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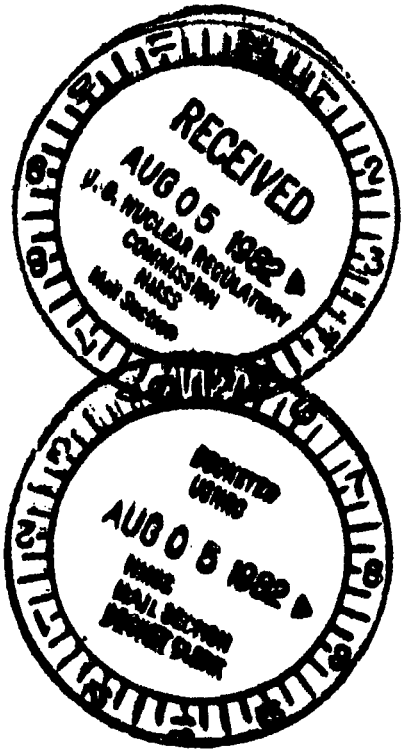
TEXAS INSTRUMENTS

INCORPORATED

ATTLEBORO, MASSACHUSETTS 02703

Materials & Electrical Products Group



July 29, 1982

Nuclear Regulatory Commission
Washington, DC 20555

Attention: Mr. R.G. Page, Chief
Uranium Fuel Licensing Branch
Division of Fuel Cycle & Material
Safety, MSS

Reference: NRC License SNM-23

Gentlemen:

Please find enclosed eight copies of the Environmental Report "Radiological Survey of the Texas Instruments Complex", dated 20 July 1982.

This submittal is being made to:

Request termination of NRC License SNM-23 as issued to Texas Instrumentes Incorporated (TI).

Demonstrate that the sampling and analysis of the study areas have been carried out in conformance to 10 CRF requirements.

Present measurements and analytical methodologies used to analyze Texas Instruments' water and soil samples. This includes calculation methods, counting techniques, instrumentation and quality assurance plan.

Document the conclusion that contaminated material was disposed of only in the study area presented. This has been verified by discussions with employees involved with the Nuclear fuel production including the Health Physicist.

If you desire additional information, please contact Francis J. Veale Jr., at (Tel. 617-699-1804).

Sincerely

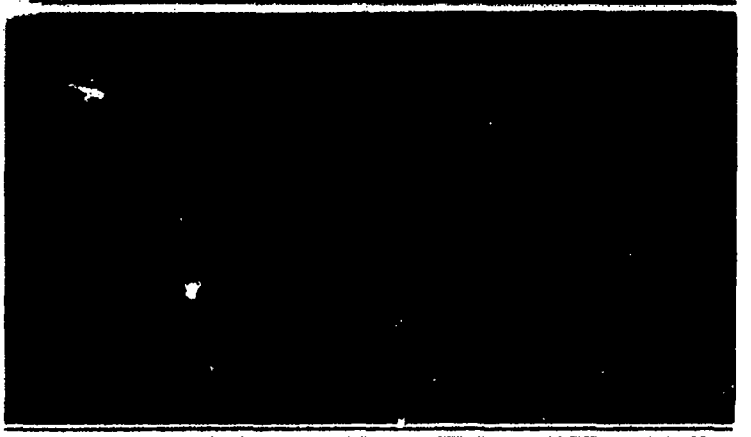
F.L. Sherman

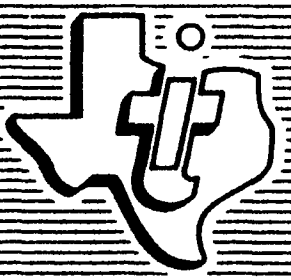
F.L. Sherman
Manager HFIR Project

CC: Bob Mossman
Tom Burkhalter

Francis J. Veale, Jr.
Manager Environmental Eng., Attleboro

21042





TEXAS INSTRUMENTS

INCORPORATED

ENVIRONMENTAL REPORT

RADIOLOGICAL SURVEY OF THE TEXAS INSTRUMENTS COMPLEX

PREPARED BY:

Francis J. Veale, Jr.
Manager of Environmental Engineering
20 July 1982

REQUEST FOR TERMINATION

OF

NUCLEAR REGULATORY COMMISSION

LICENSE SNM-23

FOREWORD

This submittal presents a request by Texas Instruments Incorporated (TI) for termination of Nuclear Regulatory Commission License SNM-23.

APPROVED BY: Tom Burkhalter 7/24/82

TOM BURKHALTER, MGR. OF CORPORATE ENVIRONMENTAL ENGINEERING

APPROVED BY: Robt Z Mossman

BOB MOSSMAN, FACILITIES MANAGER

APPROVED BY: Frank Veale

FRANK VEALE, MGR. OF ENVIRONMENTAL ENGINEERING

APPROVED BY: Fred L. Sherman

FRED L. SHERMAN, MGR. HFIR PROJECT

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APPROVED BY: Francis Veale

FRANK VEALE, MGR. OF ENVIRONMENTAL ENGINEERING

APPROVED BY: Fred L Sherman

FRED L. SHERMAN, MGR. HFIR PROJECT

INTRODUCTION

A study of radionuclide migration was conducted on the grounds of Texas Instruments in Attleboro, Massachussetts. The radiological survey consisted of shallow and deep well sampling, and soil analysis on and around the disposal site. Map 1 shows the arrangement of the newly drilled shallow wells.

The dump site is located between the grounds of the present day Buildings 11 and 12, as indicated in Figure 1.

In previous years the site was responsible for the production of nuclear fuel for commercial power facilities and the United States Naval reactor program during the 1950's. According to the records of the Industrial Hygienist, the physical state of the contaminated material was in solid form, predominately metal trash and some non-metallic trash, which was contaminated with the radionuclide U-235 as U308. There are no indications from past records or conversations that any waste fuel was disposed of at Texas Instruments by burial.

A portion of the burial site was uncovered in August of 1980 by construction workers while digging a trench. Texas Instruments sorted out the contaminated material and contained it in eleven 55 gallon drums for shipment to a nuclear waste disposal site in South Carolina.

Nineteen wells were driven around the disposal area. One core boring was taken in an acid wash treatment area, and four core borings were taken in the disposal area. The nineteen wells were identified as #1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 21, 22, 23, 24, 25, 26, 27 and 28. The core borings from the acid wash treatment area was designated as B-11A, and the remaining core borings were identified as B-12, B-13, B-14, and

B-15. The already existing deep wells were identified as #1D, 2D, 3D, 4D, 5D, 7D, 8D, 15D, 16D, 18D, 19D, 20D, and CP (Coopers Pond). Please refer to Map 3.

Commencing in December of 1981, samples were taken directly from the dump site as soil cores, water samples from the perimeter and deep wells were also acquired. Often these well sites were re-sampled which makes the data statistically more valid.

Also included in the report are the results of an aerial radiological survey of the Texas Instruments Industrial Complex and surrounding area. This survey was conducted in June of 1981 by the Remote Sensing Laboratory of the United States Department of Energy.

METHODOLOGY

A series of wells were driven around the burial site. The first set of wells was a series of perimeter wells, approximately 50 feet from the actual disposal area. The second set was a series of perimeter wells approximately 150 feet from the dump site. Finally, there was a set of pre-existing deep wells randomly placed throughout the grounds of Texas Instruments for industrial water consumption in its manufacturing processes. The locations of all wells are found on the enclosed maps. Map 1 marks only the shallow wells driven purposely for this study. Map 2 marks only the deep wells that existed prior to this investigation. Map 3 contains markings of both shallow and deep wells, and also the locations of the soil borings.

All well samples were drawn by the groundwater pump except for deep well numbers 1D, 3D, and 7D. 1D, 3D, and 7D are production wells and were sampled at the well head spigot. Please refer to the I.E.A. manual (Procedures and Equipment for Groundwater Monitoring) for information on the groundwater pump.

Refer to the radiological analysis report of C.E.P. contained in this report to find all details involved in the analytical methodology and its quality assurance plan.

RESULTS

The December 15, 1981 shallow well sampling data is shown on Table 1. It appears that all wells except 7 and 9 had significant levels of contamination. It is possible that some well to well cross contamination took place during the drilling process or was induced by surface water runoff, migration, or intrusion of water from one well to another. Re-sampling these wells after several repeated evacuations of each test hole to minimize the effects of any previous cross contamination events was performed.

The results of the second set of tests are found on Table 2. Several factors may relate to this data.

1. Surface runoff was present in large volumes over test well one. Water was ponded up to a depth of about two inches for a 12-15 foot radius around the well. Depth of the water above the well was 2-3 inches.

2. There appeared to be a large amount of suspended solids present in some of these samples even after evacuation and recharge. It was our preliminary opinion that most of the radiochemical activity present was associated with the suspended solids. Therefore, an analysis of all the samples was performed after filtration through a 0.45 micron filter.

As shown in Table 3, after filtration the gross Alpha and gross Beta concentrations were markedly low in comparison to the non-filtered analysis.

It can be seen that the majority of the radiochemical activity is in suspension as shown on Figures 2 and 3. These graphs compare the

January 1982 data with that of the filtered data. In all cases in both Alpha and Beta concentration, the filtered samples are markedly lower than the non-filtered data.

The results of the re-sampling of shallow wells #21, 22, 23, 24, 25, 26, 27, and 28 are shown included with the deep well data sampled in May of 1982. Please refer to Table 6.

An isotopic scan was performed on well samples 1 and 27 for they showed the highest concentration of gross Alpha and Beta in the previous non-filtered analysis. The results of this scan are shown in Table 4.

As can be seen in Figure 4, the perimeter wells 50 feet from the disposal area indicate a higher level of radiochemical concentration than do the perimeter wells 150 feet from the burial site. The figure appears to indicate the possibility that the radionuclide material is migrating slowly in both a Southwesterly and Southeasterly direction; with higher values found in the Southwestern direction. This is evidenced from the data on wells 1 through 5 and wells 25 and 27. Both wells 25 and 27 are in a Southwestern direction from the burial site. Wells 25 and 27 have values of 306 +/- 102 and 3063 +/- 763 pCi/liter respectively. It should be noted that there does not appear to exist any clear migratory flow. Most of the contamination appears to be located relatively close to the disposal site, as will be shown in the deep well data which contains very low levels of radiochemical activity.

The soil borings ranged from 7 +/- 6 to 600 +/- 37 pCi/liter in Alpha activity. The gross Beta concentration in all samples was 0 +/- 5 pCi/liter. This data is found in Table 5. The core B-11A was taken in

a past industrial acid wash (treatment) area of building 10. The results of this core analysis (7 +/- 6 pCi/liter gross Alpha and 0 +/- 5 pCi/liter gross Beta content) reinforces the initial premise that no radionuclide material was deposited in this area of the TI complex. This area is designated 11A on Map 3 which is enclosed within the report. The other four soil borings were taken within the dump site (refer to Map 3). All bores were extracted by means of the EPA Leachatic Extraction procedure which is listed in appendix II on page 33127 of the May 19, 1980 Federal Registration. In the test the PH was adjusted and maintained at 5.0 with acetic acid.

The results of the deep well analysis show low levels of radiochemical activity (Table 6). It was suggested that the deep wells be re-sampled due to a probable improper purging of the wells. The June 1982 sampling of the deep wells shows a decrease in radionuclide concentration (Table 7). Once again, it was recommended that a few of the wells (19D, 1D, 2D, 5D) be re-sampled. Please note (Table 9). The July data also shows a very low level of radiochemical activity.

In data reported by C.E.P., the gross Alpha and Beta concentration is separated into suspended and dissolved. The deep wells all show low levels of concentration.

To be assured of no cross contamination in the deep well sampling, the following technique was performed. After a well was sampled the pump used to obtain the well sample was flushed for 30 minutes with fresh water. After this duration of flushing, a sample of the flush water was taken. This flush sample was filtered through a 0.45 micron filter and analyzed for gross Alpha and Beta. As can be seen in Table 8, the flush samples all have extremely low concentrations of radiochemical

activity. Thus, it appears that no cross contamination was present in this set of samples. The same technique was performed on the July 1982 samples and as shown in Table 9, there was no radiochemcial activity detected in the flush sample of 5D. This is representative of the other three wells analyzed in this set of samples.

