr. Swanson encountering shale in the construction of the burial pits. Mr. Swanson stated the pits were free of ground water and did not reach the ground water table at the 13' level. The inspector noted the pits were dug on higher ground than the surrounding area.

Posting and Labeling

30. Mr. Swanson stated that a restricted area has been established with temporary fencing and signs around the slurry pile waste area and around each pit.

31. Mr. Alrutz stated the area and buildings during decontamination were roped off and signs posted. This statement was confirmed by a conversation the inspector has with John Russo of the New Jersey State Health Department, Radiological Health Unit in late October 1967. The burial pits are not marked ~~with the company~~ however, the company has them located on the plant property map.

Records

32. Mr. Swanson had available the records of moving the material to the burial site. This was classified as Company Confidential. He stated the costs

of the operation which were part of these records, caused them to be classifed as such.

33. The film badge records were available and inspected by the inspector. See paragraph 12 of this report for details.

Management Discussion

34. The items of noncompliance were discussed with Mr. Swanson. He stated that if he had realized it was necessary to apply to the commission for a license to bury the waste material he certainly would have performed the necessary paper work. Mr. Swanson stated he thought it was perfectly legal to bury on one's own property. The inspector quoted verbatim from 10 CFR 20.304 to Mr. Swanson concerning burials. He again apologized for not understanding fully these conditions. Mr. Swanson stated he did not realize he should have recorded the readings of the truck surveys.

35. Mr. Swanson stated the company was in the process of asking the Licensing Branch of the commission to terminate its license as the company does not have any material, nor does it intend to ~~[illegible]~~ reactivate the rare earths extraction manufacture.

36. The inspector stated at the conclusion of the discussion that the company will hear from the commission on the matters discussed.

To: J. Huber

From: J. P. Alrutz

Date: March 20, 1964

cc: DHFrancis - 5
EHNichols
EASwanson
JPAlrutz

Subject: Thorium Decontamination

1 John Russo and Roy Erlandson of the N. J. State Department of Health performed a radiation survey covering buildings 21, 23 and 24 today. The beta/gamma survey was performed with a Jordan ionization type meter which had been shielded with 1/4 inch of lead shielding. This allowed a measurement of the wall areas without influence from the general area background. Alpha measurements were taken with an Eberline with a 65 sq. cm. probe. Survey results are recorded on the three building plans attached. The upper figures are the beta/gamma readings in MR/hour and the lower figures are the alpha readings in counts per minute.

2. As noted on the survey records, Buildings 21 and 23 can be demolished and disposed of at dumping grounds off our premises. We also agreed not to allow the contractor to salvage the bricks or wood for re-use as the reassembly of the material into another structure may result in a detectable, though not dangerous, quantity of radiation which could be undesirable. Since our dumping area will be utilized for materials from other sources the dilution effect will virtually result in a normal background situation.

3. In the case of Building 24 the wooden frame still shows levels which make it undesirable for disposal off the premises so this wood can be burned in drums in a manner that will allow recovery of the ashes for examination of the consolidated activity. The sheet metal portion of the building can be washed and disposed of by removal to a dump.

4 The contaminated wood located between buildings 21 and 24 contains such small amounts of activity that Mr. Russo suggested that, if they were burned a few pieces at a time, no regulations would be violated. As in the previous instance the ashes would be collected and stored, if they exhibit sufficient radiation levels.

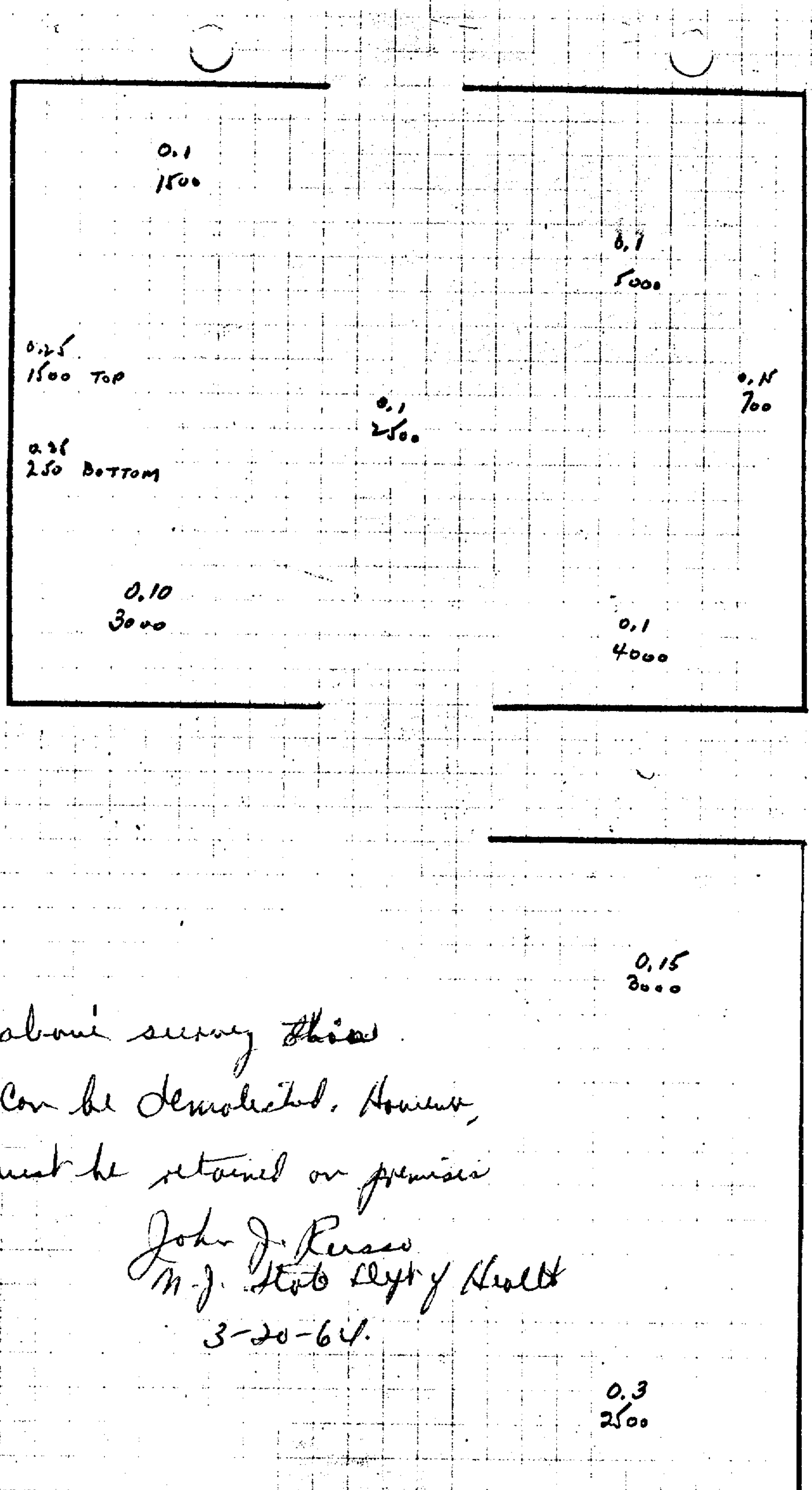
Attachment 1

5. In regard to the radiation problem at the property west of Route 17, the State representatives will consider the problem only after we have performed a survey to define what the problem is. Also, the intended use for the property will influence their decision - as industrial use will not require as strict interpretation as a school or residential use would. The film badges were inconclusive since 10 of the 13 units could not be interpreted because of some physical factor such as freezing or high humidity exposure and the other three units, which showed less than 10 MR gamma and 30 MR beta in more than 30 days exposure, were all located in the north dyke. Therefore, to examine this problem we have asked Tracerlab to perform the necessary survey and they will phone next week with a definite schedule for the work.

