C-E Power Systems
Combustion Engineering, Inc.
1000 Prospect Hill Road
Windsor, Connecticut 06095

Tel. 203/688-1911
Telex 99297

70-1100

PDR

Return to D. Cramer 396-SS

POWER SYSTEMS

DOCKETED USNRC MAY 13 1981 NMSS MAIL SECTION DOCKET CLERK

Docket 70-1100
License SNM-1067
DDH-81-145
May 1, 1981

RECEIVED 1981 MAY 8 AM 10 15 U.S. NUCLEAR REG. COMMISSION NMSS MAIL SECTION

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTN: Mr. R.G. Page, Chief
Uranium Fuel Licensing Branch
Division of Fuel Cycle and Material Safety

REF: (A) C-E Letter, DDH-80-086, dated November 10, 1980, Request for Amendment to License SNM-1067

Gentlemen:

By Reference (A) it was requested that license SNM-1067 be amended to authorize temporary possession of certain uranium and thorium waste materials for packaging and transfer to a commercial disposal facility. This letter forwards additional information in the form of a revised application in support of the original request for an amendment. This additional information has been incorporated into the criteria and demonstration sections; Attachment A and B, respectfully; and should resolve comments and/or questions presented by members of your staff.

Attachments A and B included herein supersede and therefore should replace Attachments A and B forwarded by Reference (A).

It remains our intent to package and dispose of the material within nine months after approval of the amendment, therefore the request that the amendment be effective for that period of time is unchanged.

If there should be any further questions concerning this application, please contact Mr. P.R. Rosenthal of my staff on extension 3366.

Very truly yours,

H.V. Lichtenberger,
Vice President - Nuclear Fuel
Nuclear Power Systems

RECEIVED MAY 26 1981 U.S. NUCLEAR REGULATORY COMMISSION

HVL/PRR/kam
Enclosures

FEE EXEMPT

19063

8106010565

C

Attachment A - SNM License Amendment Criteria

1. This attachment establishes the criteria to be used to package and transfer certain uranium and thorium bearing waste materials and all contaminated soil described below from Combustion Engineering's Windsor, Connecticut site to a commercial disposal facility. The material, consisting of the residue from burning scrap metal containing alloys of zirconium and thorium, was generated as part of a former U.S. Navy program. The material has been present in place for at least 20 years.

2. There are approximately 167 55-gallon drums containing this material and an additional estimated 1100 cubic feet of loose material. The material is located within a clearing in a wooded area on the Company property as shown in Attachments (B-1 and B-2). A staging area shall be established within the clearing for packaging and repackaging of the material, soil, used waste drums, and other contaminated equipment to be discarded. After packaging in new containers, the packages shall be transferred to an outdoor storage area (see Attachment B-1) where it shall remain until subsequently released to a Carrier for transport to a commercial disposal facility. Both the area where the material is now located and the latter storage area shall be established as restricted areas in accordance with 10 CFR 20. Specific dimensions of the contaminated restricted area and general arrangement of tools and equipment to be used during repackaging of the materials is shown in Attachment (B-3). The storage area shall be maintained as a contamination free area: less than 100 dpm/100 cm^2 alpha and less than 200 dpm/100 cm^2 beta-gamma activity. To ensure compliance this area shall be surveyed weekly. Additionally, both areas shall be maintained as restricted areas until acceptance criteria for unconditional release of the areas has been met and confirmed by the NRC.

3. It has been determined (see Attachment B-4 thru B-10) that the material, which is predominantly zirconium oxides, contains radioisotopes of both uranium and thorium. Based upon the sampling procedure and analysis described in Attachment B-11 and B-12, this criteria includes authorization to process 4kg of total uranium enriched in the isotop U-235 to 93% and 10kg of thorium.

4. Handling and packaging of the material shall be performed in accordance with written procedures approved by C-E's Manager of Health Physics. The procedures shall be implemented by a Radiation Work Permit (RWP), see Attachment (B-13).

5. All personnel who physically handle the material in the course of packaging shall wear protective clothing, shoe covers, gloves, and other apparel as specified by the Manager of Health Physics. All personnel who enter the restricted areas as defined in Condition 2, above, shall wear personnel dosimeters. A breathing zone lapel air sampler shall be used 100% of the time by each individual handling unpackaged material or material which is not contained. The B/Z lapel samplers shall be counted and results reviewed on a daily basis. An action limit of 50% of that allowed by 10 CFR 20.103 will be established. Upon reaching the action limit all work shall be stopped until a review of the packaging procedures can be made by the Manager of Health Physics to determine that 10 CFR 20 limits shall not be exceeded. All personnel, material, and equipment shall be surveyed prior to leaving the restricted area. A release limit of 100 dpm/100 cm^2 alpha and 200 dpm/100 cm^2 beta/gamma activity shall be observed for materials and equipment. Personnel shall be surveyed for alpha and beta/gamma activity. Release limit for personnel shall not exceed background. Background accuracy shall be acceptable if within two standard deviations of the established background level.

6. It has been determined (see Attachment B-15 and B-16) that the fissile content of the material is well below the criticality limit. Therefore criticality controls are not needed during packaging of the material. Based upon the same determination, material packaged in 55-gallon drums (Specification 17 H drums) can be stored in any array and maintained at a high degree of subcriticality. Drums shall not be stacked greater than two high. It is planned that small samples of material will be transferred to the Development Laboratory, Building #5, for analysis. This building is presently licensed for mass limit controls under license SNM-1067. For the purpose of mass limit control, each sample taken to the laboratory shall be assumed to have the highest concentration of U-235 based upon previous analysis until it has been determined by gamma spectroscopy that no uranium is present or until it has been determined by chemical assay or mass spectroscopy that the U-235 content is less than that originally assumed. None of the material shall be transferred to Buildings #17 or #21 at any time.
7. The sampling plan presented in Attachment (B-17) shall be used for determining the quantity and enrichment of uranium to be transferred to the disposal facility.
8. The material shall be packaged and released to a carrier for transport to a disposal facility in accordance with applicable provisions of 10 CFR 71 and 49 CFR Parts 100 through 199. Any package determined to have a quantity and/or enrichment of uranium exceeding the limits of 10 CFR 71, 49 CFR Parts 100 through 199, or the disposal site criteria shall be repackaged so as to comply with the applicable requirements.

9. It has been determined by laboratory tests that the radioactive materials are in the insoluble form (see Attachment B-18) therefore migration from seepage or surface water runoff is insignificant. To ensure that resuspension of the material does not occur during packaging, continuous air monitoring shall be performed in close proximity (within six (6) feet) to the loading hopper (see Attachment B-3). In addition, air sampling shall be performed at the perimeter of the restricted area both up wind and down wind. An action limit of 25% MPCa in accordance with 10 CFR 20 will be established. Upon reaching the action limit, all work shall be stopped until a review of packaging procedures and activities is made by the Manager of Health Physics to determine that 10 CFR 20 limits shall not be exceeded. Based upon results of radioactivity measured in stratification soil samples (see Attachment B-19) it is estimated that 4 to 6 inches of loose waste material will have to be removed. Most of this material is in the form of resolidified scrap metal oxides which have "capped" the surface of the soil.

10. The following target criteria will be used for the release of the land comprising the restricted areas for unrestricted use:

    a. A square grid system measuring 25' x 25' will be established over the restricted area after clean-up operations. The direct radiation dose rate will be measured at each grid area. For a diffuse source area (an area greater than 25' x 25') the gamma dose rate in air one meter above the ground should not exceed 10 ur/hr. above background. For a discrete area (an area smaller than 25' x 25') the gamma dose rate in air one meter above the ground should not exceed 18 ur/hr. above background.