Enclosed in the report is a hydrological map of the Attleboro area where Texas Instruments is located. The TI facility is marked on this map at latitude N-41 degree, 56', 45" and longitude W-71 degree, 16', 30". As can be seen, TI is located in an area on which very small to moderate supplies of groundwater can be obtained. Thus there appears to be no danger of the disposal area being located over any principal aquifers.

DISCUSSION

The results of the surface wells indicates that higher concentrations of low level radiochemical activity are found around the perimeter wells 50 feet from the disposal area. After investigation of the shallow well locations, it can be noted that most of the activity is in a Southwestern movement, but there exists no clear migratory pattern of these radionuclides. It has been observed when wells were driven that there exists a clay boundary at a depth approximately 5-10 feet below the topsoil. Previous boring records as well as environmental studies prove this observation. This appears to hinder any rapid vertical movement of the material from this area.

It is possible that perhaps the reason for the levels of concentration which were found in the 150 foot perimeter wells, is that years before during construction of Building 12, some of the material in the dump site was pushed out by bulldozers in order to grade the area. It is known that this area was subjected to heavy machinery in previous years. Perhaps very little migration has taken place over the years and the movement can be attributed to bulldozing of the soil in this area.

There appears to be very low radiochemical activity in the deep wells. In the data reported by C.E.P. the dissolved levels of concentration are higher than the suspended levels in the deep wells. Whereas the re-sampled shallow wells in this data show a higher suspended level of concentration than the dissolved. This appears to be due to the inability of the radionuclide material to enter the deep wells in the suspended form. Any migration of this radiochemical activity to the deep wells appears to be limited to the dissolved state. It should be noted that the deep wells are still considered low as compared with

values found in 10CFR20. 10CFR20 appendix B, p20-18, Table II, column 2 lists the water limits above natural background as 3X10 -5 uCi/ml. Since our data is reported in pCi/liter, a simple conversion can be made in order to compare limits with our data:

$$3X10^{-5}\ \text{u Ci/ml.}\ \frac{1000\ \text{ml}}{1\text{l}} \cdot \frac{106\ \text{pCi}}{1\text{uCi}} = 30{,}000\ \text{pCi/liter}$$

NRC position paper SECY 81-576 dated Oct. 5, 1981 gives for disposal option #1 (no restriction on the method of burial) for enriched Uranium (soluble and insoluble) a maximum permitted concentration of 30 pCi/gm of soil. However, it should be realized that our data and results are reported in the volumetric term of liters.

All results of radiochemical activity at Texas Instruments complex in Attleboro, Mass. are acceptable in accordance with the above limits given by the NRC.

TABLE 1 CONCENTRATION OF RADIONUCLIDES IN DECEMBER 14, 1981 SAMPLES

SAMPLE I.D.	GROSS ALPHA (PCI/LITER)	BETA MINUS K-40 (PCI/LITER)	TOTAL URANIUM (UG/LITER)	GROSS ALPHA - URANIUM (PCI/LITER)
1	230 ± 36	less than 3	100	79
2	288 ± 47	less than 3	240	64
4	2043 ± 221	2100 ± 48	620	1795
5	297 ± 34	17 ± 13	20	268
6	143 ± 29	less than 3	130	59
7	2	less than 3	1.7	2
8	10 ± 7	less than 3	1	12
9	3	less than 3	1.0	2
10	259 ± 80	less than 3	13	235
15	11 ± 6	less than 3	2.8	11

TABLE 2 CONCENTRATION OF RADIONUCLIDES IN JANUARY 27-28, 1982 SAMPLES

SAMPLE I.D.	GROSS ALPHA (PCI/LITER)	GROSS BETA (PCI/LITER)
1	4430 ± 1717*	2240 ± 94
2	202 ± 47	142 ± 6
3	97 ± 39*	81 ± 6
4	905 ± 144*	925 ± 23
5	550 ± 121	1186 ± 26
6	182 ± 46	185 ± 7
7	23 ± 19	16 ± 3
9	44 ± 22	38 ± 3
10	less than 2	24 ± 3
21	189 ± 92*	250 ± 12
23	149 ± 88	114 ± 9
24	54 ± 35	69 ± 4
25	306 ± 102*	299 ± 14
26	61 ± 35*	35 ± 3
27	3063 ± 763*	2923 ± 107
28	65 ± 36	87 ± 5

* HIGH STATISTICS DUE TO LARGE AMOUNTS OF SOLIDS.

TABLE 3 REPEAT ANALYSIS PERFORMED ON FILTERED PORTIONS OF JANUARY 1982 SAMPLES

SAMPLE I.D.	GROSS ALPHA (PCI/LITER)	GROSS BETA (PCI/LITER)
1	less than 2	less than 3
2	less than 2	less than 3
3	2	10 ± 2
4	15 ± 5	10 ± 2
5	5 ± 4	4 ± 2
6	less than 2	less than 3
7	less than 2	less than 3
9	less than 2	less than 3
10	less than 2	less than 3
21	less than 2	5 ± 2
23	less than 2	3 ± 2
24	less than 2	less than 3
25	less than 2	4 ± 2
26	less than 2	4 ± 2
27	6 ± 4	3 ± 2
28	less than 2	less than 3

TABLE 4 ISOTOPIC SCAN
(PCI/LITER)

	URANIUM 234	URANIUM 235	URANIUM 238
WELL 1	11.5 ± 2.0	5.2 ± 1.4	57.9 ± 4.5
WELL 27	29.9 ± 2.5	3.8 ± 0.9	52.0 ± 3.3

	THORUIM 228	THORUIM 230	THORUIM 232
WELL 1	1.4 ± 0.8	3.9 ± 1.3	2.7 ± 1.1
WELL 27	13.5 ± 1.7	9.6 ± 1.4	9.5 ± 1.4

TABLE 5 RADIOACTIVITY ANALYSES OF SOIL BORINGS AND CORE SAMPLES

CORE I.D.	GROSS ALPHA) (PCI/LITER)	GROSS BETA MINUS K-40 (PCI/LITER)	TOTAL URANIUM (MG/1)
B-11A	7 ± 6	0 ± 5	0.002
B-12	600 ± 37	0 ± 5	0.859
B-13	40 ± 8	0 ± 5	0.001
B-14	204 ± 45	0 ± 5	0.024
B-15	232 ± 47	0 ± 5	0.015

CUSTOMER [illegible]
ADDRESS 34 Forest St.
CITY Attleboro, MA 02703
ATTENTION Frank Veale
INVOICE NO. 205098

REPORT OF ANALYSIS

TABLE 6 CONCENTRATION OF RADIONUCLIDES IN MAY 1982 SAMPLES

SAMPLES RECEIVED 5/4/82	CUSTOMER ORDER NUMBER
TYPE OF ANALYSIS Water	

Sample Identification	Type of Analysis	Total pCi/liter	Suspended pCi/liter	Dissolved pCi/liter
#2D 250 ft.	Gross Alpha	34 ± 9		
	Gross Beta	31 ± 4		
#4D Deep Well Grab	Gross Alpha	8 ± 3		
	Gross Beta	3 ± 2		
#5D 200 ft.	Gross Alpha	14 ± 5		
	Gross Beta	5 ± 2		
#7D Deep Well Grab	Gross Alpha	21 ± 5		
	Gross Beta	14 ± 3		
#8D 200 ft.	Gross Alpha	< 2		
	Gross Beta	< 3		
#16D 300 ft.	Gross Alpha	22 ± 11		
	Gross Beta	16 ± 6		
#21	Gross Alpha		15 ± 8*	< 2
	Gross Beta		13 ± 3	< 3
#22	Gross Alpha		97 ± 36*	15 ± 4*
	Gross Beta		56 ± 5	10 ± 2
#23	Gross Alpha		6 ± 4	< 2
	Gross Beta		< 3	4 ± 2
#24	Gross Alpha	< 2		
	Gross Beta	< 3		
#25	Gross Alpha		112 ± 38*	9 ± 6*
	Gross Beta		59 ± 5	3 ± 2
#26	Gross Alpha		23 ± 10*	< 2
	Gross Beta		57 ± 8	3 ± 2

APPROVED BY

5/25/82 James J. Mueller, President

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Texas Instruments, Inc.
ADDRESS 34 Forest St.
CITY Attleboro, MA 02703
ATTENTION Frank Veale
INVOICE NO 205098

REPORT OF ANALYSIS

SAMPLES RECEIVED 5/4/82 | CUSTOMER ORDER NUMBER

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis	Total pCi/liter	Suspended pCi/liter	Dissolved pCi/liter
#27	Gross Alpha		92 ± 36*	28 ± 8*
	Gross Beta		5 ± 2	129 ± 11
#28	Gross Alpha		157 ± 42*	< 2
	Gross Beta		128 ± 6	7 ± 2

*These samples are being analyzed for isotopic uranium and reported by June 4, 1982

Sample #2D, #4D, #5D, #7D, and #16D will be resampled due to possible cross contamination during collection.

APPROVED BY

5/25/82 James J. Mueller, President

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

ADDRESS 34 Forest Street
CITY Attleboro, MA 02703
ATTENTION Frank Veale
INVOICE NO 206172

REPORT OF ANALYSIS

TABLE 7 CONCENTRATION OF RADIONUCLIDES IN JUNE 1982 SAMPLES

SAMPLES RECEIVED 6/11/82 | CUSTOMER ORDER NUMBER Requisition # 525814

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis	pCi/liter
# 1D	Gross Alpha (Suspended)	7 ± 3
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	< 2
	Gross Beta (Dissolved)	< 3
# 2 D 250 ft.	Gross Alpha (Suspended)	< 2
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	10 ± 4
	Gross Beta (Dissolved)	< 3
# 3D	Gross Alpha (Suspended)	< 2
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	< 2
	Gross Beta (Dissolved)	< 3
# 4D	Gross Alpha (Suspended)	< 2
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	8 ± 3
	Gross Beta (Dissolved)	< 3
# 5 D 200 ft.	Gross Alpha (Suspended)	< 2
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	16 ± 4
	Gross Beta (Dissolved)	< 3
# 7 D Grab	Gross Alpha (Suspended)	< 2
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	6 ± 3
	Gross Beta (Dissolved)	3 ± 2

APPROVED BY James J. Mueller, President
6/22/82

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Texas Instruments
ADDRESS 34 Forest Street
CITY Attleboro, MA 02703
ATTENTION Frank Veale
INVOICE NO 206172

REPORT O ANALYSI

SAMPLES RECEIVED 6/11/82 | CUSTOMER ORDER NUMBER Requisition # 525814

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis	pCi/liter
# 8 D 200 ft.	Gross Alpha (Suspended)	< 2
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	< 2
	Gross Beta (Dissolved)	< 3
# 15D 275 ft.	Gross Alpha (Suspended)	< 2
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	< 2
	Gross Beta (Dissolved)	< 3
# 16 D 300 ft.	Gross Alpha (Suspended)	< 2
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	< 2
	Gross Beta (Dissolved)	< 3
# 18 Grab	Gross Alpha (Suspended)	< 2
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	< 2
	Gross Beta (Dissolved)	< 3
# 19 D	Gross Alpha (Suspended)	< 2
	Gross Beta (Supsended)	< 3
	Gross Alpha (Dissolved)	17 ± 4
	Gross Beta (Dissolved)	< 3
# 20 D	Gross Alpha (Suspended)	< 2
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	< 2
	Gross Beta (Dissolved)	< 3

APPROVED BY
6/22/82 James J. Mueller, President

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rev...