JPA/fe

BLDG
24
3/20/64

J. Russo
R. Erlandson
J. Alvitz

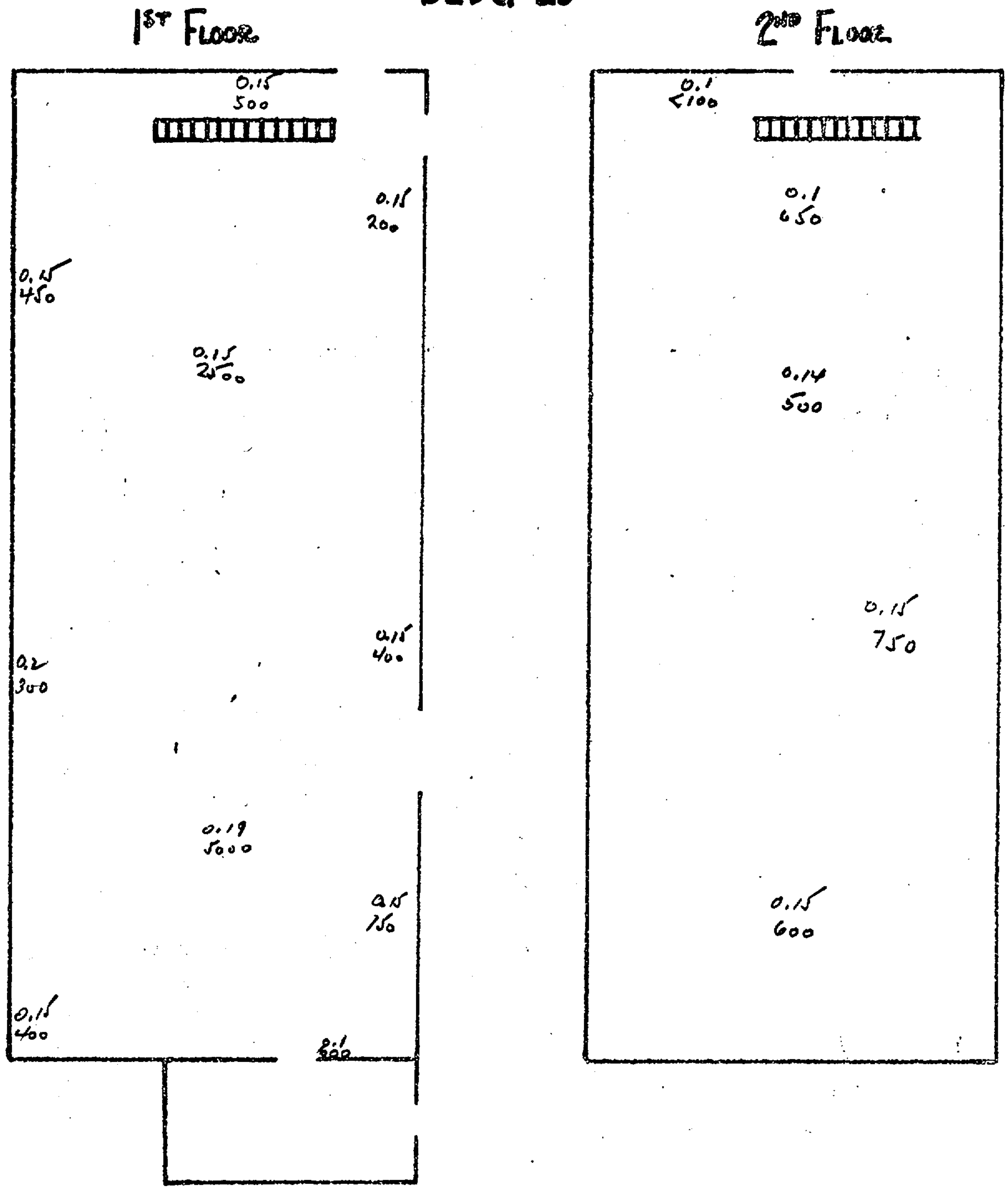


Based on above survey this building can be demolished. However, lumber must be retained on premises

John J. Russo
N.J. State Dept of Health
3-20-64.

3/20/64
J. Russo
R. Erlandson
J. Alrutz

BLDG 23



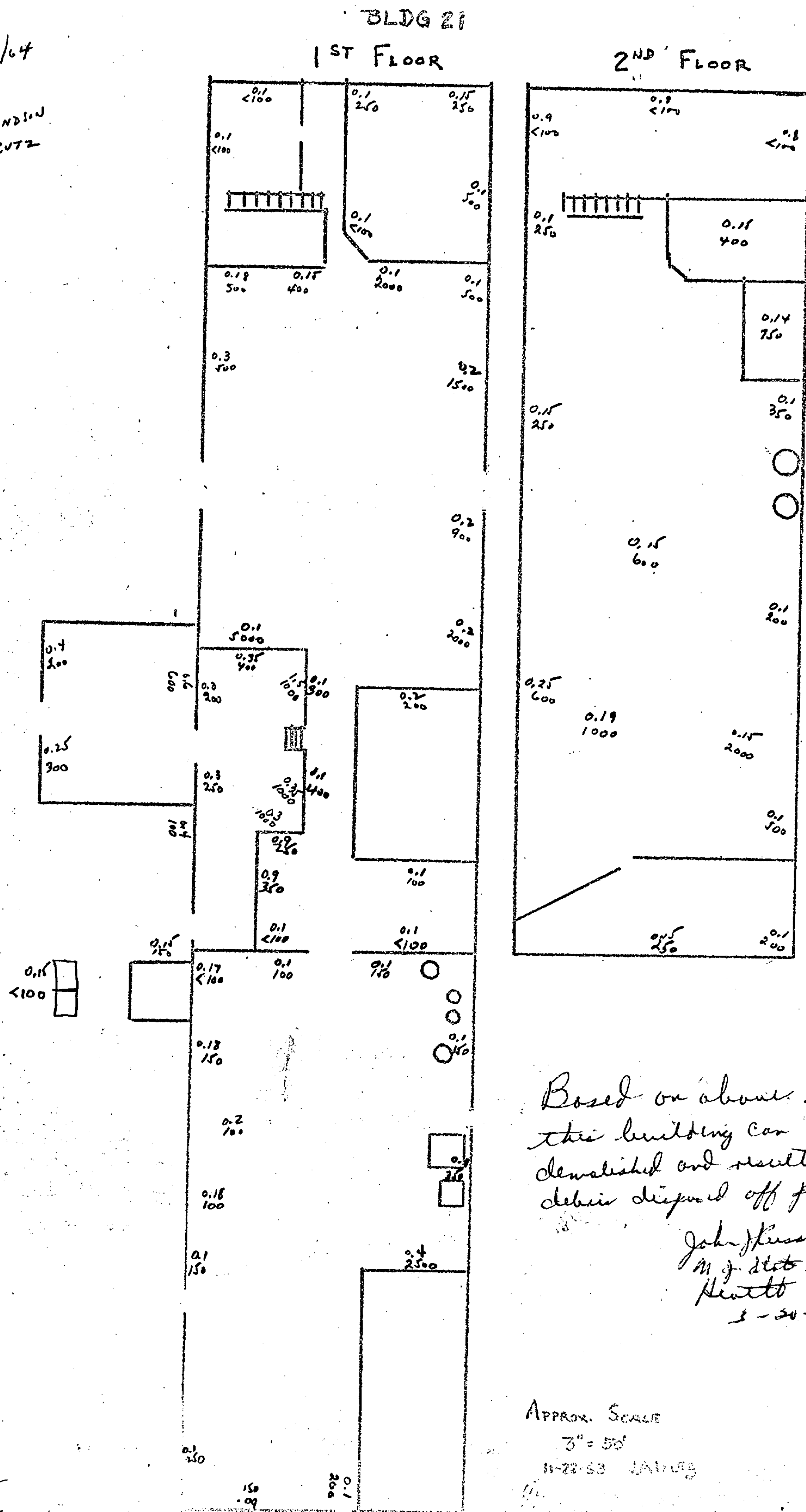
Approx. Scale
3" = 50'
11-22-63 J. Alrutz

Based on above survey this building can be demolished & resultant debris disposed off premises