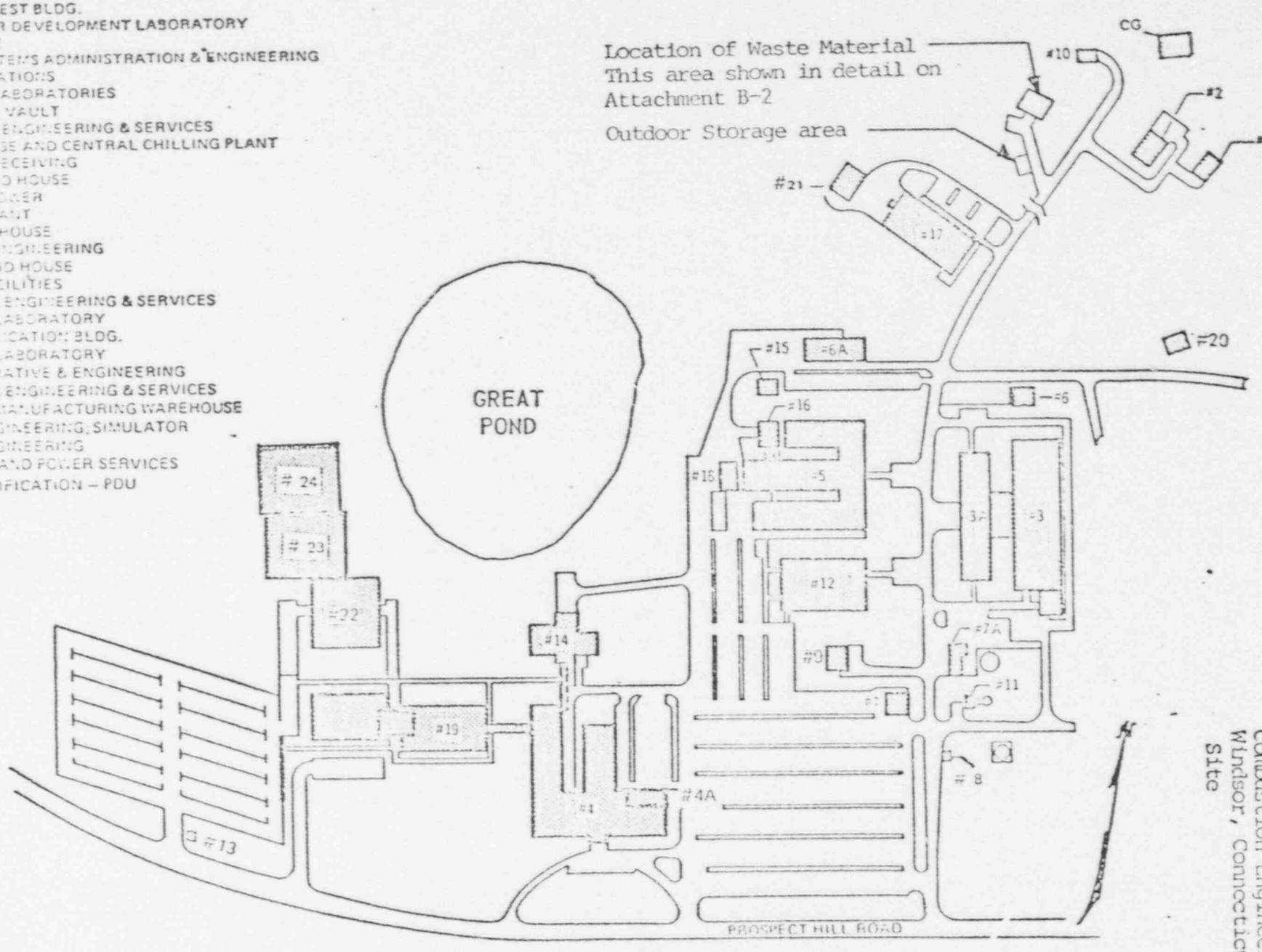
b. Representative soil samples shall be taken from each grid area and analyzed for the concentration of nuclides in dry soil. The soil shall be acceptable for unrestricted use if the dose from the sum of the major radionuclides does not contribute to a total lung dose greater than 10 mrem/year, based on calculations using the conversion factors presented in Attachment B-21 and B-22.

ATTACHMENT B

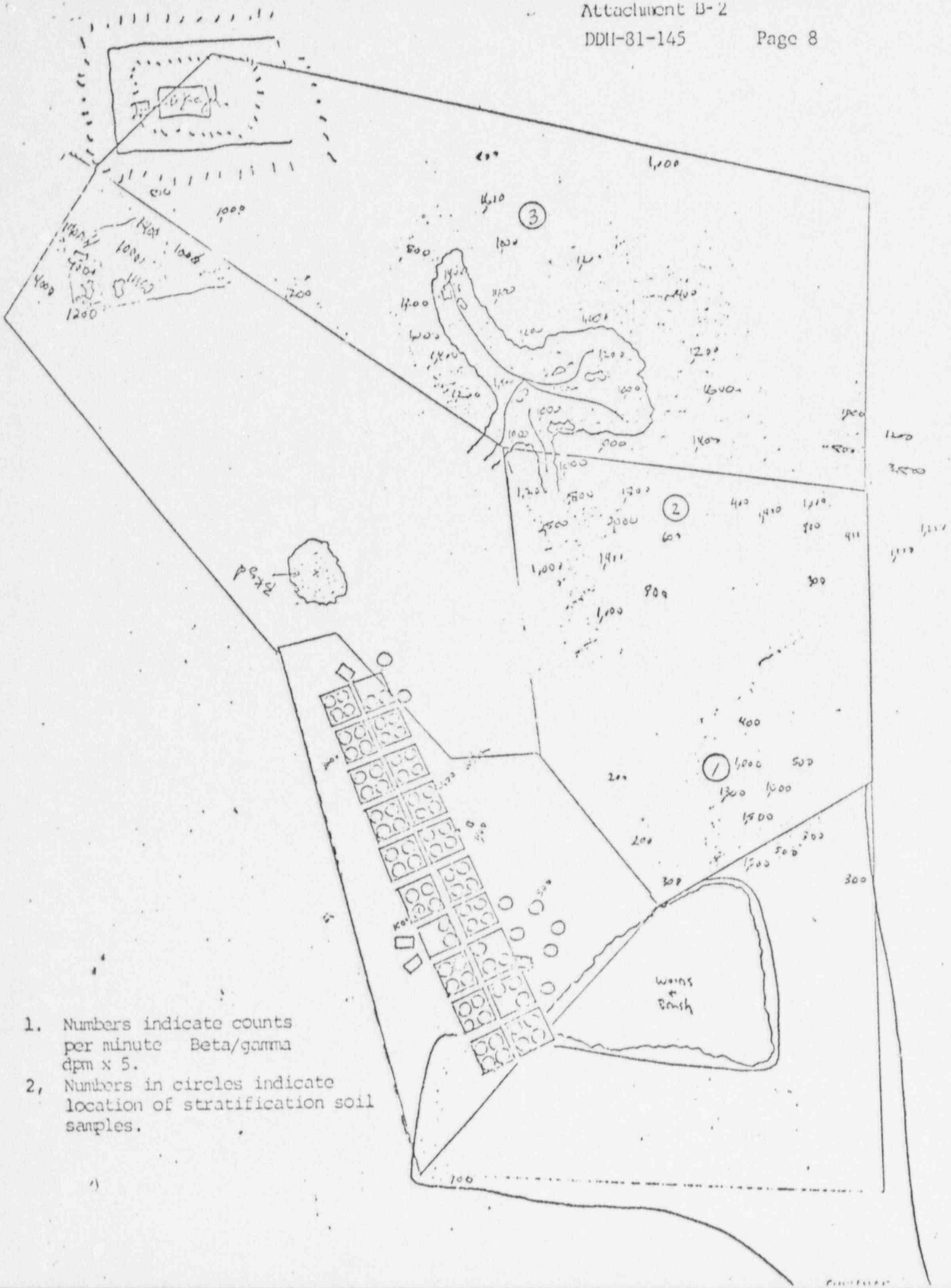
List of Contents

BUILDING IDENTIFICATION

1	STORAGE
2	NUCLEAR TEST BLDG.
3	KREISINGER DEVELOPMENT LABORATORY
3A	KDL OFFICE
4	POWER SYSTEMS ADMINISTRATION & ENGINEERING
4A	COMMUNICATIONS
5	NUCLEAR LABORATORIES
6	HOT WASTE VAULT
6A	FACILITIES ENGINEERING & SERVICES
7	POWERHOUSE AND CENTRAL CHILLING PLANT
7A	CENTRAL RECEIVING
8	EAST GUARD HOUSE
9	COOLING TOWER
10	SEWAGE PLANT
11	FIRE PUMP HOUSE
12	NUCLEAR ENGINEERING
13	WEST GUARD HOUSE
14	DINING FACILITIES
15	FACILITIES ENGINEERING & SERVICES
16	NUCLEAR LABORATORY
17	FUEL FABRICATION BLDG.
18	NUCLEAR LABORATORY
19	ADMINISTRATIVE & ENGINEERING
20	FACILITIES ENGINEERING & SERVICES
21	NUCLEAR MANUFACTURING WAREHOUSE
22	FOSSIL ENGINEERING, SIMULATOR
23	FOSSIL ENGINEERING
24	NUCLEAR AND POWER SERVICES
CG	COAL GASIFICATION – PDU