Texas Instruments
ADDRESS 35 Forest Street
CITY Attleboro, MA 02703
ATTENTION Frank Veale
INVOICE NO 206172

REPORT OF ANALYSIS

SAMPLES RECEIVED 6/11/82 | CUSTOMER ORDER NUMBER Requisition # 525814

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis	pCi/liter
CP	Gross Alpha (Suspended)	< 2
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	< 2
	Gross Beta (Dissolved)	< 3
Effulent .005	Gross Alpha (Suspended)	< 2
	Gross Beta (Suspended)	< 3
	Gross Alpha (Dissolved)	< 2
	Gross Beta (Dissolved)	< 3

APPROVED BY
6/22/82 James J. Mueller, President

Controls for Environmental Pollution, Inc.
P. O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Texas Instruments
ADDRESS 34 Forest Street
CITY Attleboro, MA 02703
ATTENTION Frank Veale
INVOICE NO. 206172

REPORT OF ANALYSIS

TABLE 8 FLUSH SAMPLES FOR CROSS CONTAMINATION CHECK IN JUNE 1982 SAMPLING

SAMPLES RECEIVED 6/11/82 | CUSTOMER ORDER NUMBER

TYPE OF ANALYSIS Filters

Sample Identification	Type of Analysis	pCi/Total Filter
Flush Sample After # 3	Gross Alpha	< 0.5
	Gross Beta	< 0.3
Flush Sample After # 5	Gross Alpha	< 0.5
	Gross Beta	< 0.3
Flush Sample After # 8	Gross Alpha	< 0.5
	Gross Beta	< 0.3
Flush Sample After # 16	Gross Alpha	1.0 ± 0.4
	Gross Beta	0.8 ± 0.3

CUSTOMER Texas Instruments
ADDRESS 34 Forest Street, Bldg. 10-6
CITY Attleboro, MA 02703
ATTENTION Frank Veale
INVOICE NO. 207040

REPORT O ANALYSI

TABLE 9 CONCENTRATION OF RADIONUCLIDES IN JULY 1982 SAMPLES

SAMPLES RECEIVED 7/2/82 | CUSTOMER ORDER NUMBER Requisition #525970

TYPE OF ANALYSIS Water

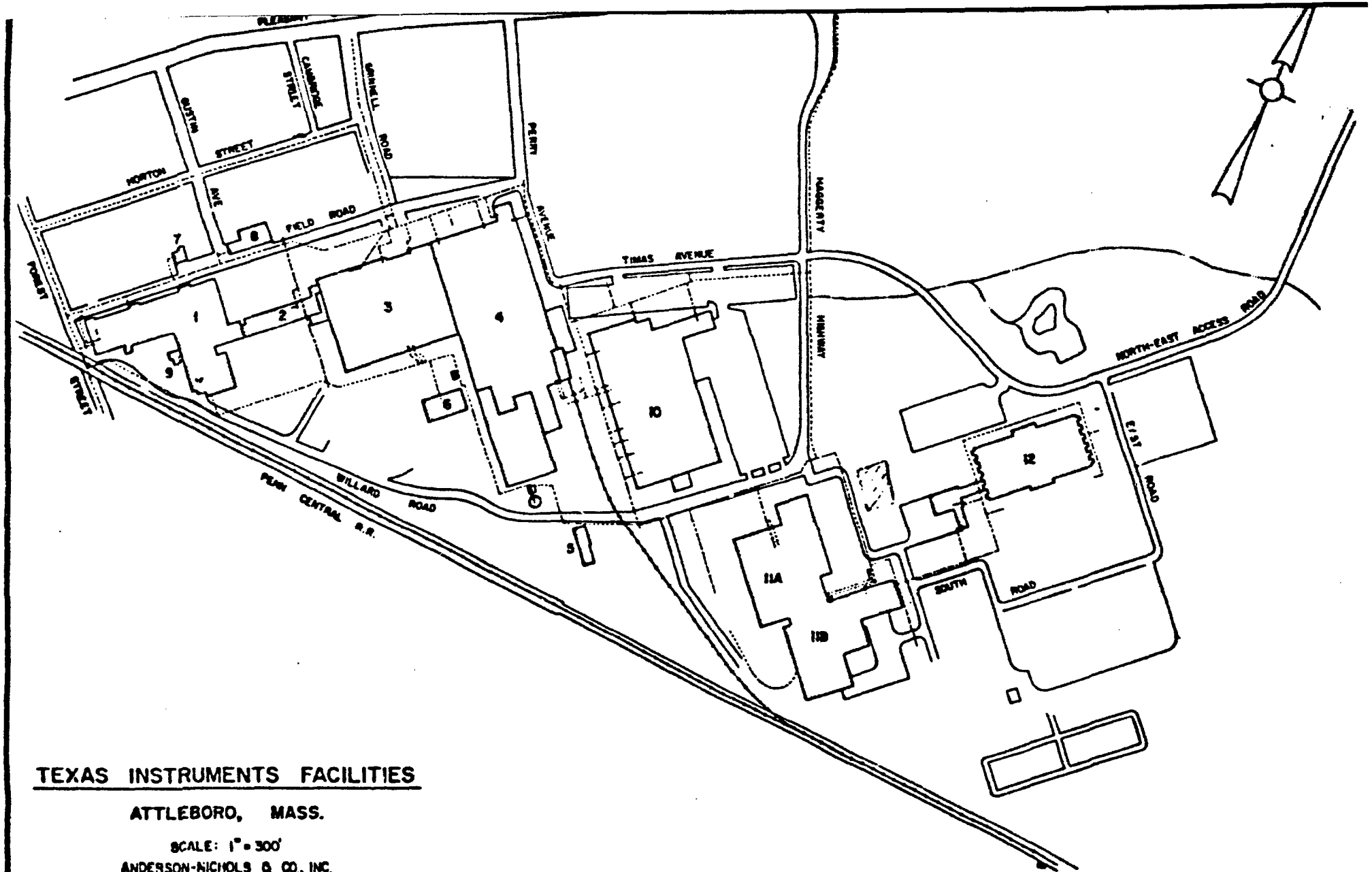
Sample Identification	Date Collected	Type of Analysis	pCi/liter	pCi/filter
#190	6/30/82	Gross Alpha (Suspended)	< 2	
		Gross Beta (Suspended)	< 3	
		Gross Alpha (Dissolved)	14 ± 5	
		Gross Beta (Dissolved)	4 ± 2	
#1D	6/30/82	Gross Alpha (Suspended)	< 2	
		Gross Beta (Suspended)	< 3	
		Gross Alpha (Dissolved)	< 2	
		Gross Beta (Dissolved)	< 3	
#2D @ 250 ft.	6/29/82	Gross Alpha (Suspended)	< 2	
		Gross Beta (Suspended)	< 3	
		Gross Alpha (Dissolved)	< 2	
		Gross Beta (Dissolved)	< 3	
#5D	6/29/82	Gross Alpha (Suspended)	< 2	
		Gross Beta (Suspended)	< 3	
		Gross Alpha (Dissolved)	11 ± 4*	
		Gross Beta (Dissolved)	9 ± 2*	
Filter Flush Sample After #5D		Gross Alpha		None Detected
		Gross Beta		None Detected

*Verified by reanalysis

APPROVED BY James J. Mueller, President

7/9/82

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502



TEXAS INSTRUMENTS FACILITIES

ATTLEBORO, MASS.

SCALE: 1" = 300'

ANDERSON-NICHOLS & CO., INC.

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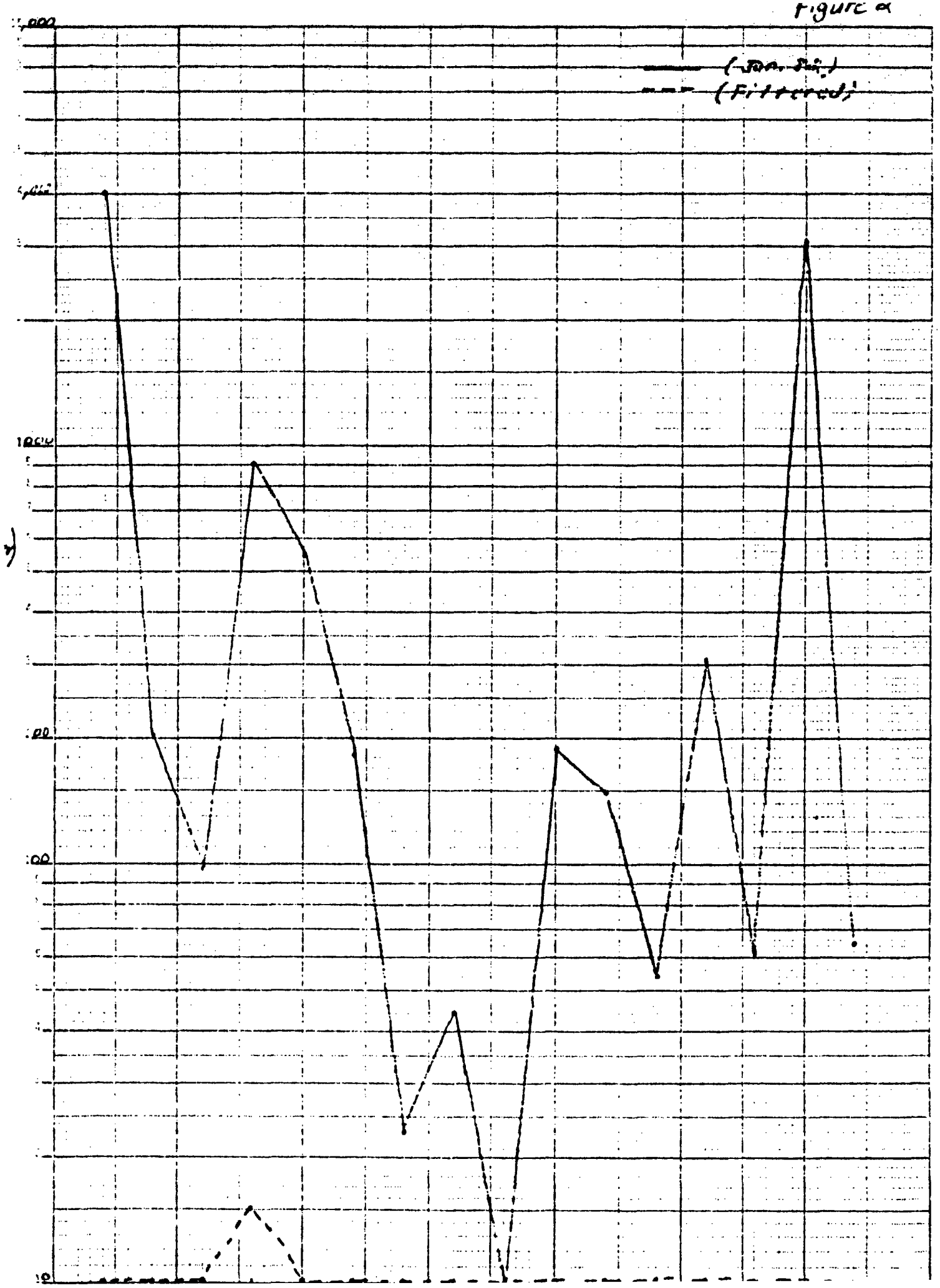