John J. Russo
M. J. Slote Dept of Health
3-20-64

3/20/64

J. Russo
R. Erlandson
J. Alcutt

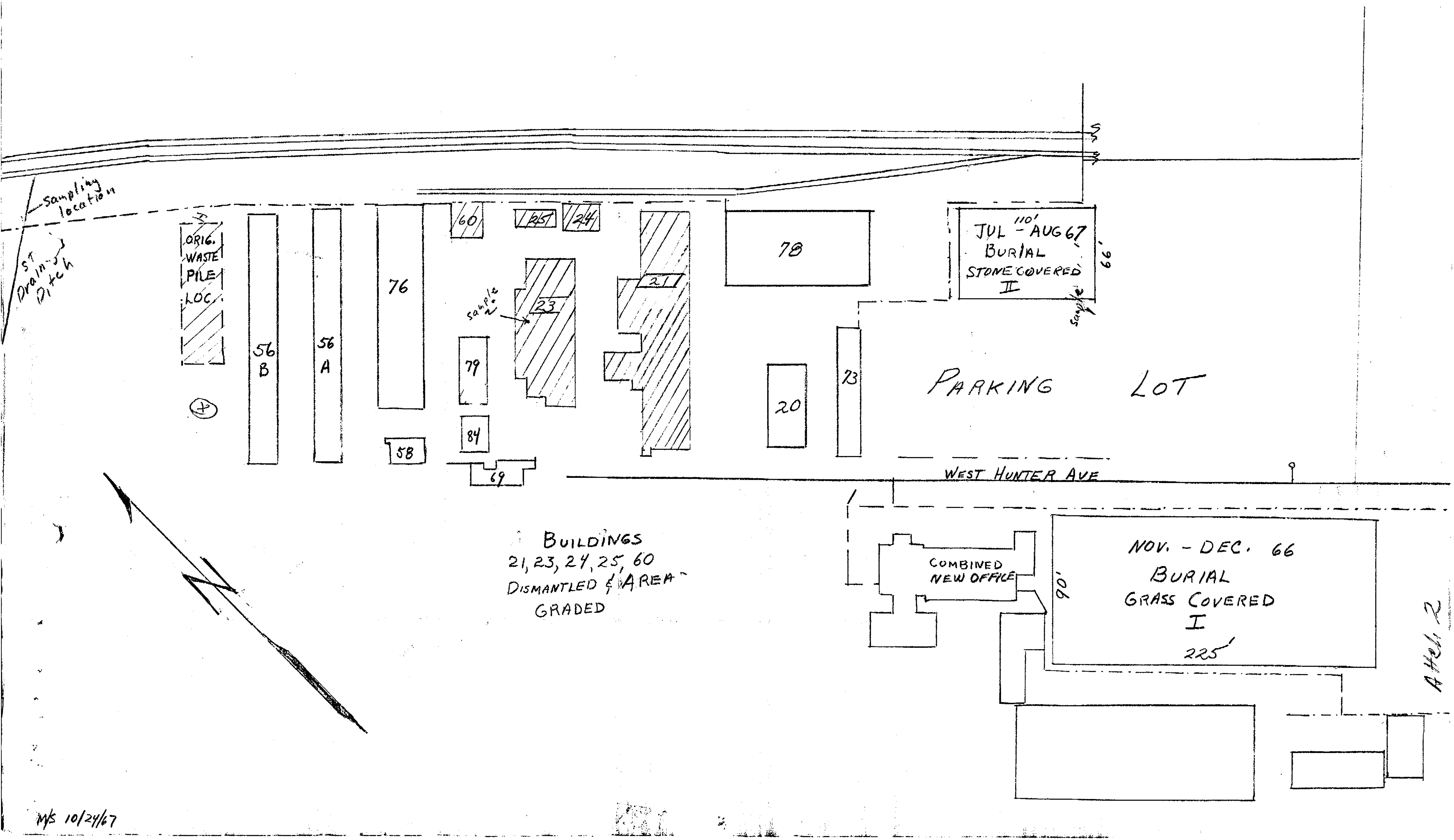


Based on above survey this building can be demolished and resultant debris disposed off premises.

John J. Russo
N.J. State Dept of Health
3-30-64.

Approx. Scale
3" = 50'

11-22-63


sampling location
ST Drain Ditch
ORIG. WASTE PILE LOC.
56 B
56 A
76
60
25
24
23
sample 2
21
79
84
58
69
78
JUL - AUG 67
110'
BURIAL
STONE COVERED
II
66'
sample
20
73
PARKING LOT
WEST HUNTER AVE
BUILDINGS
21, 23, 24, 25, 60
DISMANTLED & AREA GRADED
COMBINED NEW OFFICE
90'
NOV. - DEC. 66
BURIAL
GRASS COVERED
I
225'
Attch. 2
N
M/S 10/24/67

27 → cc MR. SHAPENN - AEC 11/2/67

450' walls bldg 21 × 20' high

9000 sq ft wall surface (changed to 32000 sq ft)

$9000 \times (2.54 \times 12)^2 = 8 \times 10^6$ sq cm (28×10^6)

(very rough mat est) If 4400 dpm/100 sq cm

44 dpm/sq cm

352×10^6 dpm/entire surface

2.22×10^6 dpm = 1 μc

159 μc for entire surface

0.159 mc " " "

Sec 20.304 Burial

Allows 1000 × 50 μc of Thorium

" 50 millicuries "

---

1 curie Th ≑ 9000 Kg = 19850#

1 millic ≑ 9 Kg

50 mc ≑ 450 Kg = 990#

1000 μc ≑ 9 kg
1 μc ≑ .009 kg
605 μc ≑ 5.44 Kg = 12.0 #
TOTAL in Bldg 23

Atch 3

To: J. Huber
From: J. P. Alrutz
Date: January 10, 1964

CC: DHFrancis - 5
EHNichols/EHN
JPAlrutz
~~Wilcox (?)~~

COPY TO MR. SHOPENN - AEC 11/2/67

Subject: Tracerlab Survey

Mr. Harold Carter of Tracerlab was here yesterday and today to perform a radiation survey in Buildings 21, 23 and 24. Simultaneous readings of the Alpha and Beta-Gamma radiations were taken at numerous points in all three buildings. Approximate locations of the points were noted on a building plan sketch, and the data was recorded on separate log sheet. The Alpha meter was represented as having a 45% counting efficiency and the probe covered 62 sq. cm. so the factor for conversion of Alpha counts per minute to Alpha disintegrations per minute per 100 sq. cm. was $\frac{100}{.45 \times 62} = 36$

Beta-Gamma readings were taken with an ionization meter which could register 0.2 mr per hour minimum; these readings were quite stable and maximum deviation from the average readings was only about 10%. A number of dry wipe samples were also taken for laboratory examination.

Building 21

Of the 184 points checked, 163 or 88.6% are well under the AEC requirement for average and peak Alpha disintegrations of 5000 and 25000 dpm/100 sq. cm. The average of the peak readings at the 184 locations is only 2340 dpm/100 sq. cm.

This activity level places the structure far under the limit allowed for burial according to 20.304 which is 50,000 microcuries of natural thorium.

Approximate surface area involved:

				two faces all walls & flrs
1st floor outside walls - one face	500 x 10 =	5000 sq. ft.		10,000
2nd " " " " "	300 x 10 =	3000 sq. ft.		6,000
1st floor " "	200 x 40 =	8000 sq. ft.		8,000
2nd floor " "	150 x 40 =	6000 sq. ft.		12,000
Partitions - two faces	2 x 500 x 10 =	10000 sq. ft.		10,000
		32000 sq. ft.		46,000
			roof	16,000
				62,000

$32{,}000 \times 144 \times 2.54^2 =$ ~~28~~ 57.6 $\times 10^6$ sq. cm total area

@ 23.4 dpm/sq. cm = ~~655~~ 1345 $\times 10^6$ dpm over entire surfaces

Since 2.22×10^6 dpm = 1 microcurie

$\frac{655 \times 10^6}{2.22 \times 10^6}$ = ~~295~~ 605 microcuries of Th (total max amount present in the building)

Atch 3

The Beta-Gamma readings for the most part exceed the AEC requirement of 0.2 mr/hour average for transfer to the general public or classification as an unrestricted area. However, our present levels could be approved for off site burial, but we should check this with the N. J. Department of Health before going to the AEC with such a proposal.

Building 23

Thirteen of the 36 Alpha readings were in excess of the AEC requirement but ten of these were floor samples. Since the lift truck is still operating in the building to handle the lead ingots a floor cleaning is impossible to accomplish at this time. Radiation levels on the second floor are not excessive even though no vacuuming has been done. As in Building 21 the Beta-Gamma levels are well over the 0.2 mr/hr. level.

Building 24

The top surface only of all the cross pieces between the studs shows high Alpha counts as does the cement floor. The Beta-Gamma levels in this building show between 1 and 2 mr/hr. even after careful vacuuming.

JPA/fe

LFE

DHF
cc JH
JA

Rec'd 1/20/64 JA

TRACERLAB

A DIVISION OF LABORATORY FOR ELECTRONICS, INC.
1601 TRAPELO ROAD • WALTHAM 54, MASSACHUSETTS
AREA CODE 617
TWINBROOK 4-6600
CABLE ADDRESS LFE

2/14/64
Copy given to N.J. Dept Health

January 16, 1964

To: Maywood Chemical Company
Maywood, New Jersey

From: Tracerlab, Inc.
Waltham, Mass.

Subject: Radiological Survey of Three Buildings, report of

1. Radiation levels were measured in buildings 21, 23, and 24 at above site on January 9 and 10th of 1964. Alpha levels were determined using an Eberline PAC-3 G with a 62 cm^2 surface area probe. Beta-gamma measurements were made with a Tracerlab S U -1 H ionization chamber having a 1 mg/cm^2 window.

Harold B. Carter

Submitted
Harold B. Carter
Technical Services

HBC/jb
Enc.
AEC Regulations

Tracerlab

4

I. Report of Building Measurements

Alpha discentigration (disintegration) rate is given as total alphas with respect to geometry. Therefore, the 5.4 alphas per disentigration of thorium-232 is summed in the units of dpm per 100 cm^2.

1. Measurements for building 21 have already been submitted. Results will be summarized in discussion.

2. Measurements for building 23

POSITION	ALPHA dpm/100cm^2	Average β,γ
1 wall	3.2-3.6x10^3	0.2
2 sill	1.2-1.4x10^3	0.3
3 wall	3.4-3.6x10^3	0.3
4 "	9.9-10.8x10^3	0.4
5 sill	6.3-7.2x10^3	0.4
6 Wall	1.6-1.8x10^3	0.4
7 "	5.4-7.2x10^2	0.4
8 "	2.1-2.3x10^3	0.6
9 "	8.1-9.0x10^2	0.6
10 "	6.3-7.2x10^2	0.4
11 "	4.6-5.4x10^2	0.8
12 "	2.7-3.6x10^2	0.6
13 "	8.1-9.0x10^2	1.1
14 "	2.7-3.6x10^2	1.0

POSITION	ALPHA dpm/100cm^2	Average β
wall 15	9.0-10-8x10^2	0.8
" 16	7.2-9.0x10^2	0.5
" 17	3.2-3.6x10^3	0.4
" 18	9.9-1-.8x10^3	0.6
Floor 19	1.2-1.4x10^4	1.2
" 20 6300	6.3-7.2x10^3 Floor	1.0
" 21 12000	1.2-1.4x10^4 F	1.8
" 22 12000	1.2-1.4x10^4 F	1.9
" 23 9900	9.9-10.8x10^3 F	2.0
" 24 6300	6.3-7.2x10^3 F	0.6
" 25 8100	8.1-9.0x10^3 F	0.7
" 26 11,100	1.1-1.2x10^4 F	2.2
" 27 8100	8.1-9.0x10^3 F	0.8
" 28	4.5-5.4x10^2 F	0.5
" 29	3.0-3.2x10^3 F	0.9
" 30 8100	8.1-9.0x10^3 F	1.3
" 31	3.4-3.6x10^3	0.6
" 32	1.3-1.4x10^3	0.8
" 33	1.2-1.4x10^3	0.6
" 34	1.8-1.9x10^3	0.6
Column 35	90-180	0.3
Beam 36	8.1-9.0x10^2	0.4