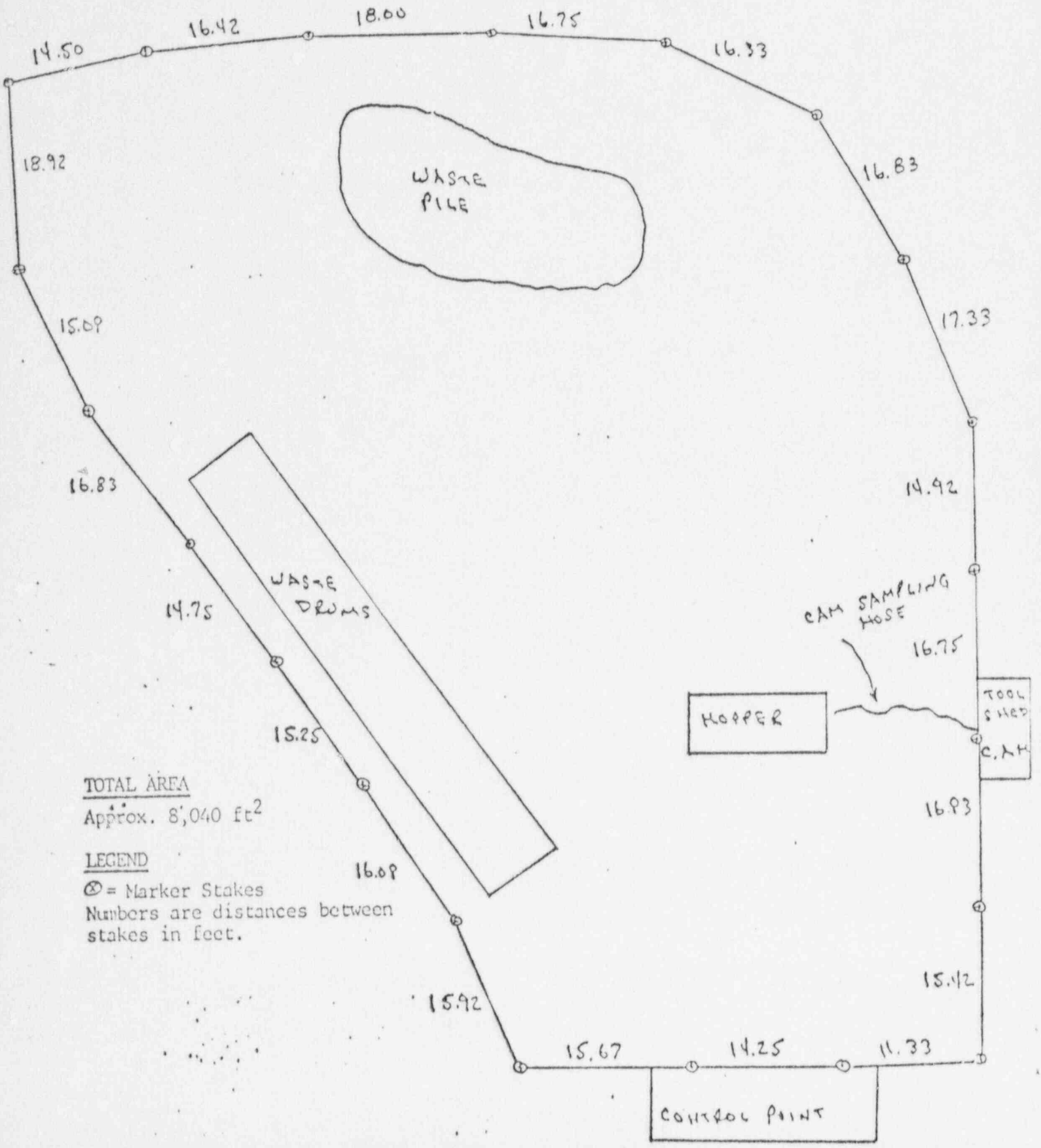


Attachment B-1
Combustion Engineering, Inc.
Windsor, Connecticut
Site



1. Numbers indicate counts per minute Beta/gamma dpm x 5.
2. Numbers in circles indicate location of stratification soil samples.

WASTE MATERIAL STAGING AREA



TOTAL AREA

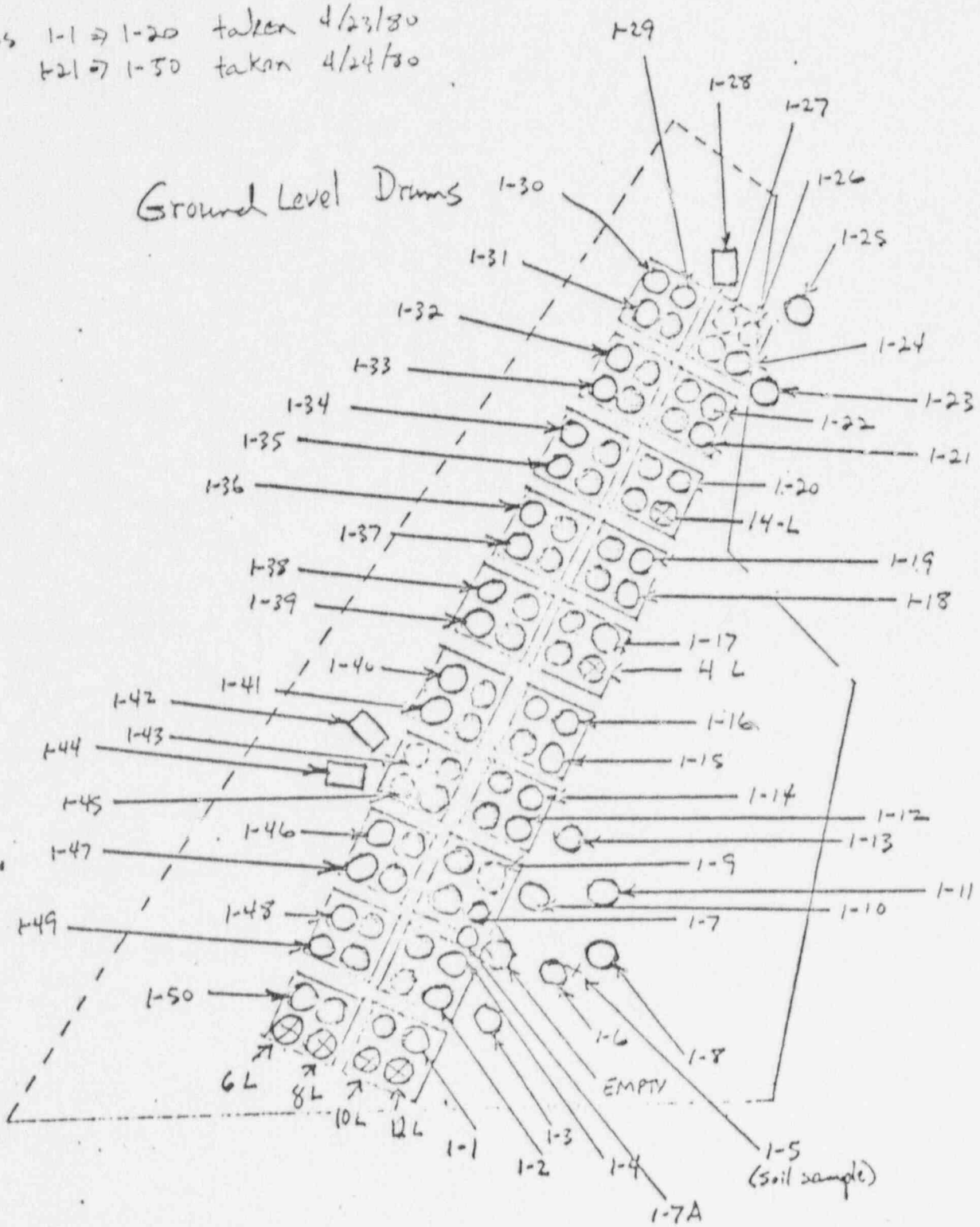
Approx. 8,040 ft^2

LEGEND

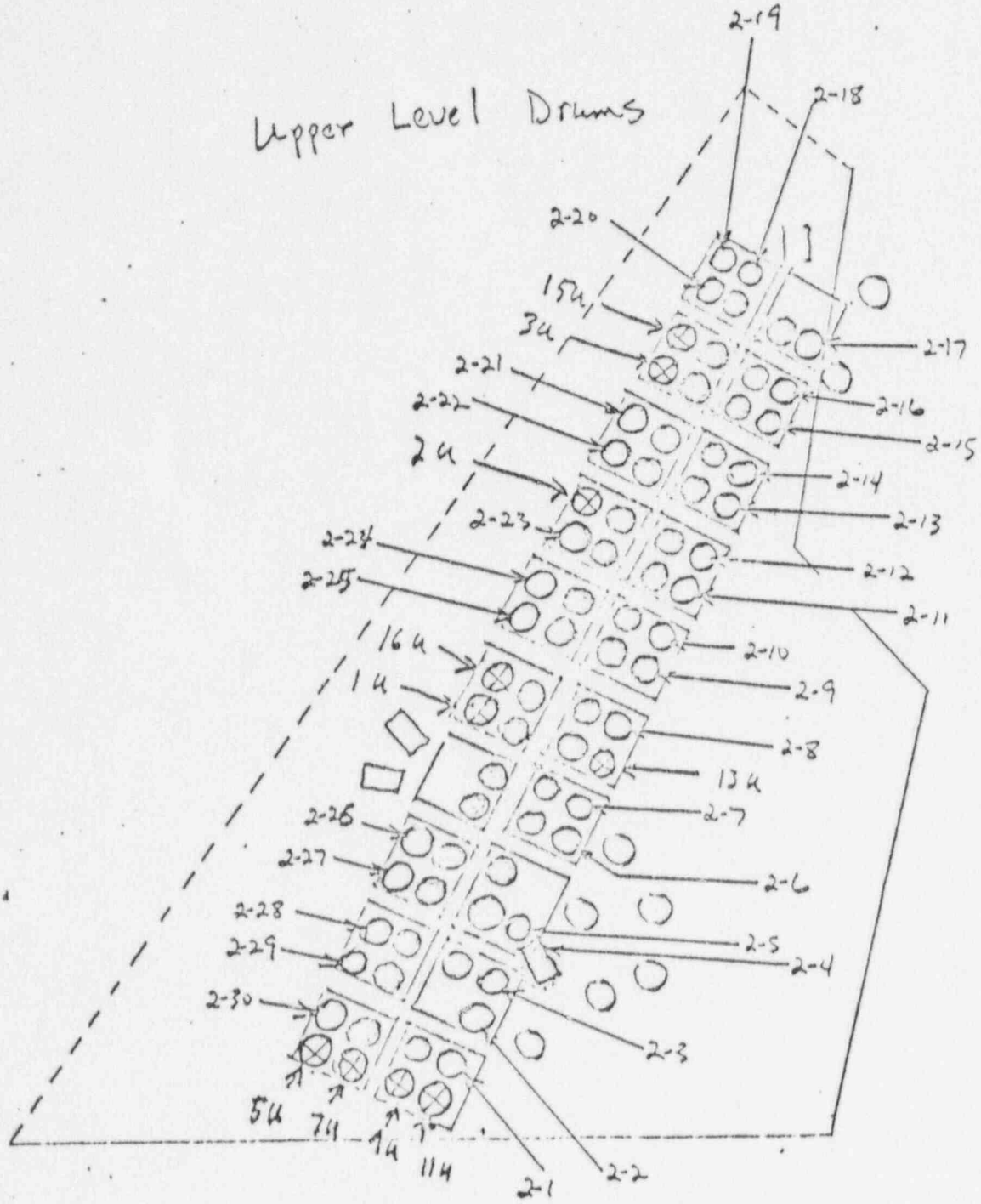
⊗ = Marker Stakes
Numbers are distances between stakes in feet.