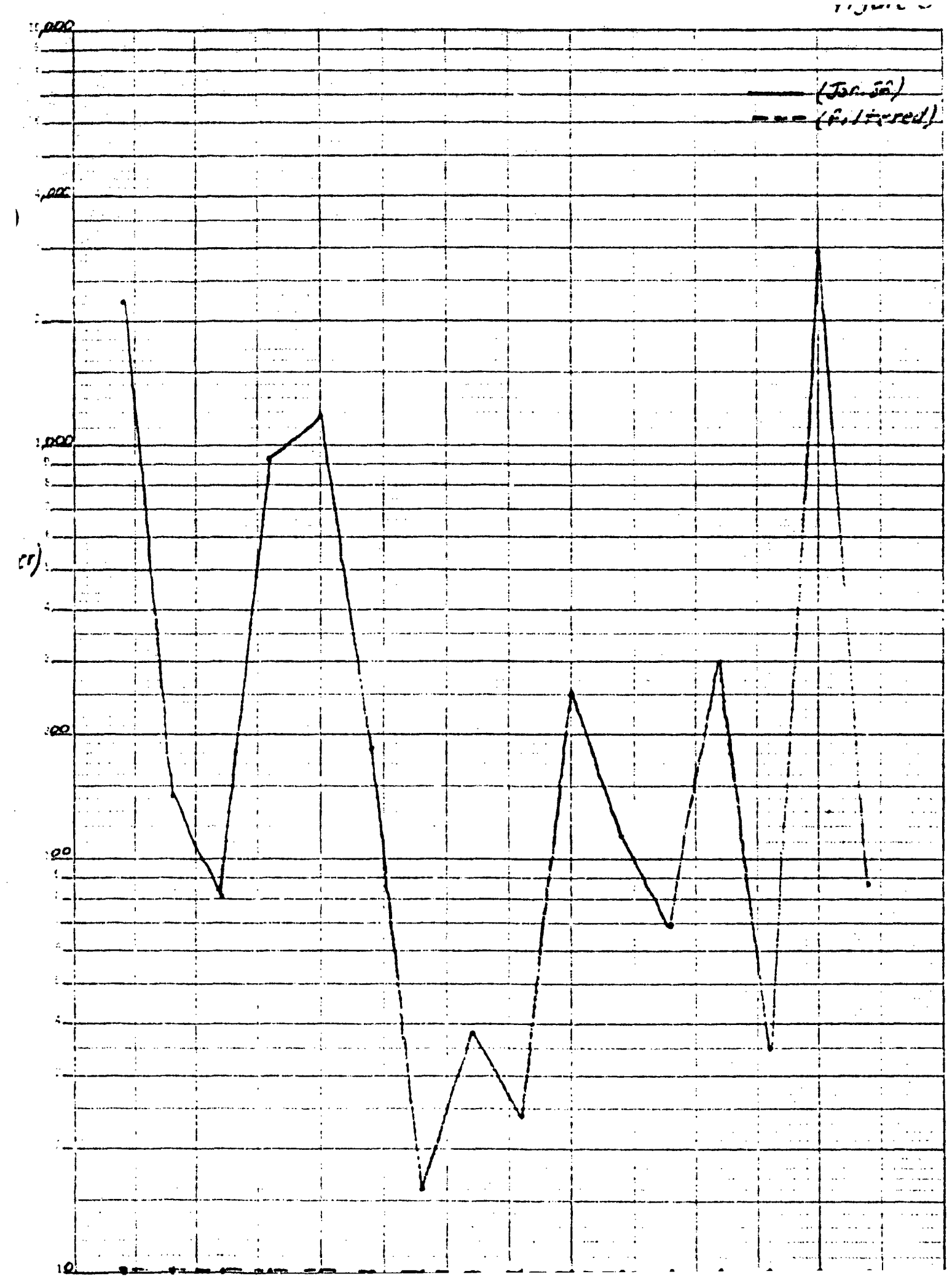
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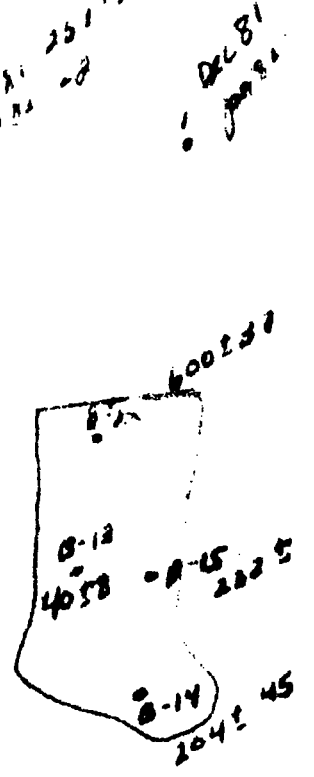


Industrial & Environmental Analysts, Inc.
P.O. Box 626 • Essex Junction, Vermont 05452 • 802-878-5138

12 January 1982

Frank Veale
Texas Instruments
34 Forest St.
Attleboro, MA 02703

Dear Frank:

Transmitted herewith are the results of analyses of water samples taken at your site December 15, 1981. Samples are identified as per the number put by Texas Instruments next to each test well. Please note that well number 3 was dry and no sample was available. In addition to the above, well fifteen was sampled.

We are still awaiting receipt of an additional two core samples prior to performing EPA leachate extraction and alpha and beta analyses.

Method of Analysis

All samples were analyzed for gross alpha radiation as per Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA Document 600-4-80-032 (August 1980). A copy of this manual was left with you and Mike Mitchell on our last visit there when the samples were taken.

The U.S. Environmental Protection Agency has published Primary Drinking Water Regulations for Radioactivity under the Safe Drinking Water Act, (Pub. L. 93-523). These proposed maximum contaminant levels limit the concentrations of natural and man-made radioactivity in drinking water supplies and set forth the proposed monitoring and measurement requirements.

Recognizing the need for a collection of analytical methods that can be used for measuring each of these radionuclides in drinking water, the Radiochemical Methods Section, Environmental Monitoring and Support Laboratory-Cincinnati, and the Quality Assurance Division, Environmental Monitoring Systems Laboratory-Las Vegas, have brought together methods from a variety of sources for the analysts and technicians having responsibility for the analysis of drinking water supplies.

As will be evident from the Method Capabilities section of the manual, Appendix A, the sensitivity of each of the procedures complies with the promulgated limits. The determination of the standard deviations in the counting rate is given in Appendix B, and the formulae for determining the necessary counting time for the required detection limit are indicated in Appendix C. These operator-tested procedures have been selected from a number of radiochemical methodology collections, (1-5) and can be utilized for routine analysis. Several of them have already been published as "standard reference methods" by recognized standard-setting organizations such as ASTM and APHA.

Factors considered in selecting these procedures for inclusion in this laboratory manual were procedure time, method capabilities, and reliability. In those cases where modifications were deemed essential, additional steps such as scavenging or other purification techniques have been included in the procedures. The precision and accuracy of each method as determined from collaborative test results or replicate single laboratory test results, are included at the end of each procedure.

Sample I.D.	Gross Alpha pCi/liter	Beta minus K-40 pCi/liter	Total Uranium ug/liter	Gross Alpha minus Uranium pCi/liter
1	138 ± 27	<3	100	79
1 A	120 ± 26	<3		
2	206 ± 58	<3	240	64
2 A	188 ± 47	<3		
4	2162 ± 204	2059 ± 35	620	1795
4 A	2043 ± 221	2100 ± 48		
5	280 ± 41	18 ± 10	20	268
5 A	297 ± 34	17 ± 13		
6	136 ± 28	<3	130	59
6 A	143 ± 29	<3		
7	<2	<3	1.7	<2
7 A	<2	<3		
8	12 ± 11	<3	<1	12
8 A	10 ± 7	<3		

Sample I.D.	Gross Alpha pCi/liter	Beta minus K-40 pCi/liter	Total Uranium ug/liter	Gross Alpha minus Uranium pCi/liter
9	<2	<3	1.0	<2
9 A	<2	<3		
10	243 ± 91	<3	13	235
10 A	259 ± 80	<3		
15	13 ± 5	<3	2.8	11
15 A	11 ± 6	<3		

It is evident that all wells except 7 and 9 have significant levels of radiochemical contamination. It is possible that some well-to-well cross contamination took place during the drilling process or was induced by surface water runoff, migration, or intrusion of water from one well to another. It would perhaps be prudent to consider resampling these wells after several repeated evacuations of each test hole to minimize the effects of any previous cross contamination events.

We shall begin analysis of the soil cores as soon as they are received and will forward that data to you in a follow-up letter.

Very truly yours,

INDUSTRIAL AND ENVIRONMENTAL ANALYSTS, INC.

Frederick T. Doane
Senior Scientist

FTD/ph

Industrial & Environmental Analysts, Inc.
P.O. Box 626 • Essex Junction, Vermont 05452 • 802-878-5138

3 February 1982

Mr. Frank Veale
Mail Stop 10-4
Texas Instruments
34 Forest St.
Attleboro, MA 02703

Dear Frank:

Transmitted herewith are the results of radioactivity analyses of the soil borings and core samples supplied to us by your office. The sample identification is as indicated by T.I. personnel on the sample container.

Each group of samples consisted of multiple containers. As per your instructions, equal portions of sample were taken from each container to form a single composite for the analysis procedure.

Prior to analyses for radiochemical parameters, each composite was subjected to the 24 hour extraction procedure outlined in the May 19, 1980 Federal Register, Volume 45, Number 98, pages 33127 through 33133. As per that procedure, the final leachate volume is adjusted to exactly 20 times the initial weight of sample.

Core Identification	Gross Alpha (picocuries/liter)	Gross Beta - Potassium 40 (picocuries/liter)	Total Uranium (mg/l)
B-11-A	7 ± 6	0 ± 5	0.002
B-12	600 ± 37	0 ± 5	0.859
B-13	40 ± 8	0 ± 5	0.001
B-14	204 ± 45	0 ± 5	0.024
B-15	232 ± 47	0 ± 5	0.015

If we may be of further assistance to you in this matter, please let us know.

Very truly yours,

INDUSTRIAL AND ENVIRONMENTAL ANALYSTS, INC.

Frederick T. Doane
Senior Scientist

FTD/ph
Enclosures

cc: Mike Mitchell

Industrial & Environmental Analysts, Inc.
P.O. Box 626 • Essex Junction, Vermont 05452 • 802-878-5138

24 February 1982

Frank Veale
Texas Instruments
Mail Stop 10-4
34 Forest St.
Attleboro, MA 02703

Dear Frank:

Transmitted herewith are the results of analyses of water samples taken at your site during our sampling activities of 27-28 January 1982. These samples were analyzed for gross alpha and gross beta activity. Procedures utilized were from the following sources:

1) Prescribed Procedures for Measurement of Radioactivity in Drinking Water - EPA-600-4-80-032, August 1980 - Method 900.0

2) Standard Methods for the Examination of Water and Wastewater, 15th. Edition, 1980 - Method 703, page 574.

Wells 1, 2, 3, 4, 5, 6, 7, 9 and 10 which had previously been sampled on December 15, 1981, were resampled after evacuation and recharge. Well 8 was frozen solid and could not be utilized.

In addition to the above, Wells 21, 23, 24, 25, 26, 27 and 28 were evacuated and sampled after recharge. Well 22 was crooked and could not be evacuated or sampled.

Production Wells 1, 3, and 7 were sampled at the well head during normal daily operation.

Sample Identification	Gross Alpha pCi/liter	Gross Beta pCi/liter
1	4430 ± 1717*	2240 ± 94
2	202 ± 47	142 ± 6
3	97 ± 39*	81 ± 6
4	905 ± 144*	925 ± 23
5	550 ± 121*	1186 ± 26
6	182 ± 46	185 ± 7
7	23 ± 19	16 ± 3
9	44 ± 22	38 ± 3
10	<2	24 ± 3
21	189 ± 92*	250 ± 12
23	149 ± 88*	114 ± 9
24	54 ± 35*	69 ± 4
25	306 ± 102*	299 ± 14
26	61 ± 35*	35 ± 3
27	3063 ± 763*	2923 ± 107
28	65 ± 36*	87 ± 5
1B	<2	<3
3B	<2	<3
7B	<2	<3

*High statistics due to large amounts of solids.

Several factors are of interest as they may relate to the above data.

1) Surface run-off was present in large amounts over test well one. Water was ponded up to a depth of about two inches for a 12-15 foot radius around the well. Depth of water above the well was 2-3 inches.

2) There appears to be a large amount of suspended solids present in some of these samples even after evacuation and recharge. It is our preliminary opinion that most of the radiochemical activity present is associated with the suspended solids. We have therefore, started an analysis of all of the above samples after filtration

2) (continued)

through a 0.45 micron filter. This data will be forwarded to you within the week. It is our understanding that these analyses will be charged to another purchase order to be coming to us from your office.

In addition to the above, we have sent samples 1 and 27 to an outside laboratory for isotopic analyses. We expect that data to also be available this week.

If we may be of further assistance to you in this matter, please let us know.

Very truly yours,

INDUSTRIAL AND ENVIRONMENTAL ANALYSTS, INC.

Frederick T. Doane
Senior Scientist

FTD/ph

cc: Mike Mitchell

Industrial & Environmental Analysts, Inc.
P.O. Box 626 • Essex Junction, Vermont 05452 • 802-878-5138

8 March 1982

Frank Veale
Texas Instruments
Mail Stop 10-4
34 Forest St.
Attleboro, MA 02703

Dear Frank:

Transmitted herewith are the results of additional analyses of water samples taken at your site during our sampling activities of 27-28 January, 1982.

As per our discussion, repeat analyses were performed on filtered portions of the samples that were reported to you in our letter of 24 February 1982.

Procedures utilized were from the following sources:

1) Prescribed Procedures for Measurement of Radioactivity in Drinking Water - EPA-600-4-80-032, August 1980 - Method 900.0

2) Standard Methods for the Examination of Water and Wastewater, 15th. Edition, 1980 - Method 703, page 574.

Well 8 was frozen solid and could not be sampled. Well 22 was crooked and could not be evacuated or sampled.