3. Measurements for building 24

POSITION	ALPHA dpm/100cm^2	Average β,γ
Sill 1 6300	6.3-7.2x10^3 TOP	1.3
Wall 2	2.7-3.6x10^2 BOTTOM	1.0
Sill 3 6300	6.3-7.2x10^3 ETC	1.2
Wall 4	2.7-3.6x10^2	1.4
Sill 5 9900	9.9-10.8x10^3	2.0
Wall 6	6.3-7.2x10^2	1.6
Sill 7 1.	1.6-1.8x10^4	1.6
Wall 8	4.5-5.4x10^2	1.2
Stud 9	1.9-2.1x10^3	0.8
Sill 10	9.9-10.8x10^3	1.0
Wall 11	9.0-10.8x10^2	0.8
Sill 12	9.9-10.8x10^3	1.6
Wall 13	90-180	0.7
Sill 14	1.2-1.4x10^4	1.2

POSITION	ALPHA dpm/100cm^2	Average β
Floor 15	8.1-9.0x10^3	1.2
" 16	1.1-1.2x10^4	1.6
" 17	1.1-1.2x10^4	1.0
" 18	8.1-9.0x10^3	2.2
" 19	9.9-10.8x10^3	1.4
Sill 20	8.1-9.0x10^3	0.5
Wall 21	4.5-5.4x10^2	0.4
Sill 22	2.4-2.7x10^3	0.7
Wall 23	90-180	0.8
Sill 24	4.5-5.4x10^3	1.6
Wall 25	2.7-3.6x10^2	
Beam 26	9.9-10,8x10^4	1.5
Floor 27	4.5-5.4x10^3	1.8
" 28	6.3-7.2x10^3	1.5
" 29	4.5-5.4x10^3	1.4

Report of Building Measurements (continued)

I POSITION	dpm/100cm^2 TOP BEAM	dpm/100cm^2 BENEATH BEAM
Site 30	$8.1\text{-}9.0\times10^3$	$6.3\text{-}7.2\times10^2$
31	$8.1\text{-}9.0\times10^3$	$2.7\text{-}3.6\times10^2$
32	$9.9\text{-}11\times10^3$	$2.7\text{-}3.6\times10^2$
33	$1.6\text{-}1.8\times10^4$	90-180
34	$8.1\text{-}9.0\times10^3$	$9.9\text{-}11\times10^2$
35	$1.2\text{-}1.3\times10^4$	$8.1\text{-}9.0\times10^2$
36	$2.4\text{-}2.7\times10^3$	$2.7\text{-}3.6\times10^2$
37	$6.3\text{-}7.2\times10^3$	90-180

II Report of Dry Smears Taken

Seventeen Smears were taken with Whatman 41 filer paper. The area of wipe sample was 100cm^2. Correction has been made to give disentigration rate of thorium-232.

Building 21		DPM Th232/100cm^2
A	wall	3.3
B	column	53
C	wall	13
D	wall scrapings	2.7 dpm Th^{232}/mg
E	floor	3.3
F	wall	3.3
G	floor	3.3
H	floor	3.3
I	floor	43
Building 24		
J	sill	173
K	floor	171
L	floor	120
Building 23		
M	column	25
N	wall	230
O	wall	3.3
P	beam	3.3
Q	floor before vacuum	3.3

III Discussion of Survey

1. Building 21
   a. Areas having a beta-gamma dose higher than 2.0 mr/hr must be classified and posted as restricted areas and higher than 5.0 mr/hr as radiation areas. Reference floor plan and Federal Register, Title 10,Part 20.
   b. A bottle of thorium was in cabinet at position 148. If the amount is in excess of 0.5 mc or 10 lb. the container must be labeled in manner specified in 10 CFR Part 20.

III Discussion of Survey (continued)

c. Wall surfaces have an average alpha disintegration rate of $3x10^3$ alphas/min./$100cm^2$. Compartments within the building do show gradients above and below this figure. Considering smear survey, particles of brick were on filter paper, it appears thorium has penetrated brick surfaces. Whether decontamination can be accomplished and to what degree on these surfaces is a moot point. Thorium may have permutated beyond the surface layer that is detectable. Gamma dose rates reinforce this idea. Floors for the most part are dirt. There is evidence monizite is mixed with the dirt. Some areas, high gamma dose, indicate large amounts of monizite is present. Concrete floors more the most part are lower than wall surfaces. Smears reveal very little activity on the concrete surfaces.

2. Building 23

a. Wall surfaces average 8×10^2 alphas/min./$100cm^2$ with maximum areas of 10^4 alphas/min./$100cm^2$. The floor is totally earthen and averages 10^4 alphas/min./$100cm^2$. Wooden flooring on the second floor appears to have fixed activity of 10^3 alphas/min./cm^2. No restricted areas exist.

3. Building 24

a. Sheet metal surfaces are noted as walls and sills denote the wooden 4 x 4's in the horizontal position. Top surfaces of sills were approximately a factor of 10 higher than bottom surfaces. Coupled with information from smears and information concerning decontamination of this building, it is unlikely penetration of thorium dust is very deep in the wood. Average dose rate from wooden sills and floor is 10^4 alphas/min./$100cm^2$. All interior surfaces are quite uniform with respect to dose rates.

4. A scrape pile between buildings 21 and 24 contains radioactivity.

IV Impression

1. Four areas in building 21 must be posted in accordance with State and Federal Regulations.

2. The total amount of thorium present is not large and is for the most part semi-fixed. The exceptions being concentrations of monizite in the ground of building 21.

3. It is very unlikely regulatory bodies would permit these building to be used at present levels of activity. Either extensive decontamination and/or razing of buildings must be done unless management wishes to have the buildings remain empty. Acceptable levels should be established with regulatory agencies before discussions concerning further disposition of the buildings made.

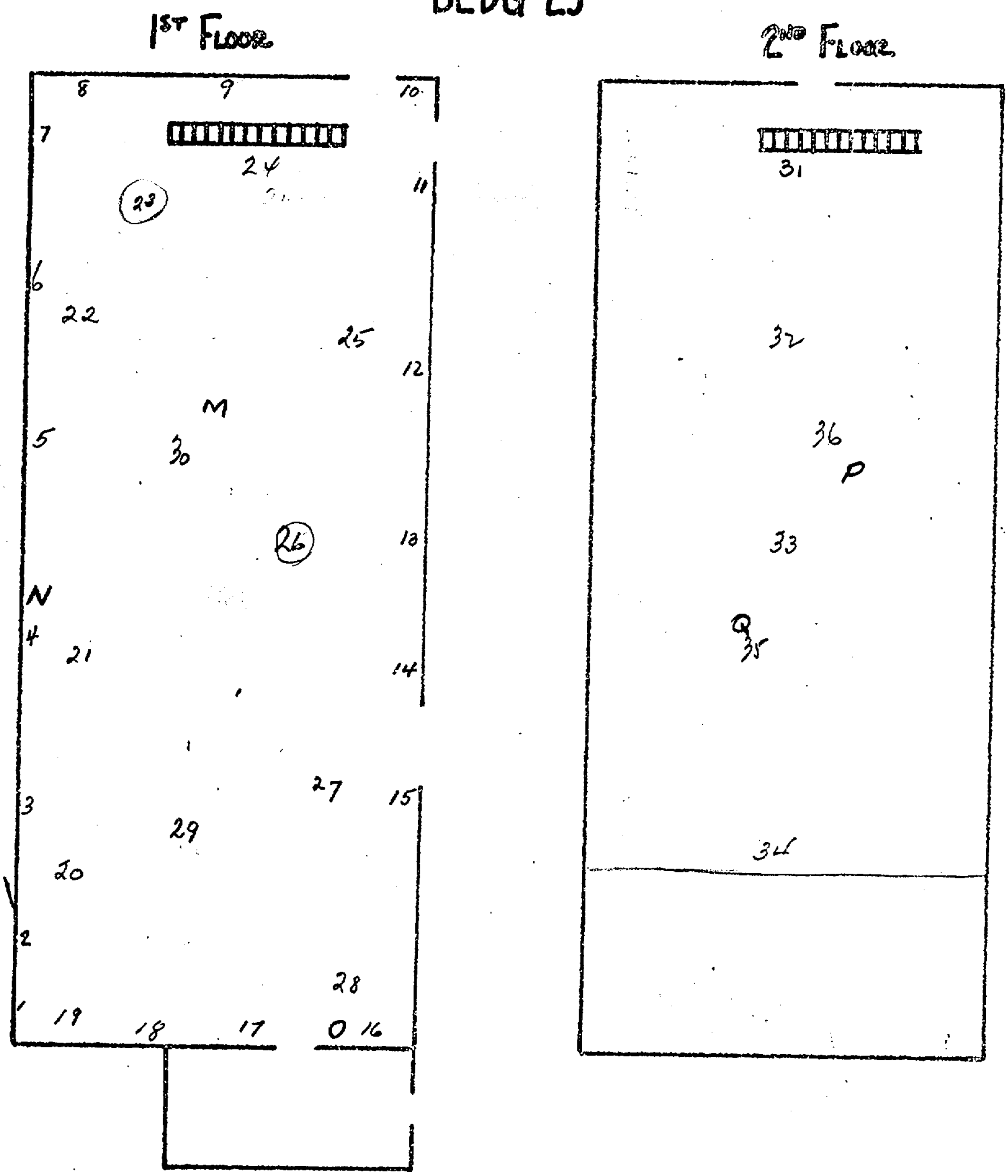
V. Disposal of Contaminated Materials

1. 10 CFR, Part 20 regulates the amounts of radioactive materials that may be released to the environs without prior A.E.C. approval. The New Jersey State Commission has extracted and set the same standards.