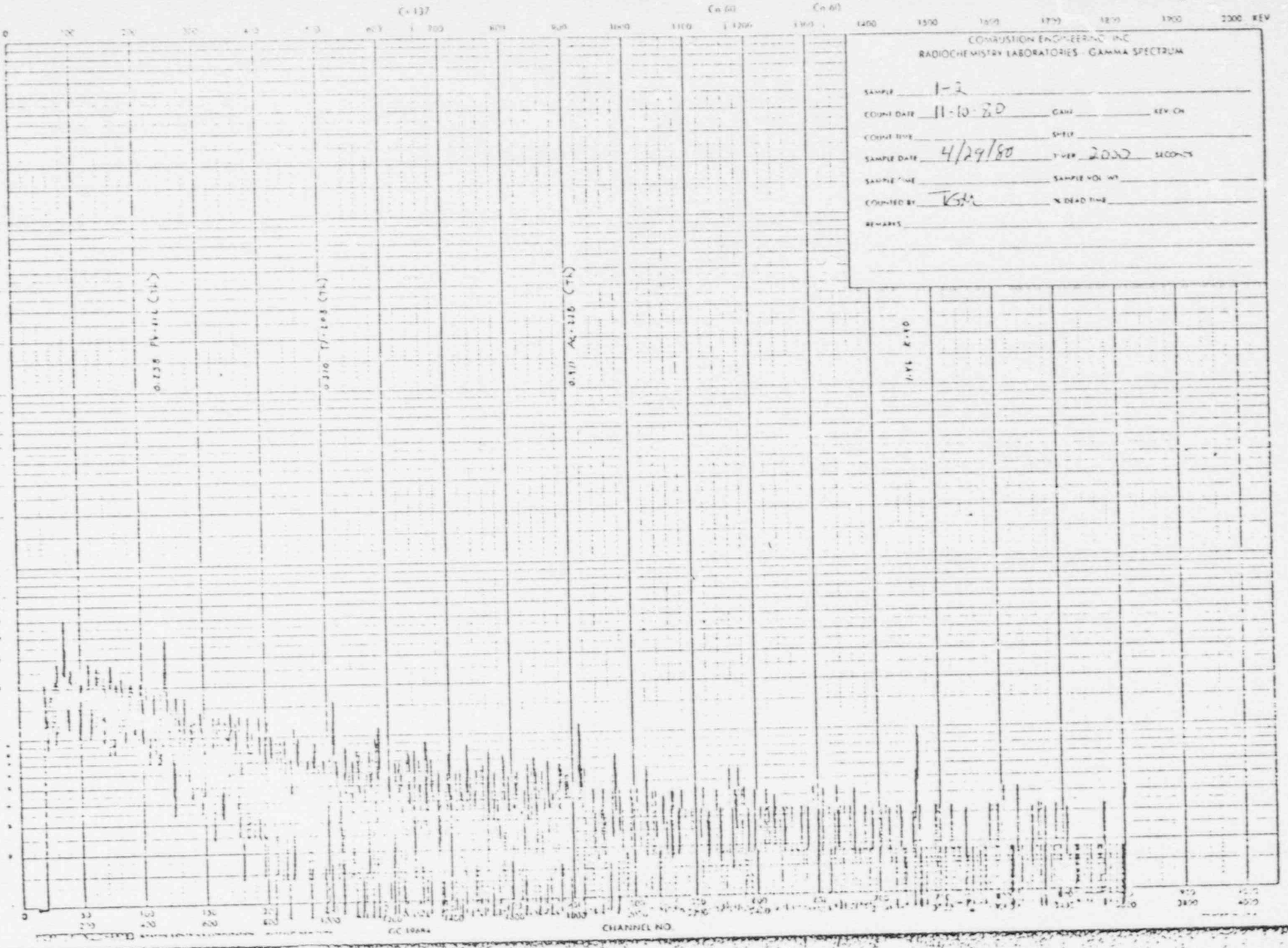
⊗ = Drums that are not accessible for sampling.
⊗ = Drums that have been previously sampled

Samples 1-1 ⇒ 1-20 taken 4/23/80
1-21 ⇒ 1-50 taken 4/24/80

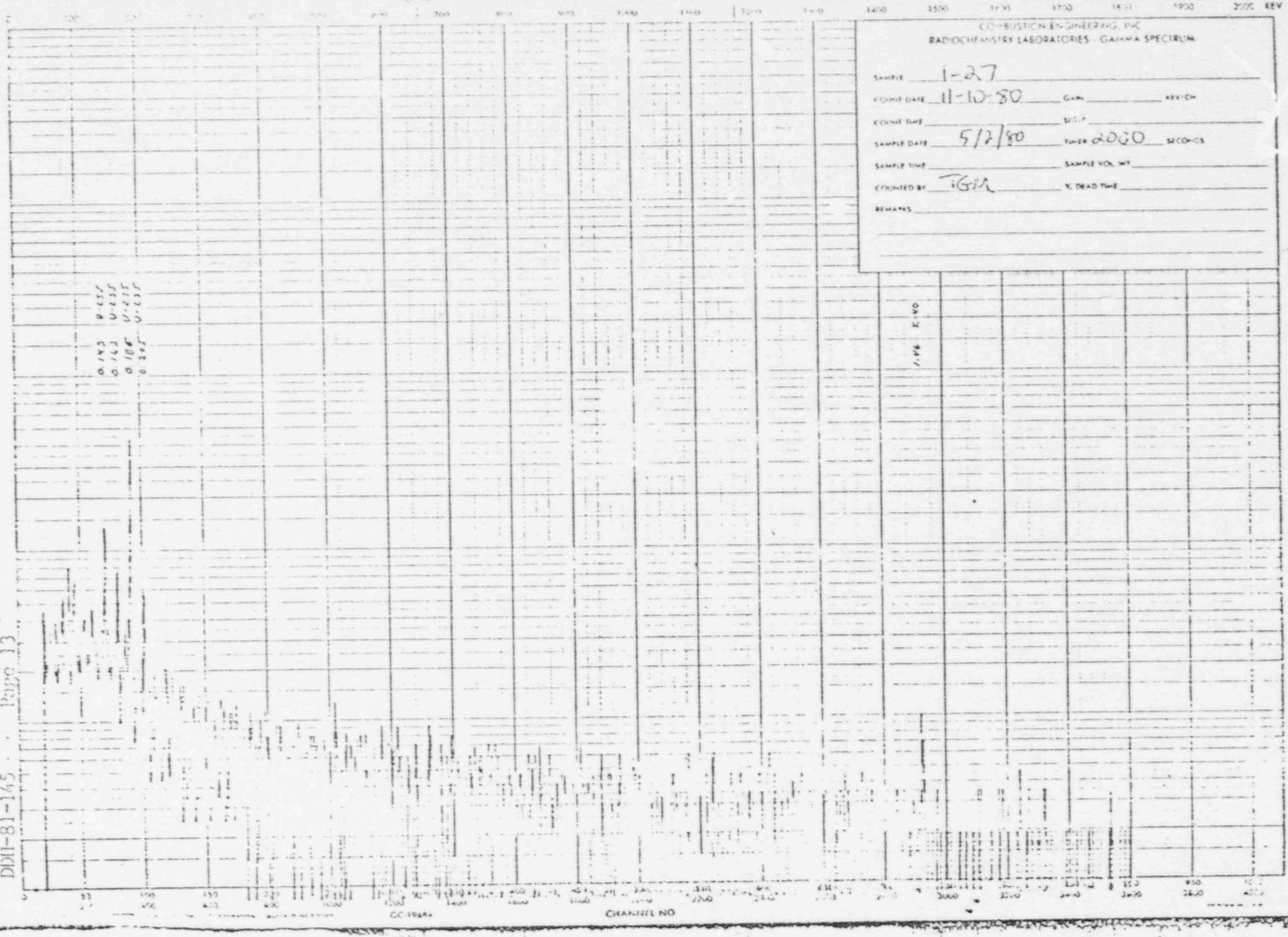


⊗ = Drums that are not accessible for sampling
⊗ = Drums that have been previously sampled