Analytical Data

Sample Identification		Gross Alpha pCi/liter	Gross Beta pCi/liter
Well No.	1	<2	<3
	2	<2	<3
	3	2	10 ± 2
	4	15 ± 5	10 ± 2
	5	5 ± 4	4 ± 2
	6	<2	<3
	7	<2	<3
	9	<2	<3
	10	<2	<3
	21	<2	5 ± 2
	23	<2	3 ± 2
	24	<2	<3
	25	<2	4 ± 2
	26	<2	4 ± 2
	27	6 ± 4	3 ± 2
	28	<2	<3

Isotopic Scan

In addition to the above an isotopic scan was performed on wells 1 and 27. The results of this scan are as follows:

	Uranium 234	Uranium 235	Uranium 238	Thorium 228	Thorium 230	Thorium 232
Well 1	11.5 ± 2.0	5.2 ± 1.4	57.9 ± 4.5	1.4 ± 0.8	3.9 ± 1.3	2.7 ± 1.1
Well 27	29.9 ± 2.5	3.8 ± 0.9	52.0 ± 3.3	13.5 ± 1.7	9.6 ± 1.4	9.5 ± 1.4

If we can be of any further assistance to you in this matter, please let us know.

Very truly yours,

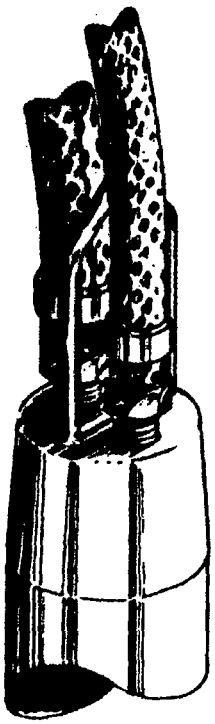
INDUSTRIAL AND ENVIRONMENTAL ANALYSTS, INC.

Frederick T. Doane

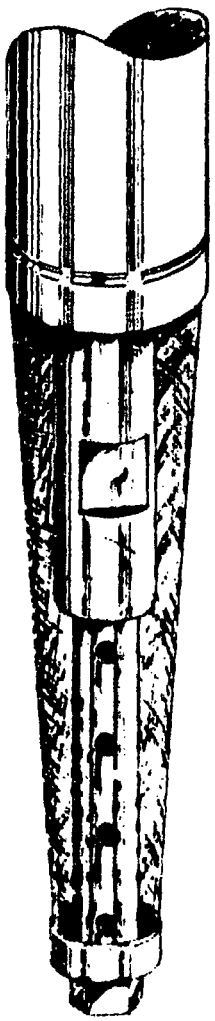
Frederick T. Doane
Senior Scientist

FTD/ph

cc: Mike Mitchell



Procedures and Equipment for Groundwater Monitoring



SPECIALISTS IN THE MEASUREMENT
AND MANAGEMENT OF GROUNDWATER
CONTAMINATION

industrial & environmental analysts, inc.

A Basic Principle

In many respects, groundwater monitoring is an infant science, spawned by recent recognition of the seriousness of groundwater contamination problems and the need for quality data to support effective remedial actions. This newness is no excuse for poor sampling techniques, as the principles of valid physical science are as applicable to new fields as to the older disciplines. Among the most relevant of these principles to groundwater monitoring is: The integrity of laboratory samples must be carefully protected. Water samples are the raw materials from which analytical conclusions, water quality diagnoses, and eventually policy decisions, are made. Any tendency for the techniques or apparatus of sample collection to alter or degrade the information content of groundwater samples must be eliminated or carefully controlled.

A corollary of this principle is that the selection of proper procedures and techniques for groundwater monitoring is a critical element in any monitoring program. IEA produces a line of high-quality sampling equipment to assist the groundwater monitor to satisfy the most stringent requirements.

Sampling Procedures

Establish Representative Well Conditions

Because of materials introduced by well construction, the contents of a new well are not representative of the aquifer to be monitored. It is necessary to achieve an equilibrium between the contents of the well and the surrounding aquifer before representative sampling can begin. Pumping from the well until an acceptable rate of change in sample contents is achieved typically requires removal of many well volumes of water. This procedure is also effective in removing contamination introduced by improper sampling methods.

As with any aspect of groundwater monitoring, it is important to conserve well construction cost where possible without compromising the validity of sample data. One technique for conserving drilling costs in multiple horizon sampling situations is the use of several wells, each screened at a different depth, in a single large borehole. Care must be taken to effectively isolate the sampling horizons if this approach is to be cost effective.

Newly constructed monitoring wells require pumping to stabilize well contents. IEA field personnel dedicate tubing to each well and use a steam-cleanable pump to prevent transfer of contaminants between wells.

Sample collection and transfer operations can be dangerous to sample quality. IEA uses a surface-actuated sample collector that puts virtually no vacuum on the sample and involves no contact with tubing. From in-situ collection until it is sealed in the shipment bottle the sample contacts only the collector. IEA can provide sample collectors in a variety of materials to meet special requirements. Stainless steel sinker is used in deep immersion conditions to overcome tubing bouyancy

Preserve Representative Well Conditions

Even after the contaminants introduced by well construction have been purged improper sampling can introduce new contamination. This is most commonly caused by contaminants carried from well to well on sampling equipment. Such "cross-contamination" can be prevented by

a) dedicating sampling equipment to individual wells, or
b) effective cleaning of equipment to be used on multiple wells

In IEA's experience, a mixture of these approaches is the most cost effective means of controlling cross-contamination. For each part of the sampling system, the difficulty of cleaning must be weighed against the cost of dedicated equipment. Because tubing for sampling and pump actuation is relatively inexpensive but difficult to clean, dedication of tubing to individual wells is the preferred method of preventing tubing-borne cross contamination. A properly designed pump, co' ,ied with effective cleaning procedures, avoids the high cost of dedicated pumps.

Establish Analytical Controls Where Alteration of Well Contents Cannot Be Prevented

Despite the most stringent practices, well construction and sampling are likely to introduce some extraneous materials. In some cases these materials are irrelevant to analysis and can be ignored. In cases where they affect the analysis, the effects can be quantified and the analysis results corrected for them.

It is also possible to "lose" materials to the sampling procedure and equipment. Improper handling of dissolved organics can cause them to be stripped or purged before reaching the sample bottle. Such materials can also be lost to adsorption on the sampling equipment. Such losses can be controlled by proper selection and use of equipment and by analytical controls.

The materials of which the IEA pump is constructed (stainless steel, teflon, vyton) allow only trace or undetectable levels of possible contaminants to enter the sample. To permit extremely stringent control and quantification of any pump-introduced contaminants, IEA provides a certificate of chemical analysis with each serial numbered pump. This certificate documents the absence or negligible levels of all parameters listed in the Safe Drinking Water Act and Priority Pollutant Consent Decree. State of the art analytical techniques are used as the basis of this documentation. A sample of ultrapure 18 megohm resistivity water is circulated through the pump for two hours, a period which far exceeds the ten to thirty second pump-to-sample contact time experienced in actual sampling applications. The water is then analysed by gas chromatograph, graphite furnace atomic absorption, and gas chromatograph/mass spectrometer techniques.

Pump Design

IEA's experience as a groundwater consulting company has convinced us that a pump engineered for valid results in the field and in the lab must have several key design features

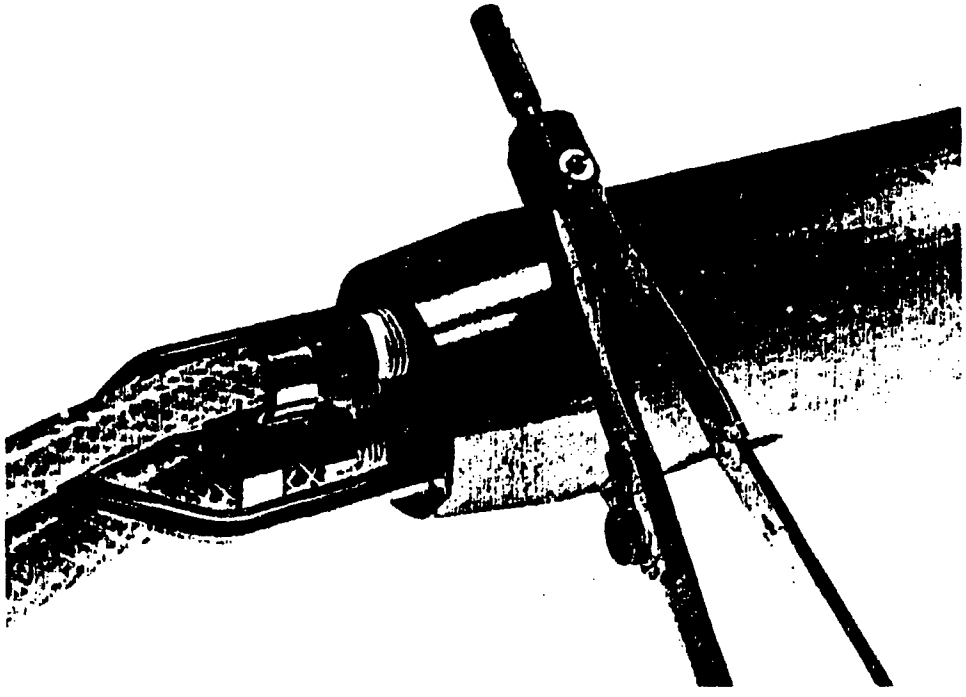
- easy and complete cleanability
- gentle treatment of volatile organics to prevent purging or vacuum stripping them from samples
- versatility in source of pumping energy to permit convenient use under a wide range of field conditions.

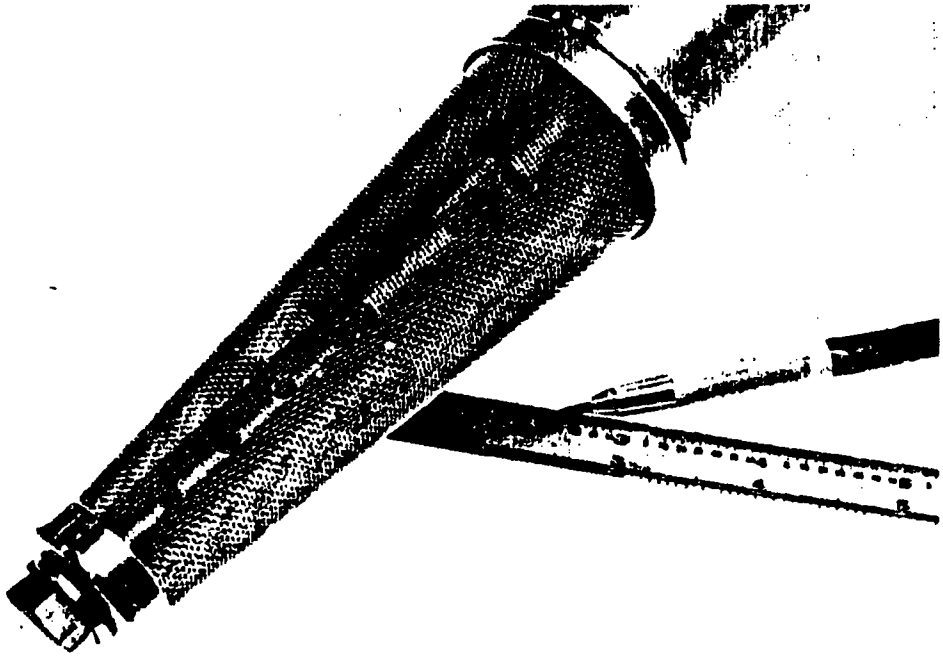
The basic principle behind these design requirements is that the pump is one part of an expensive monitoring program, and that the pump should enhance productivity of all elements of the program. This approach dictated several instances of increasing the cost of the pump in pursuit of a more cost-effective overall program.