2. Possible methods of disposal are burial on site, burial at local dump sites, disposal at sea and incineration. The amounts of activity and economics involved will dictate the method or methods to be used.

SURVEY BY
TRACERLAB
1-10-64

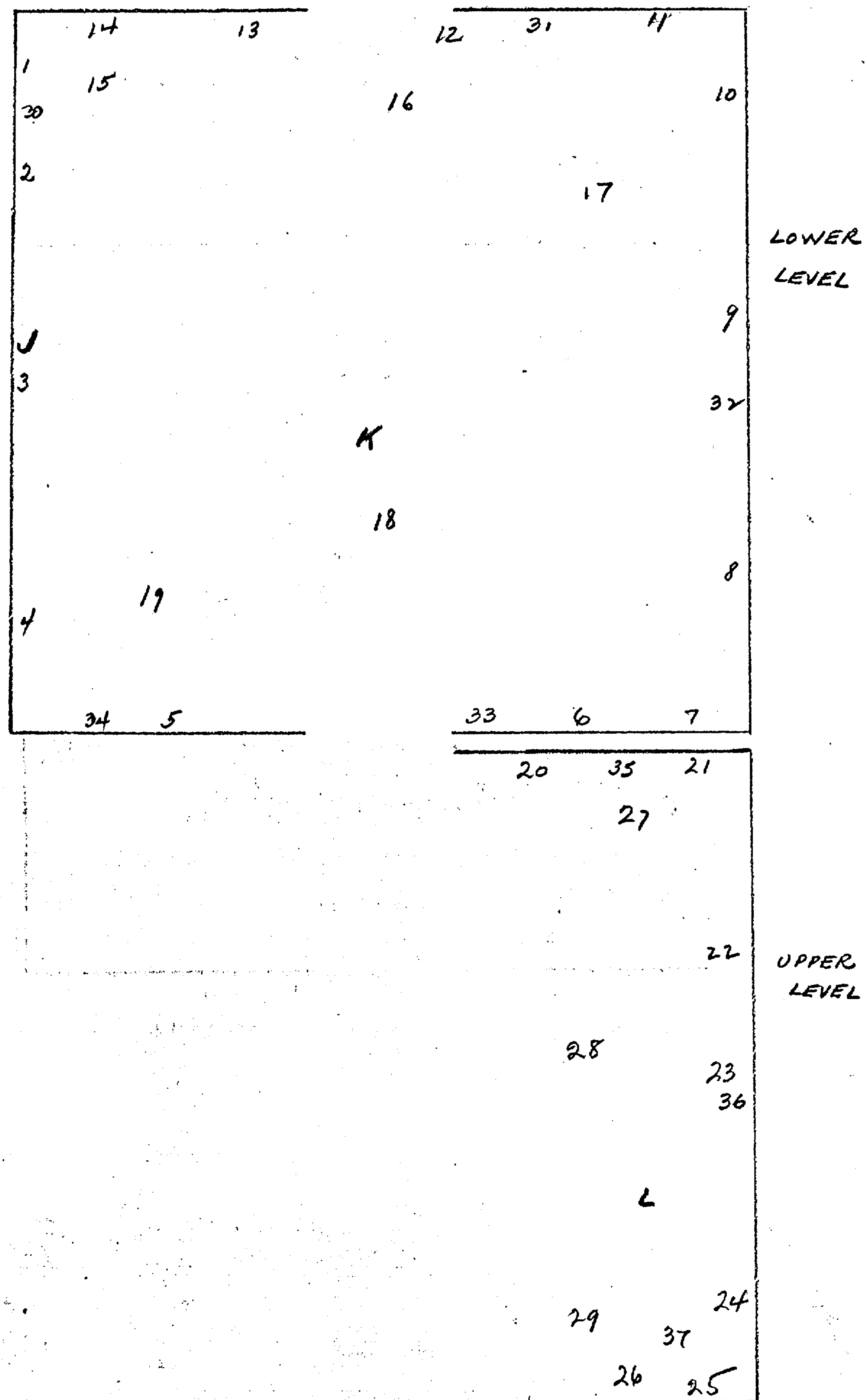
BLDG 23



Approx. Scale
3" = 50'
11-22-63 J. Alrutz

BLDG 24

SURVEY BY
TRACERLAB
1-10-69



1-10-69

TRACERLAB SMEARS

BLDG 21	A.	WALL
"	B.	COLUMN
"	C.	WALL
"	D.	WALL SCRAPING
"	E.	FLOOR
"	F.	WALL
"	G.	FLOOR
"	H.	FLOOR
"	I.	FLOOR
BLDG 24	J.	SILL
"	K.	FLOOR
"	L.	FLOOR
BLDG 23	M.	COLUMN
"	N.	WALL
"	O.	WALL
"	P.	BEAM
"	Q	FLOOR BEFORE VACUUMING

1-9-64 Bldg Maywood

$f = \frac{1}{.45 \times 62} = 3.6$

$c/m \times 1.5^2 = 0.f\ldots$

$.45 \times 62\ cm^2\ 100\ldots$

Sheet No 1

POSITION No.	LOCATION	INSTRUMENT COUNTS/MIN α MIN–MAX	ACTUAL DISINT./MIN α PER 100 cm^2	βγ AVERAGE
1	Floor	150-200	$7.2 \cdot 10^2 - 9.0 \cdot 10^2$	0
2	Sill	40-50	$1.6 - 1.8 \times 10^2$	0.2
3	Floor	100-150	$4.5 - 5.4 \times 10^2$	0
4	"	400-600	$1.8 - 2.2 \times 10^3$	0.6
✓ 5	"	1500-2000	$6.3 - 7.2 \times 10^3$	0.6
6	Hose	300-400	$1.3 - 1.4 \times 10^3$	
7	Floor	800-1000	$2.9 - 3.6 \times 10^3$	0.7
8	"	200-250	$8.1 - 9.0 \times 10^2$	0.5
✓ 9	Wall	1750-2000	$6.7 - 7.2 \times 10^3$	
10	Floor	650-700	$2.4 - 2.5 \times 10^3$	1.2
11	Sill	550-600	$2.1 - 2.2 \times 10^3$	0.9
12	Floor	900-1100	$3.6 - 4.0 \times 10^3$	0.12
13	Floor	800-900	$3.1 - 3.2 \times 10^3$	0.15
14	Floor	700-900	$2.9 - 3.2 \times 10^3$	(2.4)
✓ 15	Wall	1750-2000	$6.7 - 7.2 \times 10^3$	1.4
16	Floor	400-450	$1.5 - 1.6 \times 10^3$	1.8
17	Wall	250-300	$1.0 - 1.1 \times 10^3$	1.2
18	Floor	350-500	$1.5 - 1.8 \times 10^3$	0.3
19	Wall	0-50	$9.0 \times 10^1 - 1.8 \times 10^2$	0
20	Floor	475-525	$1.8 - 1.9 \times 10^3$	0.5
21	Wall	0-50	$9.0 \times 10^1 - 1.8 \times 10^2$	0.2
22	Wall	25-50	$1.3 - 1.8 \times 10^2$	0.8
23	Floor	0-25	45-90	0.6
24	"	0-20	36-72	0.5
25	Wall	0-20	36-72	0.3

α readings in min – max.

α dpm/100 cm^2 in av – max.