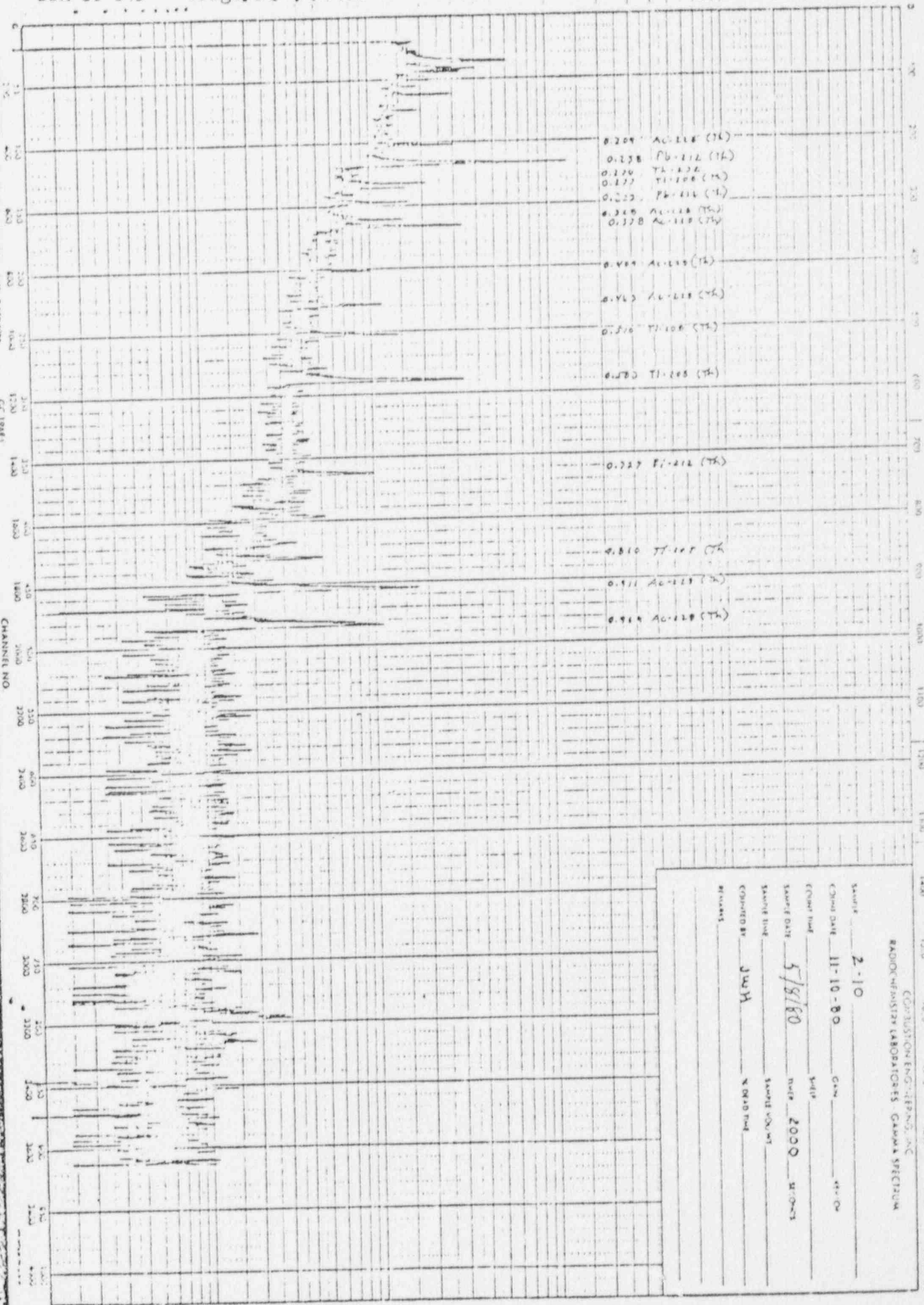


Attachment B-6

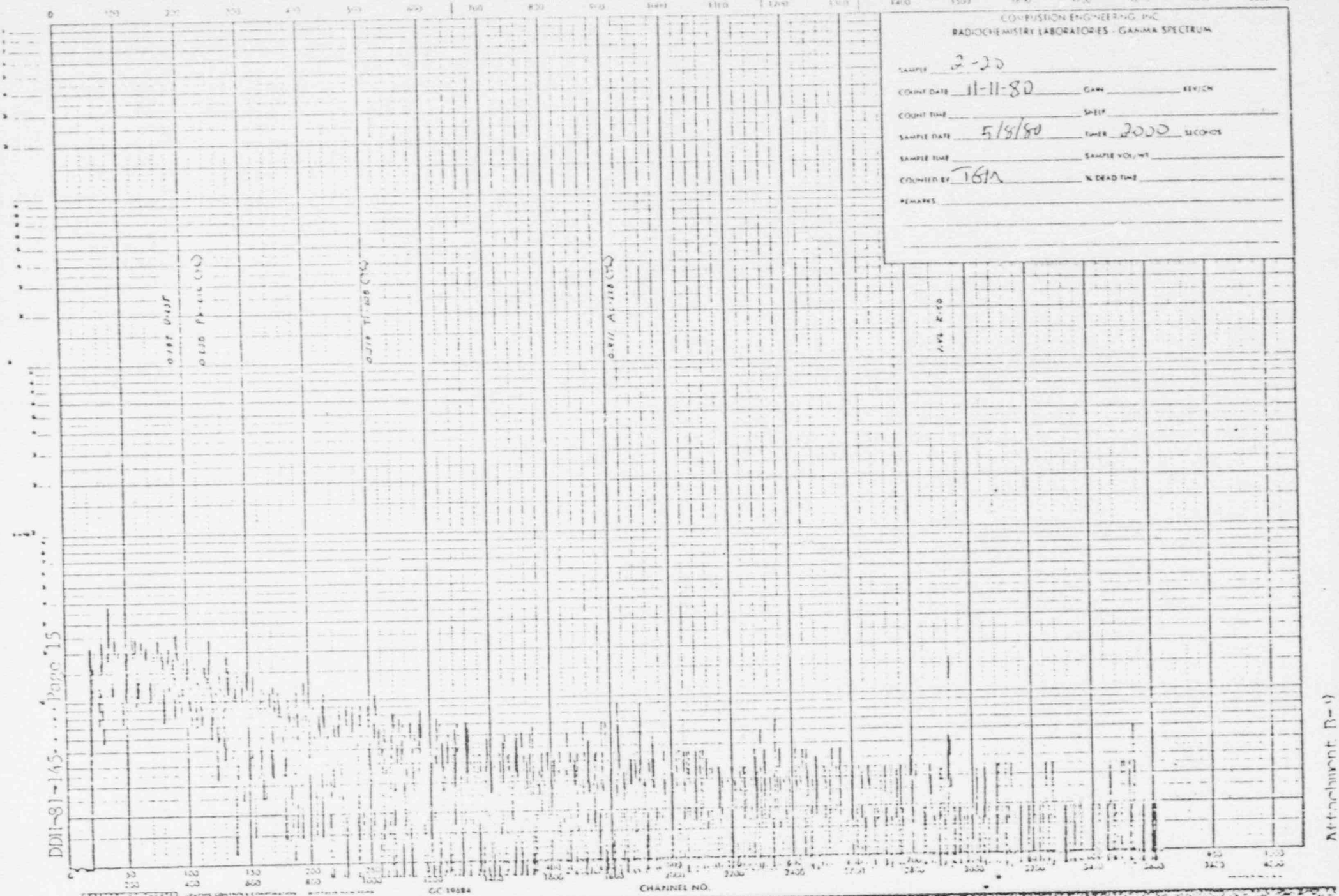


DDI-81-145 Page 13

Attachment B-7

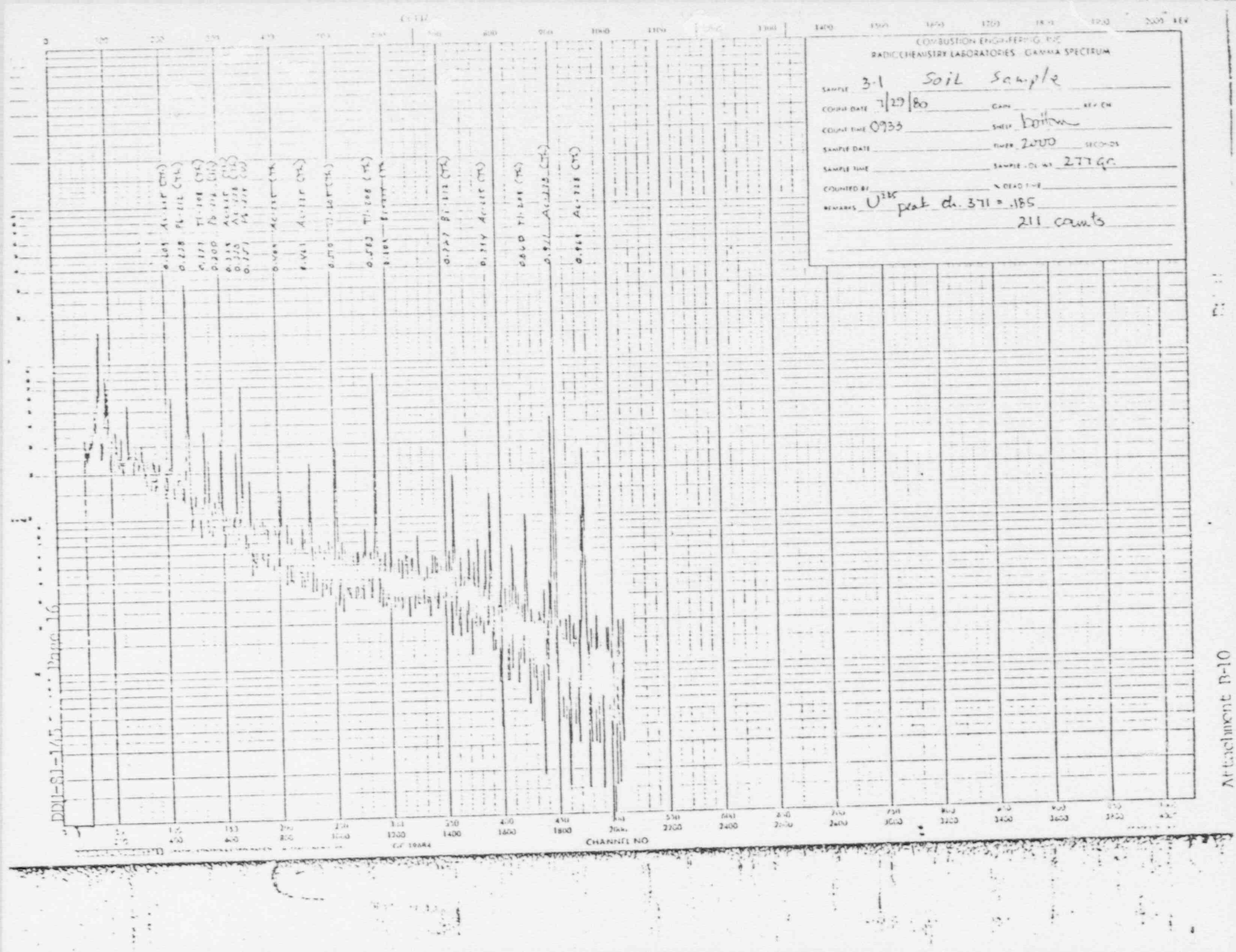


Attachment B-8



DDI-81-145-..., Page "15" ...

Attachment B-4


COMBUSTION ENGINEERING, INC.
RADIOCHEMISTRY LABORATORIES - GAMMA SPECTRUM
SAMPLE 3-1 Soil Sample
COUNT DATE 7/29/80
COUNT TIME 0933
SAMPLE DATE
SAMPLE TIME
COUNTED BY
REMARKS U235 pk. dt. 371 = .185
211 counts
SHELF bottom
TIMER 2000 SECONDS
SAMPLE WT. ca. 277 gr.
CHANNEL NO.
DDL-81-145 Page 16
Attachment B-10

Attachment B-11

There exists 167 55 gallon drums of waste material. Of this total 96 drums have been surveyed using a mult-channel analyzer with the following results:

Number of Drums	Radioactive Contents
25	Uranium only
35	Thorium only
23	Uranium and Thorium
13	No detectable activity
Total 96	

Seventy one of the drums have not been surveyed at the present time because they are in the inner rows of drums and are inaccessible until the outer drums have been removed. Assuming that the material in the unsurveyed drums is of the same nature and type as the surveyed drums, it is estimated that for the total of 167 drums the following would result:

Number of Drums	Radioactive Contents
43	Uranium only
61	Thorium only
40	Uranium and Thorium
23	No detectable radioactivity
Total 167	

All of the MCA scans which indicated the presence of uranium were reviewed to determine which samples exhibited the highest activity per unit weight of material. Seven samples were conservatively selected and sent to a subcontractor for mass spectroscope analysis. The results are shown in attachment B-12. Using the results from attachment B-12 and an average measured material density, the total quantity of uranium and U-235 was determine:

Attachment B-11(con't.)

Sample Number	PPM U	CC./Drum U	Total C.C. U	Density grams/c.c.	% U-235	Total U Kg.	U-235 Grams
1-11	285.00	60.527	717.25	1.5	75.41	1.076	811.41
1-25-2	8.20	1.741	20.64	1.5	82.73	0.031	25.65
1-27	1.98	0.421	4.98	1.5	64.47	0.007	4.51
1-28-2	4.50	0.956	11.33	1.5	26.06	0.017	4.43
1-45-2	146.00	31.007	366.81	1.5	1.02	0.550	5.61
2-15-2	105.00	22.299	253.76	1.5	1.45	0.381	5.52
2-17-2	1.16	0.246	2.92	1.5	64.00	0.004	2.80
					Total-----	2.066	859.93

The quantity of thorium was estimated by using a measured density for thorium of 0.986 grams/c.c. and assuming that the material was homogeneous in the 61 drums projected to contain only thorium. One half this value was used to estimate the thorium content of the drums which indicate presence of both thorium and uranium. All MCA gamma spectrum results of loose material indicate the presence of only thorium and therefore all 1100ft.^{3} of loose material is assumed to be thorium. The following is a summary of the total quantity of thorium present:

61 drums	thorium only	1.916 Kg.