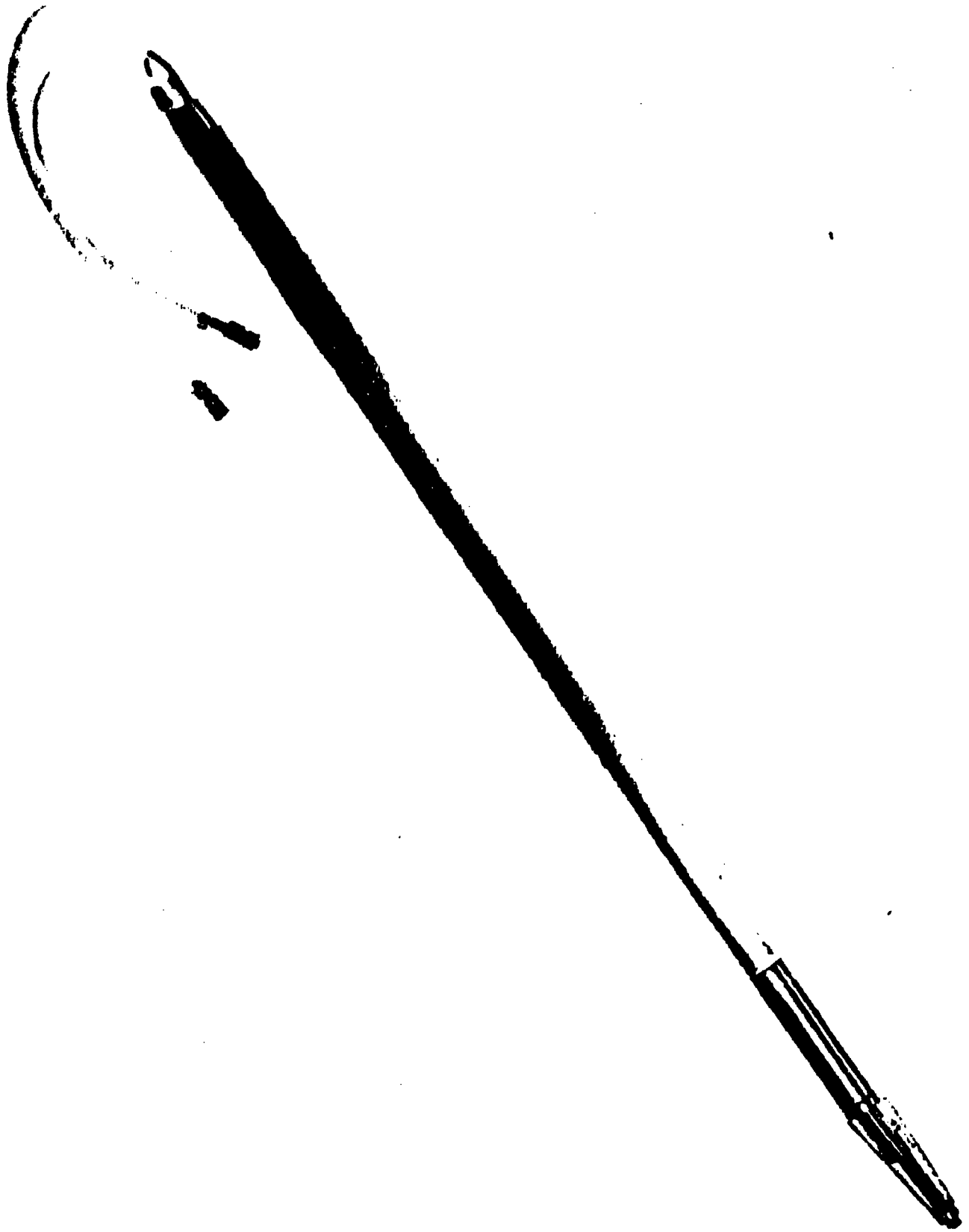
- Quick connect fittings are used on all air supply and sample collection lines.
- The pump control panel will operate for up to 48 hours on a fully charged 12-volt motorcycle battery. An optional feature permits operation from either 120 volt ac or a NiCad power pack fully contained in the panel.
- Air for energizing the pump can be supplied by compressors (gasoline, ac or dc powered) or compressed air tanks. In low-lift pumping situations, or in high-lift, low yield situations, the pump can be effectively actuated by a hand powered pump
- The IEA control panel allows the "compression" and "fill" strokes of the pump to be separately timed. This degree of "tunability" allows pump settings to be selected to optimize either on pumping time or on air consumption, depending on field circumstances.

A High-Quality Sampling Instrument

The IEA pump is constructed of stainless steel and teflon, with a vyton bladder. The top and bottom ends are tapered to minimize snagging in the well bore. Hose sets are supplied with a stainless steel lifting cable, and the pump has a massive lifting bail built in to the top. The pump intake valve is protected from clogging by a stainless steel screen. The screen will pass, and the pump will handle, fine suspension of silt and clay.







industrial & environmental analysts, inc.

for further information, contact:

P O. Box 626
Essex Junction, Vermont 05452
(802) 878-5138

EG&G
ENERGY MEASUREMENTS GROUP

THE
REMOTE
SENSING
LABORATORY
OF THE UNITED STATES
DEPARTMENT OF ENERGY

EG&G SURVEY REPORT
NRC-8204
APRIL 1982

AN AERIAL RADIOLOGICAL SURVEY OF THE

TEXAS INSTRUMENTS INDUSTRIAL COMPLEX

AND SURROUNDING AREA

ATTLEBORO, MASSACHUSETTS

DATE OF SURVEY: JUNE 1981

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ATTLEBORO, MASSACHUSETTS

DATE OF SURVEY: JUNE 1981

R. T. Reiman
Project Scientist

REVIEWED BY

W. J. Tipton

W. J. Tipton, Head
Nuclear Radiation Physics Section

This Document is UNCLASSIFIED

G. P. Stobie

G. P. Stobie
Classification Officer

This work was performed by EG&G for the United States Nuclear Regulatory Commission through an EAO transfer of funds to Contract Number DE-AC08-76NV01183 with the United States Department of Energy.

ABSTRACT

An aerial radiological survey was conducted over the Texas Instruments (TI) industrial complex in Attleboro, Massachusetts, during the period 15 through 23 June 1981. The survey was flown at an altitude of 46 m (150 ft) by a helicopter containing twenty sodium iodide detectors.

Gamma ray data were collected over a 40 km² (approximately 16 square miles) area centered on the complex by flying north-south lines spaced 76 m (250 ft) apart. The processed data indicated that detected radioisotopes and their associated gamma ray exposure rates were generally consistent with those expected from normal background emitters. External exposure rates were generally less than 11 microroentgens per hour (μR/h) except for one location identified in this report.

The survey of the TI industrial complex was requested by the United States Nuclear Regulatory Commission (NRC) and was conducted by the United States Department of Energy's (DOE's) Remote Sensing Laboratory (RSL). The RSL is operated for DOE by EG&G, an independent contractor.

CONTENTS

1.0 INTRODUCTION

The United States Department of Energy (DOE) maintains a Remote Sensing Laboratory (RSL) to provide a state-of-the-art remote sensing capability for use at all sites of interest to the DOE and other government agencies where authorized by the DOE. The RSL is operated by EG&G under the direction of the DOE Nevada Operations Office as part of an integrated contract. One of the major functions of the RSL is to manage an aerial surveillance program called the Aerial Measuring System (AMS).

Since 1958 the AMS and its predecessor, the Aerial Radiological Measuring System (ARMS), have continued a nationwide effort to document the radiological character surrounding specific sites of interest. These sites include nuclear power plants, nuclear waste dumps, and research and development laboratories where radioactive materials may be used. The AMS has the capability of performing large area radiological mapping, high altitude aerial photography, multispectral photography, multispectral aerial scanning, and airborne gas and particulate sampling. The survey operations are conducted at the request of federal or state agencies and by direction of the DOE.

The aerial radiological survey of the Texas Instruments industrial complex and surrounding area in Attleboro, Massachusetts, was requested by the U. S. Nuclear Regulatory Commission.

2.0 NATURAL BACKGROUND RADIATION

Natural background radiation originates from the decay of radioactive elements present in the earth and from cosmic rays entering the earth's atmosphere from space. The radioactive elements present in the earth are uranium and its decay products, thorium and its decay products, and radioactive potassium. Natural terrestrial gamma radiation originates from the decay of these elements. Local concentrations of these nuclides typically produce radiation levels ranging from 1 to 15 μR/h within the United States.[1] The natural terrestrial radiation levels are dependent upon the geologic and topographic character immediately surrounding the point of interest.

One member of each of the uranium and thorium decay chains is a noble gas (radon) which can both diffuse through the soil and be transported in the air to other locations. Therefore, the level of airborne radiation depends on the meteorological conditions, the mineral content of the soil, and soil permeability, etc., existing at each location at a particular time. Typically, the airborne radiation contributes from 1 to 10% of the natural background radiation levels.

Cosmic rays, the space component, interact in a complex manner with the elements of the earth's atmosphere and soil. These interactions and the cosmic rays themselves produce an additional natural source of radiation. Radiation levels due to cosmic rays vary with elevation and geomagnetic latitude. Typical levels in the United States range from 3.3 μR/h in Key West, Florida to 7.2 μR/h in Flagstaff, Arizona.[1]

3.0 SURVEY SITE

The Texas Instruments industrial complex is located in the northeast section of Attleboro, Massachusetts, bounded by Pleasant Street (Route 123) to the north and the New York, New Haven, and Hartford Railroad to the south. The majority of the complex is engaged with non-nuclear related metallurgy. A portion of Building 10 (Figure 1) within the complex was dedicated at the time of the survey to the fabrication of ^{235}U enriched fuel plates for research reactors and also for the National Bureau of Standards. In the past, fuel for naval reactors was also fabricated on site.

4.0 SURVEY PROCEDURES AND EQUIPMENT

4.1 Operational Support

A Messerschmitt-Bolkow-Blohm (MBB) BO-105 helicopter (Figure 2) was used for this survey. The aircraft carried a crew of two along with a fourth generation version of a lightweight specialized data recording apparatus called the Radiation and Environmental Data Acquisition and Recording (REDAR IV) system. One gamma ray detector pod was mounted on each side of the helicopter. Each detector pod contained 10 sodium iodide (thallium activated) crystals, 12.7

Figure 1. BUILDING 10, TEXAS INSTRUMENTS INDUSTRIAL COMPLEX

cm in diameter and 5.1 cm in height. The detectors were calibrated with americium-241 (60 keV) and sodium-22 (0.511 and 1.27 MeV) gamma ray sources. Normalized outputs from each detector were then combined for each array in a 10-way summing amplifier. The outputs from each array were matched and combined in a two-way summing amplifier. Finally, the signal was adjusted in the analog-to-digital converter so the calibration peak appeared in a pre-selected channel of the multichannel analyzer.

Figure 2. *MESSERSCHMITT-BOLKOW-BLOHM BO-105 HELICOPTER WITH DETECTOR PODS*

The data acquisition and recording system contained five microprocessor controlled subsystems used in the collection of survey information. The first, a control subsystem, was responsible for collecting, at 1-second intervals, gross count, live time, spectral, and aircraft position data. Additionally, the first microprocessor sent the data to the tape subsystem every 4 seconds for recording. Spectral data were collected in two memories which operated in a time-share mode (i.e., one memory collected data while the other was being read). The second microprocessor controlled the display subsystem, which collected and formatted the data for display on two cathode-ray tubes aboard the aircraft. The third microprocessor controlled the tape subsystem, composed of the processor and a dual digital cartridge recorder. The system recorded four 1-second blocks of data on magnetic tape every 4 seconds. Each data cartridge contained sufficient magnetic tape for approximately 1 hour of data collection time. The fourth microprocessor controlled the steering indicator subsystem used to aid the pilot in flying straight, predetermined flight lines. The fifth microprocessor controlled a special usage subsystem not used during this survey.

4.2 Aircraft Positioning

The helicopter position was established with two systems: a trisponder microwave ranging system and a radar altimeter. The trisponder master unit, mounted in the aircraft, interrogated two remote transceivers which were mounted in an appropriate geometric configuration several kilometers outside the survey area. By measuring the round-trip propagation time between the master and remote units, the master unit computed the distance to each. These distances were recorded on magnetic tape each second and in subsequent computer processing were converted to position coordinates and scaled to fit an aerial photograph.

The radar altimeter aboard the helicopter similarly measured the time lag for the return of a pulsed signal and converted this to aircraft altitude. For this survey, altitude accuracy was ± 1 meter or 3%, whichever was greater. These data were also recorded on magnetic tape so that any variations in gamma ray signal strength caused by altitude fluctuation could be accurately compensated.

4.3 Survey Procedures

The survey area covered approximately 40 km^2 (16 square miles) and was centered on the Texas Instruments industrial complex. An aerial photograph was used to define the area of the survey. Area coverage was obtained by flying 85 parallel lines approximately 6 km (4 miles) long, spaced at 76 m (250 ft) intervals, at an altitude of 46 m (150 ft) above ground level (AGL), and at a ground speed of approximately 65 knots. Before proceeding to the survey area and again upon returning from the area, water lines were flown over Narragansett Bay at survey altitude and speed to monitor the non-terrestrial background (i.e., airborne radon, natural emissions from the aircraft, and cosmic radiation).