Position	Location	α counts/min	α dis/min/100 sq cm	βγ Aver
26	Sill	0	0	0
27	Floor	125-175	$5.4-6.3 \times 10^2$	0.8
28	Wall	25-50	$1.3-1.8 \times 10^2$	0.8
29	Floor	0-25	45-90	0
30	Floor	150-200	$6.3-7.2 \times 10^2$	1.2
31	Wall	300-350	$1.2-1.3 \times 10^3$	0.7
32	Wall	800-1000	$2.9-3.6 \times 10^3$	0.7
33	Wall	200-250	$8.1-9.0 \times 10^2$	0.6
34	"	2000-2500	$8.1-9.0 \times 10^3$	0.8
35	Sill	0-25	45-90	0.2
36	Wall	175-200	$6.6-7.2 \times 10^2$	0.3
37	"	25-50	$1.3-1.8 \times 10^2$	0.2
38	"	0	— 0	0
39	Floor	25-50	$1.3-1.8 \times 10^2$	0.5
40	"	0-25	45-90	0.7
41	"	25-50	$1.3-1.8 \times 10^2$	2.4
42	"	0-25	45-90	0.7
43	"	0-25	45-90	0
44	"	25-50	45-90	0.5
45	Wall	0	—	0
46	"	0	—	0
47	"	0	—	0.3
48	"	220-260	$8.6-9.4 \times 10^2$	0.3
49	"	450-550	$1.8-2.0 \times 10^3$	0.6
50	"	300-400	$1.3-1.4 \times 10^3$	0.8

Position	Location	α Counts/min	α disin/min 100 sq cm	βγ aver
51	Floor	250-300	$1.0-1.1 \times 10^3$	0.7
52	"	350-450	$1.4-1.6 \times 10^3$	0.8
53	"	450-550	$1.8-2.0 \times 10^3$	0.6
54	Wall	0-25	45-90	0.5
55	"	50-100	$1.8-3.6 \times 10^2$	0.6
56	"	0-25	45-90	0.2
57	"	100-200	$5.4-7.2 \times 10^2$	0.7
58	"	25-50	$1.3-1.8 \times 10^2$	0.3
59	"	25-50	$1.3-1.8 \times 10^2$	0.2
60	"	25-50	$1.3-1.8 \times 10^2$	0.2
61	"	250-350	$1.1-1.3 \times 10^3$	0.4
62	Floor	250-300	$1.0-1.1 \times 10^3$	0.4
63	Wall	25-75	$1.8-2.7 \times 10^2$	0
64	"	25-50	$1.3-1.8 \times 10^2$	0.2
65	"	25-50	$1.3-1.8 \times 10^2$	0.2
66	"	25-50	$1.3-1.8 \times 10^2$	0.2
67	"	100-150	$4.5-5.4 \times 10^2$	0.2
68	"	350-450	$1.4-1.6 \times 10^3$	0.8
69	"	500-650	$2.1-2.3 \times 10^3$	(3.2)
70	"	50-150	$3.6-5.4 \times 10^2$	1.2
71	Floor	2500-3000	$1.0-1.1 \times 10^4$	(5.6)
72	"	25-50	$1.3-1.8 \times 10^2$	0.8
73	"	25-50	$1.3-1.8 \times 10^2$	0.5
74	"	25-50	$1.3-1.8 \times 10^2$	0.6
75	Wall	0-25	45-90	0.3

		α counts/min		
76	Wall	0	0 —	0.2
77	"	0-25	45-90	0.5
78	"	50-100	$2.7-3.6 \times 10^2$	(3.4)
✓ 79	Floor	8,000-10,000	$3.2-3.6 \times 10^4$	(10.0)
80	Wall	100-150	$4.5-5.4 \times 10^2$	0.8
81	"	25-50	$1.3-1.8 \times 10^2$	0.5
82	"	50-100	$2.7-3.6 \times 10^2$	0.3
83	"	100-150	$4.5-5.4 \times 10^2$	0.2
84	"	150-250	$7.2-9.0 \times 10^2$	0.3
85	"	100-200	$5.4-7.2 \times 10^2$	0.4
86	Floor	250-350	$1.1-1.3 \times 10^3$	0.8
87	"	200-300	$9.0-11 \times 10^2$	0.8
88	"	400-500	$1.6-1.8 \times 10^3$	1.0
✓ 89	"	2000-3000	$9.0-11 \times 10^3$	(10.0)
✓ 90	Wall	3000-4000	$1.1-1.4 \times 10^4$	(6.2)
✓ 91	"	1500-2000	$6.3-7.2 \times 10^3$	(3.8)
✓ 92	"	2500-3000	$1.0-1.1 \times 10^4$	(5.2)
✓ 93	"	2500-3500	$1.1-1.3 \times 10^4$	(3.4)
94	Cement base	300-400	$1.3-1.4 \times 10^3$	(2.8)
95	Wall	150-200	$6.3-7.2 \times 10^2$	(2.4)
96	"	200-300	$9.0-11 \times 10^2$	(2.2)
97	"	100-200	$5.4-7.2 \times 10^2$	(2.8)
98	Floor	500-550	$1.9-2.0 \times 10^3$	(3.0)
✓ 99	"	4500-5500	$1.8-2.0 \times 10^4$	(6.5)
100	Wall	650-750	$2.5-2.7 \times 10^3$	(3.6)

Position	Location	α Counts/Min	α Dis/Min/100 sq cm	βγ Aver.	Position	Location	Counts/Min	α disin/min/100 sq cm	βγ Aver.
101	Shelf	250-300	$1.0-1.1 \times 10^3$	3.0	126	Bench	500-700	$2.2-2.5 \times 10^3$	0.4
102	Wall	250-350	$1.0-1.1 \times 10^3$	3.0	127	Floor	250-350	$1.1-1.3 \times 10^3$	0.8
103	"	100-150	$4.5-5.4 \times 10^2$	3.2	128	Wall	0-50	90-180	0.8
104	Floor	0-50	90-180	4.0	129	Shelf	25-50	$1.3-1.8 \times 10^2$	0.3
105	Wall	0-50	90-180	4.8	130	Wall	100-150	$5.4-7.2 \times 10^2$	0.5
106	"	250-350	$1.1-1.3 \times 10^3$	4.2	131	Floor	400-500	$1.6-1.8 \times 10^3$	0.7
107	Floor	250-350	$1.1-1.3 \times 10^3$	3.8	132	Wall	150-250	$7.2-9.0 \times 10^2$	0.6
108	"	150-200	$6.3-7.2 \times 10^2$	4.2	133	Shelf	200-250	$8.1-9.0 \times 10^2$	0.6
109	Stair	300-450	$1.3-1.6 \times 10^3$	2.2	134	Wall	100-150	$5.4-7.2 \times 10^2$	0.8
110	"	400-550	$1.7-2.0 \times 10^3$	1.6	135	Sill	1000-1500	$5.4-7.2 \times 10^3$	1.0
111	Wall	0-50	90-180	0	136	Hood	50-100	$2.7-3.6 \times 10^2$	0.8
112	"	150-200	$6.3-7.2 \times 10^2$	0	137	"	50-100	$2.7-3.6 \times 10^2$	0.6
113	"	0-50	90-180	0	138	Wall	50-100	$2.7-3.6 \times 10^2$	0.5
114	Sill	100-200	$5.4-7.2 \times 10^2$	0.2	139	Sill	50-150	$3.6-7.2 \times 10^2$	0.6
115	Wall	50-100	$2.7-3.6 \times 10^2$	0.2	140	Wall	0-50	90-180	0.4
116	Shelf	50-100	$2.7-3.6 \times 10^2$	0.3	141	"	0-25	45-90	0.5
117	Bench	0-25	45-90	0	142	"	25-50	$1.3-1.8 \times 10^2$	0.6
118	Shelf	0-50	90-180	0.2	143	Wall	100-175	$7.2-6.3 \times 10^2$	1.2
119	Cabinet	250-350	$1.1-1.3 \times 10^3$	0.4	144	"	50-100	$2.7-3.6 \times 10^2$	1.0
120	Floor	800-1000	$3.2-3.6 \times 10^3$	0.8	145	"	75-150	$3.6-5.4 \times 10^2$	1.0
121	"	400-500	$1.6-1.8 \times 10^3$	0.6	146	Sill	400-500	$1.6-1.8 \times 10^3$	1.0
122	"	750-900	$3.0-3.2 \times 10^3$	0.7	147	Wall	50-100	$2.7-3.6 \times 10^2$	0.8
123	Wall	100-150	$4.5-5.4 \times 10^2$	0.5	148	Closet	0-50	90-180	3.2
124	Sill	200-250	$8.1-9.0 \times 10^2$	0.4	149	Wall	50-100	$2.7-3.6 \times 10^2$	0.3
125	Table	350-450	$1.4-1.6 \times 10^3$	0.8	150	Floor	600-750	$2.4-2.7 \times 10^3$	0.4