40 drums	thorium and uranium	0.628 Kg.
1100 ft.^{3} loose material	thorium only	4.756 Kg.
		7.300 Kg.

TELEDYNE ISOTOPES
50 VAN BUREN AVENUE
WESTWOOD, NEW JERSEY 07675
(201) 664-7070 TELEX 13-4474

TELEDYNE ISOTOPES

REPORT OF ANALYSIS

RUN DATE 08/26/80

MR W M GRAVES 9452-510
COMBUSTION ENGINEERING INC
POWER SYS, FUELS & MATLS DEV
1000 PROSPECT HILL RD
WINDSOR CT 06095

WORK ORDER NUMBER	CUSTOMER P.O. NUMBER	DATE-RECVD	DELIV-DATE
3-2952		08/18/80	08/29/80

NUCLEAR FUEL

		TOTAL UPPM	U234	U235	U236	U238
F3542	1-11	285	.772	75.409	.379	23.440
F3543	1-25-2	8.2	.994	82.726	.416	15.914
F3544	1-27	1.98	.724	64.473	.338	34.465
F3545	1-28-2	4.50	.294	26.061	.137	73.508
F3546	1-45-2	146	.0082	1.020	LT.001	98.972
F3547	2-15-2	105	.015	1.454	LT.001	98.531
F3548	2-17-2	1.16	.636	63.995	.322	35.047

LAST PAGE OF REPORT
APPROVED BY L.CASABONA 08/26/80
MANAGER MASS SPEC SERVICES
SEND 1 COPIES TO COSODS MR W M GRAVES 9452-510

ATTACHMENT B-13

This procedure, and associated Radiation Work Permit, are submitted as a demonstration of the method to be used to ensure that the necessary radiological controls are being implemented. It should be recognized that, due to the nature of the task, changes to the procedure may be required and that changes may be made without prior notification of the NRC staff. These changes, however, will not violate the conditions of Attachment A, nor reduce the effectiveness of the procedure.

DEVELOPMENT DEPARTMENT
URANIUM AND THORIUM BEARING WASTE
PACKAGING PROCEDURE

PROCEDURE NUMBER: DDH-81-142

Prepared by: _____ Date: 4-8-81

Approved by: _____ Date: 4/8/81

Original Issue: 4/8/81

Revision: _____

Date: _____

1.0 SCOPE

1.1 This procedure covers the work required to package uranium and thorium bearing wastes for disposal.

2.0 PREREQUISITES

2.1 An amendment to License SNM-1067 has been approved to authorize possession of the low level waste material.

2.2 All personnel working in accordance with this procedure are trained as radiation workers.

2.3 The area to be worked in is posted and maintained as a restricted area.

2.4 A Radiation Work Permit is issued to cover the work performed under this procedure.

2.5 Prior to loading, new and old drums have been marked with an indentifying lable.

2.6 The area surrounding the loading station has been covered to collect any spillage.

3.0 EQUIPMENT

3.1 Alpha friskers

3.2 Beta friskers

3.3 Alpha/Beta smear counting equipment

3.4 Continuous air monitor

3.5 Breathing zone air samplers

3.6 Survey instruments capable of monitoring areas and equipment at existing radiation levels.

3.7 Special loading hopper

4.0 SPECIAL PRECAUTIONS

4.1 Work will not be performed, if it is raining or if there is a threat of precipitation, if the wind velocity as measured at Bradley Airport exceeds 30 mph or if the Manager - Health Physics determines the weather conditions to be unfavorable.