Ground-based measurements were made in the survey area with a pressurized ionization chamber. Surface and profile soil samples were

taken at each location where ion chamber measurements were made.

4.4 Data Processing Equipment

The data recorded on the magnetic tape cartridge by the REDAR IV during the survey were processed in the field with the Radiation and Environmental Data Analyzer and Computer (REDAC) system. The mainframe of this system was a 16-bit Data General NOVA 840 computer system mounted in a mobile data processing laboratory (Figure 3). An extensive inventory of software and supporting equipment was available for detailed data analysis.

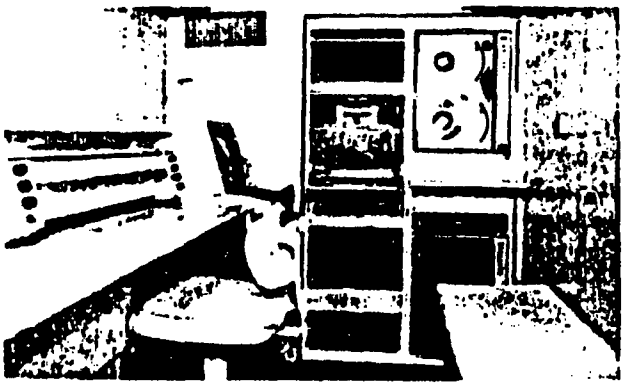

Figure 3. *MOBILE COMPUTER PROCESSING LABORATORY*

Additional processing was performed at the Remote Sensing Laboratory in Las Vegas, Nevada, with a 16-bit Data General ECLIPSE S/130 computer system.

5.0 ANALYSIS AND RESULTS

The results of the aerial survey are shown in Figure 4 as isograms of exposure rates. The isograms represent a sum of terrestrial exposure rates as inferred from aerial data and the cosmic ray exposure rate (3.7 μR/h) as reported by Lindeken et al.[1]

The terrestrial exposure rate was estimated by extracting the non-terrestrial contribution from the gross count rates over the survey area and then multiplying the results by an empirically derived conversion factor. It should be noted that the terrestrial exposure rate was indeed normalized to 1 meter above the ground, but only as averages over a large area. Aerial systems average radiation levels over an area whose diameter may be five to ten times the survey altitude, depending on the actual gamma ray energies involved and the source distribution with depth. For activity fairly uniformly distributed over large areas, such as typical of natural background radiation, the agreement between ground-based readings and those inferred from aerial data is generally quite good. Because of the large area averaging property of the airborne system, however, localized anomalies will appear to be spread over a larger area with a lower activity than actually exists on the ground. Therefore, for localized anomalies, ground-based measurements will not agree very well with the aerial results. The aerial data, therefore, simply serve to identify the existence of such anomalies. Ground surveys are required for more accurate definition of their spatial extent and intensity.

The aerial data were processed specifically for the 185.7 keV gamma ray from ^{235}U using a special spectrum stripping technique which suppresses normally occurring variations in natural background radiation. No anomalies of ^{235}U were found. The minimum detectable activity (MDA) for ^{235}U in the TI survey was 0.5 $\mu Ci/m^2$ for a surface distribution and 6 mCi for an exposed point source. These detection limits assume no shelf-shielding. The MDA-value for a surface distribution assumes the activity was spread over an area of approximately 0.2 km^2 (8×10^{-2} square miles) or larger. Although there was more than 6 mCi of ^{235}U inside Building 10 at the time of the survey, the attenuating property of the building and self-attenuation were sufficient enough to completely shield the 185.7 keV gamma ray of ^{235}U from the airborne platform. Figure 5 is a spectral plot of the data taken over the Texas Instruments complex and is typical of natural background for the Attleboro area.

The only anomaly found in the survey area was located approximately 2.7 km (1.7 miles) west-northwest of the Texas Instruments complex. Spectral analysis of the data revealed a photopeak at 740 keV (Figure 6). Located at the center of the anomaly was the firm Gamma Diagnostics, Inc. NRC Region I confirmed that

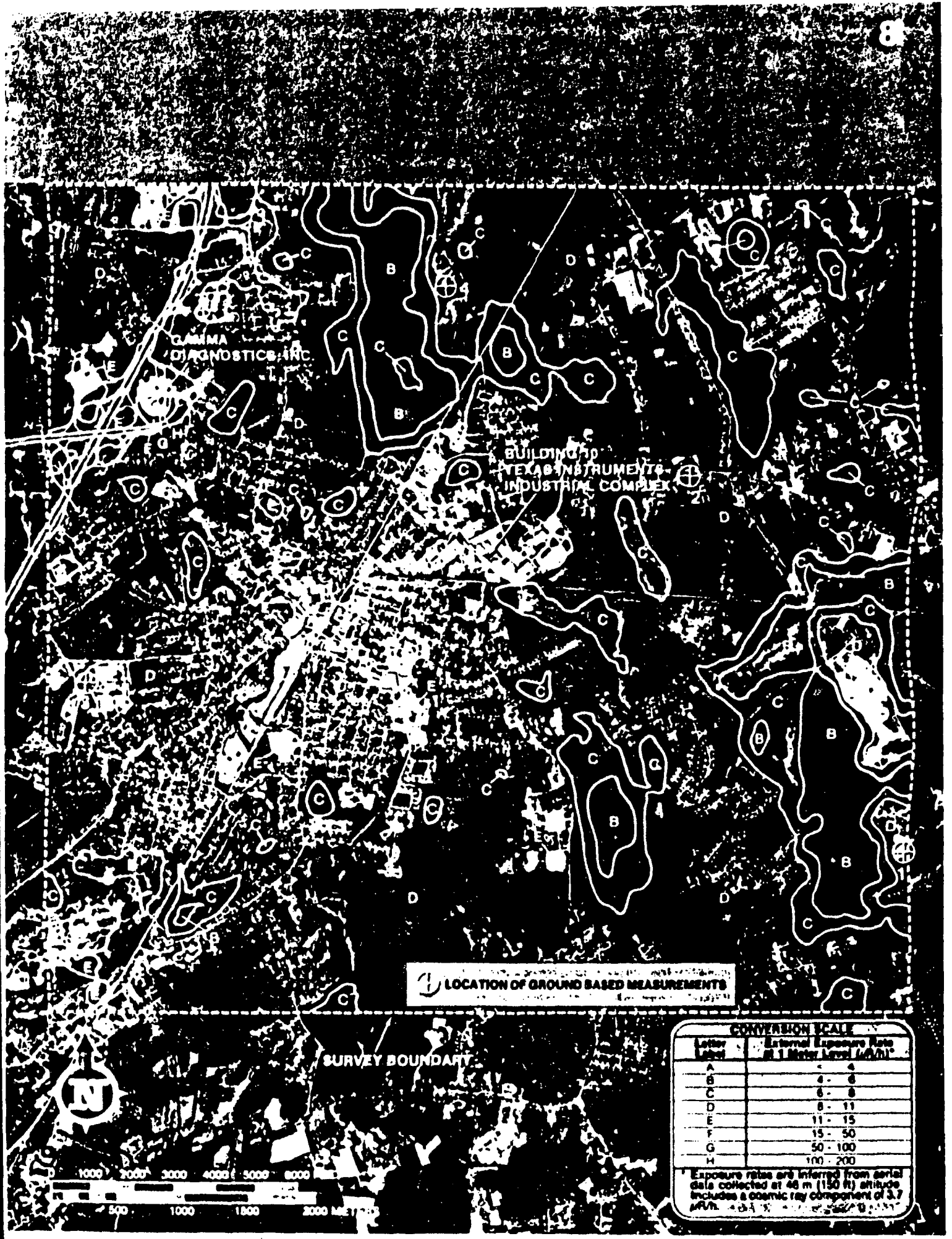

Figure 4. *EXPOSURE RATE ISORADIATION CONTOURS OVERLAID ON AN AERIAL PHOTOGRAPH OF ATTLEBORO.*

Gamma Diagnostics had several curies of the gamma source ^{99}Mo, which emits a 740 keV gamma ray.

Ground-based measurements were made at four locations within the survey area (Figure 4). At each location, a measurement was made with a high pressure ionization chamber and soil samples were taken. The soil samples were analyzed at the RSL in Santa Barbara, California, and an exposure rate at the 1 m AGL was estimated. The techniques used for the measurements and analyses are described in Reference 2. The results of the ground-based measurements are reported in Table 1. The exposure rates at 1 m AGL inferred from aerial data over the respective ground measurement locations are also reported in Table 1.

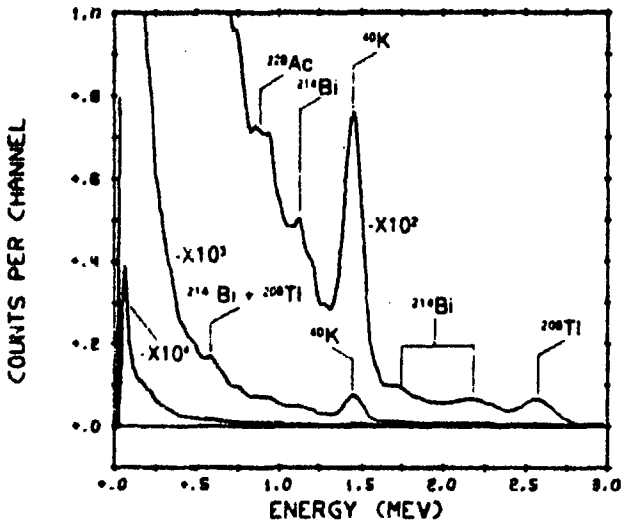

Figure 5. *BACKGROUND GAMMA RAY SPECTRUM TYPICAL OF THE AREA AROUND THE TEXAS INSTRUMENTS INDUSTRIAL COMPLEX*

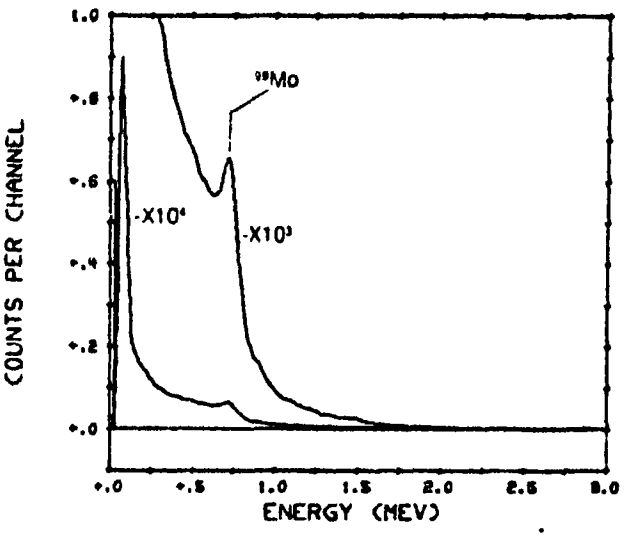

Figure 6. *GAMMA RAY SPECTRUM INDICATING THE PRESENCE OF ^{99}Mo*

Table 1. Comparison of Results from Aerial and Ground-Based Measurements

Location[1]	Exposure Rate (μR/h at 1 meter)		
	Ion Chamber	Soil Analysis[2]	Aerial Data[2]
1	10.3	9.8	8 - 11
2	10.0	10.6	8 - 11
3	10.2	10.6	8 - 11
4	9.6	9.3	8 - 11

[1] Refer to Figure 4.

[2] Includes cosmic ray contribution of 3.7 μR/h.

REFERENCES

1. Lindeken, C. L.; Peterson, K. R.; Jones, D. E.; and McMillen, R. E. 1972. "Geographical Variations in Environmental Radiation Background in the United States," *Proceedings of the Second International Symposium on the Natural Radiation Environment,* (Houston, Texas USA 1972) Vol. 1, pp 317-332.

2. Mohr, R.; Fritzshe, A. E.; and Franks, L. 1976. *Ground Survey Procedures.* Report No. EGG-1183-2339. Santa Barbara, CA: EG&G.

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REPORT TO

TEXAS INSTRUMENTS, INC.