16

Position	Location	α Counts/Min	α Dis/Min/100 sq cm	βγ Aver.
151	Floor	1500-2000	$6.3-7.2 \times 10^3$	1.0
152	"	500-600	$2.0-2.2 \times 10^3$	0.6
153	"	1500-2000	$6.3-7.2 \times 10^3$	0.3
154	"	3000-4000	$1.3-1.4 \times 10^4$	0.4
155	"	650-1000	$3.0-3.6 \times 10^3$	0.4
156	"	460-560	$1.8-2.0 \times 10^3$	0.8
157	"	750-900	$3.0-3.4 \times 10^3$	1.0
158	"	850-1000	$3.3-3.6 \times 10^3$	0.8
159	"	2500-3000	$1.0-1.1 \times 10^4$	0.8
160	"	6000-7500	$2.4-2.7 \times 10^4$	(3.5)
161	"	800-1000	$3.2-3.6 \times 10^3$	1.2
162	"	900-1500	$4.3-5.4 \times 10^3$	1.0
163	Sill	400-500	$1.6-1.8 \times 10^3$	0.5
164	Wall	50-125	$2.7-4.5 \times 10^2$	0.2
165	"	50-150	$3.6-5.4 \times 10^2$	0.5
166	Floor	1500-2000	$6.3-7.2 \times 10^3$	0.8
167	Wall	100-150	$4.5-5.4 \times 10^2$	0.3
168	Hood	500-600	$2.0-2.2 \times 10^3$	0.8
169	"	500-650	$2.0-2.3 \times 10^3$	0.7
170	Sill	50-100	$2.7-3.6 \times 10^2$	0.2
171	Wall	50-100	$2.7-3.6 \times 10^2$	0.4
172	Bench	1500-2000	$6.3-7.2 \times 10^3$	0.8
173	Floor	700-850	$2.8-3.0 \times 10^3$	0.7
174	Wall	50-100	$2.7-3.6 \times 10^2$	0
175	Sill	150-200	$6.3-7.2 \times 10^2$	0.2
176	Wall	50-100	$2.7-3.6 \times 10^2$	0.2
177	"	50-100	$2.7-3.6 \times 10^2$	0.4
178	"	50-100	$2.7-3.6 \times 10^2$	0.6
179	Sill	300-400	$1.3-1.4 \times 10^3$	0.8
180	Floor	2500-3000	$1.0-1.1 \times 10^4$	1.2
181	"	450-600	$1.9-2.2 \times 10^3$	0.5
182	"	300-400	$1.3-1.4 \times 10^3$	0.5
183	Shelf	2500-3500	$1.1-1.3 \times 10^4$	0.3
184	Floor	200-300	~~8.4~~ 9.0 -11×10^2	0.4

5000 25000

5×10^3 25×10^3

135 5400 – 7200

151

153

154

159

160

166

172

180

183

BLDG 24 TRACER LAB DATA 1-10-64

Position	Location	α Counts Min-Max	α Dis/Min/100 sq cm	BY Av.
1	Sill	1500-2000		1.3
2	Wall	50-100		1.0
3	Sill	1500-2000		1.2
4	Wall	50-100		1.4
5	Sill	2500-3000		2.0
6	Wall	150-200		1.6
7	Sill	4000-5000		1.6
8	Wall	100-150		1.2
9	Stud	500-600		0.8
10	Sill	2500-3000		1.0
11	Wall	200-300		0.8
12	Sill	2500-3000		1.6
13	Wall	0-50		0.7
14	Sill	3000-4000		1.2
15	Floor	2000-2500		1.2
16	"	3000-3500		1.6
17	"	3000-3500		1.0
18	"	2000-2500		2.2
19	"	2500-3000		1.4
20	Sill	2000-2500		0.5
21	Wall	100-150		0.4
22	Sill	600-750		0.7
23	Wall	0-50		0.8
24	Sill	1000-1500		1.6
25	Wall	50-100		1.4

Position	Location	α Counts Min-Max	α Dis/Min/100 sq cm	BY Av.
26	Beam	2500-3000		1.5
27	Floor	1000-1500		1.8
28	"	1500-2000		1.5
29	"	1000-1500		1.4
30	Sill TOP / BOT	2000-2500 / 150-200		
31	" "	2000-2500 / 50-100		
32	" "	2500-3000 / 50-100		
33	" "	4000-5000 / 0-50		
34	" "	2000-2500 / 250-300		
35	" "	3000-3500 / 200-250		
36	" "	650-750 / 50-100		
37	" "	1500-2000 / 0-50		

BLDG 23 TRACERLAB DATA 1-10-64

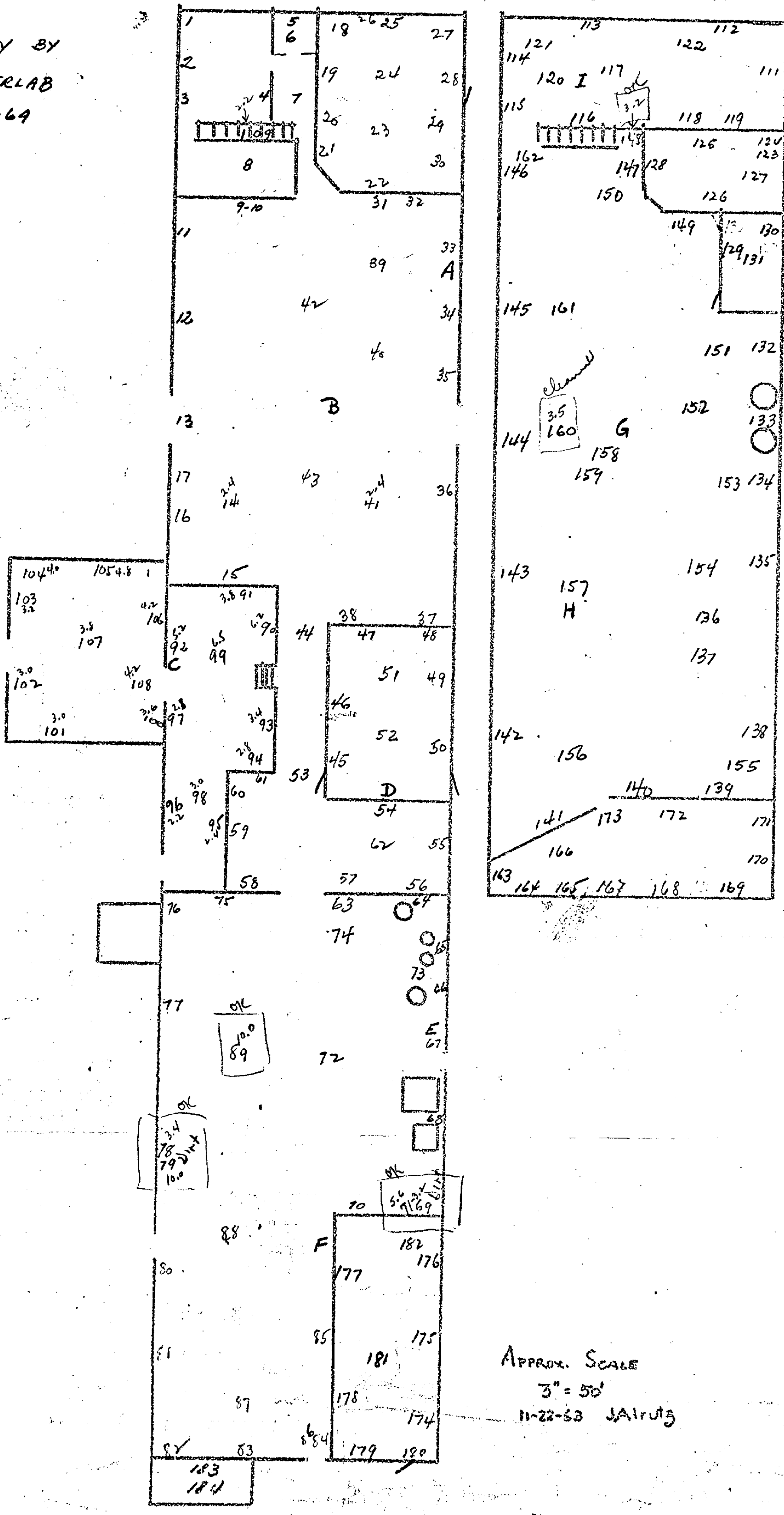
POSITION	LOCATION	α COUNTS MIN-MAX	α DIS/MIN/100 sq cm	βγ AV.	POSITION	LOCATION	α COUNTS MIN-MAX	α DIS/MIN/100 sq cm	βγ AV.
1	Wall	800-1000		0.2	26	Floor	3000-3500		2.2
2	Sill	300-400		0.3	27	"	2000-2500		0.8
3	Wall	900-1000		0.3	28	"	100-150		0.5
4	"	2500-3000		0.4	29	"	800-900		0.9
5	Sill	1500-2000		0.4	30	"	2000-2500		1.3
6	Wall	400-500		0.4	31	"	900-1000		0.6
7	"	100-200		0.4	32	"	350-400		0.8
8	"	550-650		0.6	33	"	300-400		0.6
9	"	200-250		0.6	34	"	450-550		0.6
10	"	150-200		0.4	35	Column	0-50		0.3
11	"	100-150		0.8	36	Beam	200-250		0.4
12	"	50-100		0.6					
13	"	200-250		1.1					
14	"	50-100		1.0					
15	"	200-300		0.8					
16	"	150-250		0.5					
17	"	800-1000		0.4					
18	"	2500-3000		0.6					
19	Floor	3000-4000		1.2					
20	"	1500-2000		1.0					
21	"	3000-4000		1.8					
22	"	3000-4000		1.9					
23	"	2500-3000		2.0					
24	"	1500-2000		0.6					
25	"	2000-2500		0.7					