4.2 Data Sheet #1 must be completed, reviewed and approved by Health Physics personnel for each repackaged drum, prior to that drum being released for disposal.

5.0 PROCEDURE

5.1 Drum Repackaging

5.1.1 Place a new empty drum under the hopper

5.1.2 Transfer as many old drums to the hopper as may be required to fill the new drum.

5.1.3 Carefully fill the new drum from the hopper (see step 5.1.4).

NOTE: ENSURE THE DATA SHEET FOR THE NEW DRUM REFLECTS THE I.D. NUMBERS OF THE OLD DRUMS THAT COMPRISE IT.

5.1.4 Obtain 3 samples, approximately 50cc each, when the new drum is approximately 1/3, 2/3 and full. Identify sample container with same I.D. number as the new drum.

5.1.5 When the new drum is full, place a lid on the drum.

5.1.6 Perform a smear survey of the new drum. Decontaminate the drum as necessary for release to the storage area.

5.1.7 Weigh the new drum and record the weight on the data sheet.

5.1.8 Transfer the new drum from the loading area to the storage area.

NOTE: PRIOR TO TRANSFERRING THE NEW DRUM TO THE STORAGE AREA ITEMS 1 THRU 6 OF THE DATA SHEET MUST BE COMPLETED AND SIGNED BY THE COGNIZANT HEALTH PHYSICS TECHNICIAN IN THE SPACE AVAILABLE.

5.2 Loose Material Packaging

NOTE: DO NOT BEGIN THIS SECTION OF THE PROCEDURE UNTIL ALL WASTE DRUMS HAVE BEEN SUCCESSFULLY REPACKAGED.

5.2.1 Place 2 or 3 new empty drums in a front loader.

5.2.2 Carefully transfer the loose material from the area to the drums.

5.2.3 Obtain 3 samples, approximately 50cc each, when the new drum is approximately 1/3, 2/3 and full. Identify sample container with same I.D. number on the new drum.

5.2.4 When the new drum is full, place a lid on the drum.

5.2.5 Perform a smear survey on the new drum. Decontaminate the drum as necessary for release to the storage area.

5.2.6 Weigh the new drum and record the weight on the data sheet.

5.2.7 Transfer the new drum from the loading area to the storage area.

NOTE: PRIOR TO TRANSFERRING THE NEW DRUM TO THE STORAGE AREA, ITEMS 1 THRU 6 OF THE DATA SHEET MUST BE COMPLETED AND SIGNED BY THE COGNIZANT HEALTH PHYSICS TECHNICIAN IN THE SPACE AVAILABLE.

URANIUM & THORIUM BEARING WASTE

PACKAGING DATA SHEET

1. Date: _____
2. New Drum I.D. Number: _____
3. From old drums: _____, _____, _____, _____, _____ (step 5.1.3 only)
4. Sample obtained and identified _____ (H.P. initial)
5. Drum Smear Survey

   Alpha: _____ DPM/100cm^2
   Beta/Gamma: _____ DPM/100cm^2
6. Weight of drum:

   Gross Weight: _____ lbs.
   Net Weight: _____ lbs.

   Items 1 through 6 above have been completed

   _____ _____
   Signature Date
7. Weight of sample: _____ grams
8. Analysis results:

   Enrichment _____ % U235

   Total U _____ grams

   Total U235 _____ grams

   Specific Activity _____ ci/gram

   Isotopes _____, _____, _____

   Weight of material _____ lbs.
9. Total Activity: _____ curies

   Items 7 through 9 have been completed

   _____ _____
   Signature Date
10. Chemical Form: _____
11. Physical Form: _____
12. Radiation Survey:

    Contact: _____ mr/hr

    3 feet: _____ mr/hr
13. Drum Seal Number: _____

    Items 10 through 13 have been completed

    _____ _____
    Signature Date

Date sheet reviewed and drum released for disposal

POWER SYSTEMS

SAMPLE

RADIATION WORK PERMIT

Requestor	Date Start	Date Expire	R.W.P. No.
	6/1/81	6/7/81	111

Work Area: Waste Material Staging Area

If RWP is for more than one day, RWP must be initialed and dated by HP before work starts

Date	6/1	6/2					
Initial	[illegible]	[illegible]					

Job Description: Packaging of Uranium and Thoriun waste

R.W.P. must be initialed by all authorized personnel prior to starting work

Authorized Personnel	Initial	Allowable Weekly Exposure	Daily Allowable Exposure						
			Date 6/1	Date 6/2	Date	Date	Date	Date	Date
John Doe	JD	100	100	98					
Jack Jones	JJ	100	100	97					
Joe Blow	JB	100	100	98					

Radiation Levels: 1-3 mrem/hr at contact — Mrem/Hr

Contamination Levels: 500-2000 — ~~DPM/100 cm²~~ Beta/Alpha

Requirements

- ☒ TLD
- ☒ Dosimeter
- ☒ B-Z Air Sampler
- ☐ Lab Coat
- ☒ Full PC's
- ☒ Cloth/Plastic Booties
- ☐ Cloth Hood
- ☐ Rubbers
- ☐ Plastic Gloves
- ☐ Rubber Gloves
- ☐ Cotton Gloves
- ☐ Plastic Suit
- ☒ Approved Procedure
- ☒ Other (Specify Below)

Special Instructions

1. Procedure PDH-81-142 must be posted and followed
2. CAM must be in operation whenever work is performed
3. H.P. coverage required at all times

Approved By	Date	Terminated By	Date
[signature]	6/1/81		

C-E 6090291 (6/79)

SAMPLE

POWER SYSTEMS

To: P. R. Rosenthal (A)

cc: R. S. Harding (C)
W. A. Goodwin (C)

R. J. Klotz
PHD-80-132
October 30, 1980

Criticality Evaluation
of Waste Drums

The fissile contents of the samples analyzed by teledyne have been compared to the limits in ANS N16.1 and all samples, including F3542 which has the highest concentration of U-235, are well below the criticality limit. The degree of subcriticality can best be shown by taking the U-235 concentration in the above sample and assuming it is mixed with water in this same concentration. The resulting concentration is still a factor of 37 below the uniform Aqueous Solution limits in ANS N16.1. Of course, the other materials in the samples will act as a poison and further reduce the criticality safety factor. Again we are making the above conclusions on the highest measured concentration which is over a factor of 30 higher than the next highest measured concentration.

RJK:njm

ATTACHMENT B-15

CRITICALITY EVALUATION OF WASTE DRUMS USING THE SURFACE DENSITY METHOD

Reference I - R.L. Stevenson and R.H. Odegaarden "Studies of Surface Density Spacing Criteria Using KENO Calculations". Trans. Amr. Nucl. Soc. 12,890 (1969).

In addition to the criticality evaluation of Attachment B-15, an evaluation was performed by the surface density method described in Reference I above.

Results of a mass spectrum analysis performed on a representative sample of the waste drums, see Attachment B-12, indicates the drum with the highest concentration of U-235 would contain 152.16×10^{-6} grams U-235 per c.c. One square foot of surface area in a single drum 86.4 cm. high would contain:

$$86.4 \text{ cm} \times 929.03 \text{ cm}^2 = 80265 \text{ c.c.}$$

$$80265 \text{ c.c.} \times 152.16 \times 10^{-6} \text{ grams/c.c.} = 12.2 \text{ grams/ft.}^2$$

Since attachment A requests authorization to stock drums two high, the surface density for this drum with the highest concentration of U-235 would be 24.4 grams/ft^2. This value is over seven times below the surface density limit of 175 grams U-235 per ft^2 specified by reference 1. This is considered to be very conservative since the calculations are based upon a mass spectrum analysis for a drum containing 30 times more uranium than the other drums sampled.

Attachment B- 16

Sampling Plan

A 150 C.C. sample will be obtained from each new 55 gallon drum as it is packaged. An attempt will be made to obtain a representative sample by taking 50 C.C. of material when the drum is 1/3 full, 50 C.C. of material when the drum is 2/3 full and 50 C.C. when the drum is full. Each 150 C.C. sample will be transferred to the Development Department Laboratory for gamma spectroscopy.

If results of the gamma spectrum scan indicates the presence of thorium only, the drum will be considered to be homogeneous containing thorium at a measured density.

If results of the gamma spectrum indicate the presence of uranium or uranium mixed with thorium, a portion of the 150 C.C. sample will be sent to an independent laboratory for assay to determine radioistope concentration and U-235 enrichment. The quantity of the radioactive material and the enrichment in the drum will be calculated using the method outlined in Attachment B-11.