BLDG 21

SURVEY BY
TRACERLAB
1-9-64

1ST FLOOR

2ND FLOOR

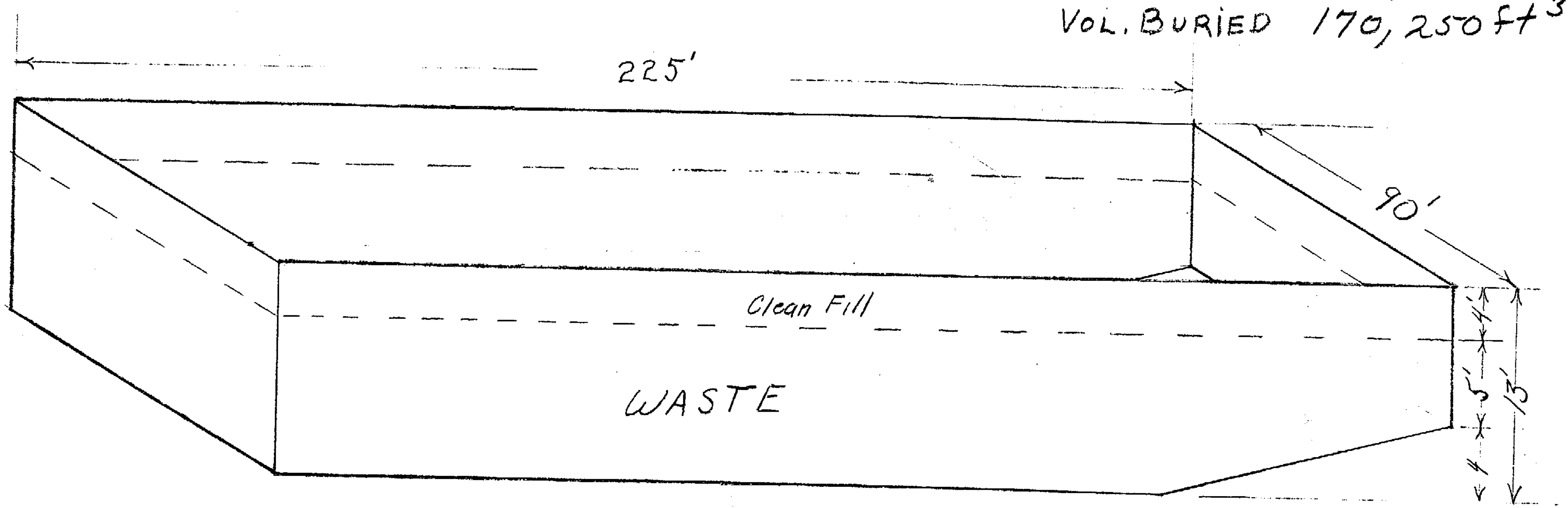


APPROX. SCALE
3" = 50'
11-22-63 J.A.Kuts

PIT I

TOTAL VOL 262,250 ft^3

VOL. BURIED 170,250 ft^3



BURIAL PROFILE

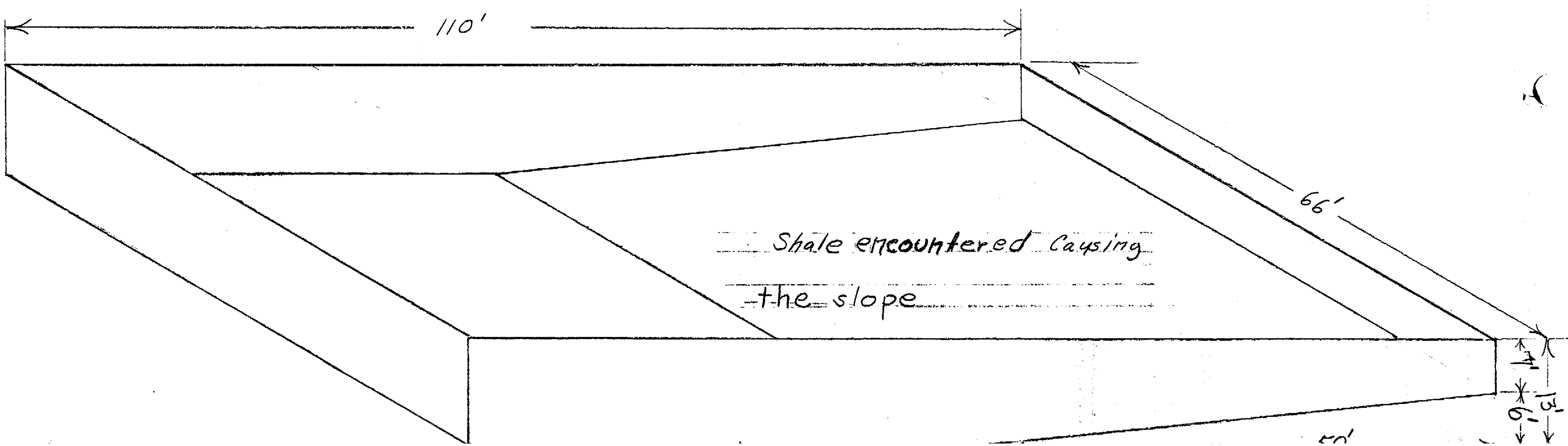
Attachment 4

Pit II

1/16" = 1'

Total Vol. 84,480 ft.^{3}

Net Vol Buried
55,440 ft.^{3}



Attachment 5

CC: DHFrancis - 5
JHuber
HRSpiess
EASwanson
JPAlrutz
File

COPY TO MR. SHOPENN-AEC- 11/2/67

February 21, 1964

Mr. William Aaroe
Radiological Health Program
Department of Health
17 West State Street
Trenton, New Jersey

Dear Mr. Aaroe:

During your visit here last Friday I agreed to furnish my calculation for the quantity of thorium present on the walls of Building 21.

Peak alpha readings at 184 internal locations showed an average of 2340 dpm/100 sq. cm. and the approximate surface areas involved are as follows:

Outside walls -	both faces -	16,000 sq. ft.
First Floor	one face	8,000
Second floor	both faces	12,000
Roof	both faces	16,000
Partitions	both faces	10,000
TOTAL		62,000 sq. ft.

$62{,}000 \times 144 \times 2.54^2 = 57.6 \times 10^6$ sq. cm. total area.
@ 23.4 dpm/sq. cm. = 1345×10^6 dpm over all surfaces of structure.

$\frac{1345 \times 10^6}{2.22 \times 10^6}$ = 605 microcuries of thorium present over all surfaces of structure.

$\frac{605 \times 9 \times 2.2}{1000}$ = 12.0 pounds thorium present over all surfaces of structure.

Since the federal regulation allows single burials of quantities of thorium up to 50,000 microcuries, it's clear that the amount involved here is quite insignificant by comparison.

2.22×10^6 dpm = 1 μc

1 μc Th ≏ .009 kg

1 c Th ≏ 9000 kg ≏ 19800#
1 mc " ≏ 9 kg
50 mc ≏ 450 " ≏ 990#

Attachment 6

We trust that this information will prove useful in your evaluation of the problem, and we shall look forward to your early return so that a complete solution can soon be accomplished.

Very truly yours,

STEPAN CHEMICAL COMPANY
Maywood Division

James P. Alrutz
Production Manager

JPA/fe

$Th(PO_3)_4$ Thorium metaphosphate is used in this calculation as it has the ~~greater~~ largest amount of Thorium by weight in its formula than the other ~~P~~ Phosphates of Thorium.

Calculations of % by concentration of Thorium

$Th(PO_3)_4$ % by weight

$$\frac{232 \text{ wt. Thorium}}{548 \text{ wt total Compound}} = 42\%$$

~~$Th_3(PO_4)_4$ #4~~

C. Gigi

Account

Attachment 6

(Attachment 7)

Given:

Amount of Slurry - 2,160,000 pounds

Concentration - 1.5% $Th(PO_4)_2$

Weight to Activity of Thorium - 9×10^3 Kilograms/Curie

% of Thorium in $Th(PO_4)_2$ - 42%

To achieve Total # Curies of activity

Amount slurry in lbs converted to Kilograms multiplied by Concentration and % of Thorium divided by weight to Activity ratio of Thorium.

$$\frac{2.16 \times 10^6 \text{ lbs}}{2.2 \text{ lbs/Kg}} = .982 \times 10^6 \cdot 1.5 \times 10^{-2} \times 4.2 \times 10^{-1} =$$

$(.982 \times 10^6)(6.3 \times 10^{-3})$ Kgs of Thorium

6.19×10^3 Kgs

~~$\frac{6.19 \times 10^3 \text{ Kg}}{9K/\text{curie}} = .688 \times 10^3$ Curies~~ ~~.688 Curies~~

$$\frac{6.19 \times 10^3 \text{ Kg}}{9 \times 10^3 \text{ Kg}} = .688 \text{ Curie}$$

$$\frac{.688}{9.82 \times 10^8 \text{ gms}} = \frac{68.8 \times 10^{-2}}{9.82 \times 10^8}$$

7.03×10^{-10} Curies/gm.

7.03×10^{-4} μc/gm.

Assuming the Depth of the holes are equal then the ratio of material buried in each hole is

$$\frac{66 \times 110}{(66 \times 110) + (90 \cdot 225)} = \frac{7.26 \times 10^3}{7.26 \times 10^3 + 20.25 \times 10^3} = 26.4$$

$$\frac{90 \cdot 225}{(66 \cdot 110) + (90 \cdot 225)} = \frac{20,250}{27,510} = 73.7$$

$66 \times 110 = 7,260$
$225 \cdot 90 = 20,250$
27,510

Small Hole .181 .179 ci July - Aug. 67

Large Hole .509 Ci .509 ci Nov. Dec. 66

.688 Total ci.

Maximum allowable is 1000 × 50 μCi

50 mci.

Burial in Nov. & Dec. 66 was 10 × that permitted.

Burial in July & Aug 67 was 3.6 × that permitted