POWER SYSTEMS

To: P. R. Rosenthal

cc: W. M. Graves
J. M. Limbert

Waste Oxide Leach Test
(791201)

E. A. Hagelstein

FMDC-80-060

November 6, 1980

A water leach test has been conducted on six (6) waste oxide samples collected from storage drums by Health Physics personnel. The purpose of the test was to determine the leachability of radioactive constituents by rainwater from the oxide material.

The test was performed by placing the sample materials in contact with simulated rainwater for a period of fifteen (15) days. At the end of the leach period, a portion of the liquid was removed, filtered and analyzed for alpha and beta radioactivity and chemical uranium. Results of these analyses are listed in Table 1 as Samples 1-6 and are reported per milliliter of leach solution.

A liquid presumed to be rainwater was found in the bottom of drum 2-24. This water was extracted from the drum and also analyzed for radioactivity and uranium content. These results are listed in Table 1 as Sample No. 7 and are reported per milliliter of liquid extract.

The test results show that no significant radioactive material was leached from samples 1, 2, 4, 5 and 6. However, Sample No. 3 from drum 1-35 indicates leaching of some alpha and beta radioactivity. No detectable uranium was leached from any sample. The liquid extracted from drum 2-24, Sample No. 7, contained no measurable radioactivity or uranium.

The test procedure in detail is as follows. Simulated rainwater was prepared by saturating demineralized water with carbon dioxide and atmospheric gases. The resultant pH of this solution was 4.8. A 50-gm portion of each waste oxide sample was placed in a 3.25 in. diameter plastic container. Simulated rainwater (100 ml) was added, and the container was capped and left undisturbed for 15 days. At the end of that period, a liquid sample was collected from the supernate of each container and filtered through 0.2 micron filter paper. The liquid extracted from drum 2-24 was also filtered in the same manner. Alpha and beta radioactivity of the filtered liquids was determined by counting 10 ml. of evaporated liquid for 1 hr. in a low background proportional counter. Measurements for uranium content were performed with a uranium fluorimeter.

The minimum detectable activities listed in Table 1 are equal to the two standard deviations counting uncertainty or error and are reported as the result when they are equal to or greater than the measured radioactivity concentration. The minimum sensitivities listed for uranium concentrations are based upon minimum detectable meter deflection and instrument response to uranium standards.

E. A. Hagelstein

EAH/bco
Attachment

Table 1

Leach Test Results

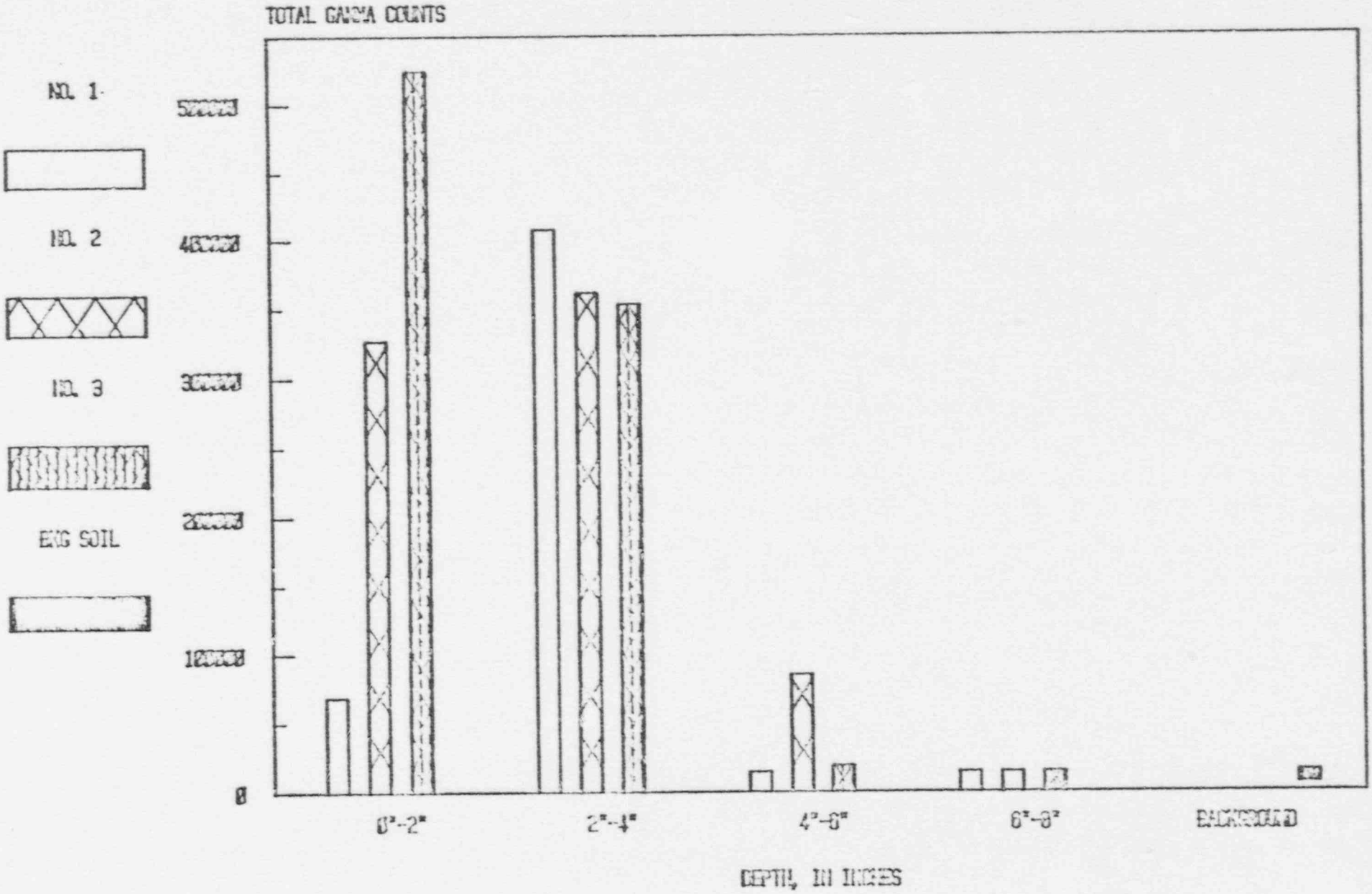
Sample Number	Sample Identification	Alpha D/M/ml	Alpha μCi/ml	Beta D/M/ml	Beta μCi/ml	Uranium Micrograms/ml
1	1-8	$\leq$0.07	$\leq 3.2 \times 10^{-8}$	$\leq$0.14	$\leq 6.3 \times 10^{-8}$	$\leq$2
2	1-24	0.13±0.08	5.9×10^{-8}	$\leq$0.14	$\leq 6.3 \times 10^{-8}$	$\leq$1
3	1-35	0.28±0.09	1.3×10^{-7}	1.03±0.09	4.6×10^{-7}	$\leq$1
4	2-1	$\leq$0.07	$\leq 3.2 \times 10^{-8}$	$\leq$0.14	$\leq 6.3 \times 10^{-8}$	$\leq$1
5	2-19	$\leq$0.07	$\leq 3.2 \times 10^{-8}$	$\leq$0.14	$\leq 6.3 \times 10^{-8}$	$\leq$1
6	2-24	$\leq$0.07	$\leq 3.2 \times 10^{-8}$	$\leq$0.14	$\leq 6.3 \times 10^{-8}$	$\leq$1
7	Extract 2-24	<0.07	$\leq 3.2 \times 10^{-8}$	$\leq$0.14	$\leq 6.3 \times 10^{-8}$	$\leq$1

Attachment B-18

Three stratification soil samples were obtained in the approximate location indicated in Attachment B-2. Radioactivity variation with depth for each of the three samples is shown in Attachment B-20. The only radioisotope identified was thorium or its daughters. All three stratification samples were in the form of resolidified scrap metal oxides which have "capped" the surface of the soil. Based upon results of these samples it is estimated that the "cap" will have to be removed to a depth of approximately six inches.

RADIOACTIVITY, VARIATION WITH DEPTH

(TOTAL GAMMA)



Attachment B- 20

Release of the land for unrestricted use

Since it has been determined that the materials are in the insoluble form, radiation dose to man through the food ingestion pathways is considered to be insignificant. The significant pathways of dose to be considered for unrestricted release of the land are from external direct radiation (whole - body) and from inhalation of particulates (lung burden) due to long term resuspension of radionuclides from the soil. The target criteria to be used for release of the land for unrestricted use is presented in Attachment A. The dose conversion factors to be used to determine lung burden are shown in Attachment B-22.

Dose Conversion Factors for Lung

Radionuclide	Dose Conversion Factor (Rem/μ Ci inhaled)
U-238	390
U-235	420
U-234	450
Th-232	590
Th-230	440
Th-228	1310
Ra-228	1100
Pu-239	480
Pu-238	510
Pb-210	370

These dose conversion factors are based a

"Y" compound with an AMAD of 1.0 μm.