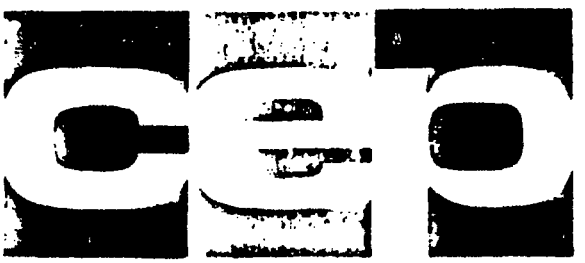
ATTLEBORO, MA. 02703

RADIOLOGICAL ANALYSIS

ON

TEST WELLS LOCATED ON

TEXAS INSTRUMENTS SITE



REPORT TO

TEXAS INSTRUMENTS, INC.

ATTLEBORO, MA. 02703

RADIOLOGICAL ANALYSIS

ON

TEST WELLS LOCATED ON

TEXAS INSTRUMENTS SITE

PREPARED BY

JAMES J. MUELLER

INVOICE NO. 206172

DATED JUNE 21, 1982

CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

1925 ROSINA STREET - POST OFFICE BOX 5351

SANTA FE, NEW MEXICO 87502

Table of Contents

Tables

Introduction

This document has been prepared by Controls for Environmental Pollution, Inc., (CEP), as requested by Frank Veale of Texas Instruments, Inc., Attleboro, Massachusetts.

The following discussion will include; analytical methodologies used to analyze Texas Instruments, Inc's water samples, calculation method, counting techniques, instrumentation and quality assurance plan.

1.0 Analytical Methods

The analytical methods used in this program are methods that have been studied collaboratively and found acceptable. Methods were selected for the analysis of these water samples, on the basis of those methods which would provide the most precise and accurate results. Interferences associated with the analyses have been removed chemically. CEP possesses sufficient information about the chemistry of these waters to make the needed corrections.

1.1 Radiochemical Methodology

1.1.1 Gross Alpha and Beta (Total)

A 1.0 liter of aliquot of water is evaporated to dryness and transferred to a weighed planchet. The Gross Alpha and Gross Beta radioactivity is measured by counting the planchet in an internal gas flow, proportional low background counter (Beckman Wide Beta II) which has a sixty percent beta efficiency using Strontium, Yttrium-90 and forty percent alpha efficiency using Plutonium-239. The self-absorption correction was performed on all samples which is based on mg/cm^2 of dissolved and suspended

solids collected on planchet.

1.1.2 Gross Alpha and Beta (Suspended)

A 1.0 liter of the sample is filtered using a 0.45 micron filter (millipore type), and the filter and suspended material is placed on a two-inch stainless-steel planchet. The Alpha and Beta activity is determined using a thin window, low background, gas flow proportional counter (Beckman Wide Beta II) which has a sixty percent efficiency using Strontium, Yttrium-90. The self-absorption correction was performed on all samples which is based on mg/cm^2 of material filtered.

1.1.3 Gross Alpha and Beta (Dissolved)

The filtrate from Section 1.1.2 above is evaporated to dryness. The sample is plancheted on a two-inch stainless-steel planchet using dilute nitric acid, and counted on a thin window, low background, gas flow proportional counter (Beckman Wide Beta II), having sixty percent efficiency using Strontium, Yttrium-90. The self-absorption correction was performed on all samples which is based on mg/cm^2 of dissolved solids collected on planchet.

1.1.4 Isotopic Uranium (U-234, U-235, U-238)

A suitable aliquot is spiked with a standardized Uranium-232 solution. The sample is purified by passing the solution through an ion exchange resin column. The elutriate is evaporated and electroplated onto a stainless-steel disc. The counting of

the sample is performed on a surface barrier detector utilizing a multi-channel analyzer (Northern Scientific). The Uranium recovery is determined from the Uranium-232 spike recovery.

2.0 Nuclear Instrumentation

2.1 Beckman Wide Beta II Low Background Gas Proportional System (Simultaneous) Gross Alpha and Gross Beta

The Beckman Wide Beta II two-inch planchet counting system has an average of 2.5 cpm Beta background and 0.1 cpm Alpha background. The detector has a sixty percent efficiency for Strontium-90 and forty percent for Plutonium-239. This system has been designed for simultaneous alpha and beta counting. The system sample capacity is one-hundred samples.

2.2 Alpha Spectrometry Systems (Isotopic Uranium U-234, U-235, U-238)

One Alpha Spectrometer consists of four silicon surface barrier detectors contained in a vacuum chamber and connected to a Northern Scientific multi-channel pulse height analyzer. The second spectrometer consists of eight silicon surface barrier detectors contained in separate vacuum chambers and is connected to a second Northern Scientific Spectrometer.

3.0 Activity Determinations

Analytical detection limits are governed by a number of factors including:

3.1 Sample Size

The sample size is taken based on the numerical data one wishes to obtain which can describe a particular situation and which can be

interpreted as a basis for possible action. The sample size has to be representative and provide for accurate analysis of the entire process is invalid.

3.2 Counting Efficiency

The fundamental quality in the measurement of radioactive substance is the number of disintegrations per unit time. As with most physical measurements in analytical chemistry, it is seldom possible to make an absolute measurement of the disintegration rate but rather it is necessary to compare the sample with one or more standards. The standards determine the counter efficiency which may then be used to convert sample counts per minute (cpm) to disintegrations per minute (dpm).

3.3 Background Count Rate

Any counter will show a certain counting rate without a sample in position. This background counting rate comes from several sources: 1) natural environmental radiation from the surroundings, 2) cosmic radiation, and 3) the natural radioactivity in the counter material itself.

The background counting rate will depend on the amount of these types of radiation and the sensitivity of the counter to the radiation.

3.4 Background and Sample Counting Time

The amount of time devoted to counting background depends on the level of activity being measured. In general, with low level samples, this time should be about equal to that devoted to counting a sample.

3.5 Time Interval Between Sample Collection and Counting

Decay measurements are useful in identifying certain short-lived isotopes. The disintegration constant, or its related quantity, the half-life, is one of the basic characteristics of a specific radionuclide and is readily determined if the half-life is sufficiently short.

3.6 Chemical Recovery of the Analytical Procedures

Most radiochemical analyses are carried out in such a way that losses occur during the separations. These losses occur due to a large number of contaminants that may be present and interfere during chemical separations. Thus it is necessary to include a technique for estimating these losses in the development of the analytical procedure.

The activities per unit sample mass or volume are determined using the following formula:

$$A = \frac{C-B}{(2.22)(V)(R)(E)(e^{-\lambda t})} \pm \frac{1.96\left[\frac{C+B}{T}\right]^{1/2}}{(2.22)(V)(R)(E)(e^{-\lambda t})}$$

WHERE:

- **A** = Activity as pCi units sample mass or volume.
- **C** = Sample count rate in counts per minute.
- **B** = Background counts per minute.
- **V** = Sample volume or mass analyzed.
- **E** = Counter efficiency and cpm/dpm.
- **2.22** = Numerical constants to convert disintegrations per minute to picocuries.
- **$(e^{-\lambda t})$** = Decay factor to correct the activity to time of collection.
- **T** = Counting time in minutes.
- **1.96** = Statistical constant for the 95% confidence level.
- **R** = Chemical recovery or photon yield.

Limits of Detection for Water

Parameter	pCi/liter
Gross Alpha	2
Gross Beta	3
Isotopic Uranium (U-234, U-235, U-238)	0.6

4.0 Quality Control Program

The overall objectives of the Quality Control Program are to:

4.1 Verify that work procedures and practices are adequate to assure that Texas Instruments, Inc., is kept within the limits regulated by State and Federal agencies.

4.2 Coordinate the in-house quality control program, independent of external programs, to assure that CEP is operating at maximum efficiency.

Upon arrival at the laboratory each sample is assigned a code number. The code number is placed on all apparatus used for that sample during radiochemical determinations.

Internal standard spike samples and blanks are analyzed as part of CEP's in-house Quality Control Program. Reagents, carriers and isotopes are standardized to meet the demand within the laboratory. Deionized water quality is monitored and maintained.

In addition, CEP participates in the U.S. Environmental Protection Agency inter-laboratory cross-check program.

Calibration is carried out using certified standards traceable to NBS, supplied by NBS, EPA, and Radiochemical Centre, Amersham, England. Since these same standards are used by the Health and Safety Laboratory of the AEC, the U.S. Public Health Service Laboratories, Lawrence Radiation Laboratory, and most other government

laboratories, proper inter-calibration with other agencies is assured. This is most important in interpretation of environmental data generated by other laboratories.

See Appendix A for Controls for Environmental Pollution, Inc.'s Quality Assurance Plan.

Water Samples Received at CEP on 5/4/82

Sample Identification	Type of Analysis	Total pCi/l	Suspended pCi/l	Dissolved pCi/l	Suspended U-234 pCi/l	Suspended U-235 pCi/l	Suspended U-238 pCi/l	Dissolved U-234 pCi/l	Dissolved U-235 pCi/l	Dissolved U-238 pCi/l
#2D 250 ft.	Gross Alpha Gross Beta	34 ± 9 31 ± 4								
#4D Deep Well Grab	Gross Alpha Gross Beta	8 ± 3 3 ± 2								
#5D 200 ft.	Gross Alpha Gross Beta	14 ± 5 5 ± 2								
#7D Deep Well Grab	Gross Alpha Gross Beta	21 ± 5 14 ± 3								
#8D 200 ft.	Gross Alpha Gross Beta	< 2 < 3								
#16D 300 ft.	Gross Alpha Gross Beta	22 ± 11 16 ± 6								
#21	Gross Alpha Gross Beta		15 ± 8 13 ± 3	< 2 < 3	2.4 ± 1.4	0.6 ± 0.4	2.6 ± 1.0			
#22	Gross Alpha Gross Beta		97 ± 36 56 ± 5	15 ± 4 10 ± 2	56.9 ± 4.3	17.6 ± 2.8	10.1 ± 2.6	8.6 ± 2.0	5.6 ± 1.6	5.0 ± 1.5
#23	Gross Alpha Gross Beta	6 ± 4 < 3	< 2 4 ± 2							
#24	Gross Alpha Gross Beta	< 2 < 3								
#25	Gross Alpha Gross Beta		112 ± 38 59 ± 5	9 ± 6 3 ± 2	7.8 ± 2.2	0.8 ± 0.5	1.7 ± 1.1	7.9 ± 2.7	0.6 ± 0.4	3.6 ± 1.5
#26	Gross Alpha Gross Beta		23 ± 10 57 ± 8	< 2 3 ± 2	3.3 ± 0.9	0.7 ± 0.4	3.2 ± 0.8			

Water Samples Received at CEP on 5/6/82 (Cont.)

Sample Identification	Type of Analysis	Total pCi/l	Suspended pCi/l	Dissolved pCi/l	Suspended U-234 pCi/l	Suspended U-235 pCi/l	Suspended U-238 pCi/l	Dissolved U-234 pCi/l	Dissolved U-235 pCi/l	Dissolved U-238 pCi/l
#27	Gross Alpha		92 ± 36*	28 ± 8**	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
	Gross Beta		52 ± 2	129 ± 11						
#28	Gross Alpha		157 ± 42	< 2	9.2 ± 1.9	1.0 ± 0.5	9.4 ± 3.0			
	Gross Beta		128 ± 6	7 ± 2						

*Suspended Alpha activity could be attributed to Radium-226.

**Dissolved Alpha activity could be attributed to Radium-226.

Water Samples Received at CEP on 6/11/82

Sample Identification	Type of Analysis	Suspended pCi/l	Dissolved pCi/l	Suspended U-234 pCi/l	Suspended U-235 pCi/l	Suspended U-238 pCi/l	Dissolved U-234 pCi/l	Dissolved U-235 pCi/l	Dissolved U-238 pCi/l
#1D	Gross Alpha	7 ± 3*	< 2	< 0.6*	< 0.6*	< 0.6*			
	Gross Beta	< 3	< 3						
#2D	Gross Alpha	< 2	10 ± 4				5.2 ± 1.0	0.6 ± 0.4	5.0 ± 1.0
250 ft.	Gross Beta	< 3	< 3						
#3D	Gross Alpha	< 2	< 2						
	Gross Beta	< 3	< 3						
#4D	Gross Alpha	< 2	8 ± 3						
	Gross Beta	< 3	< 3						
#5D	Gross Alpha	< 2	16 ± 4				9.0 ± 2.0	1.0 ± 0.5	9.1 ± 1.9
200 ft.	Gross Beta	< 3	< 3						
#7D	Gross Alpha	< 2	6 ± 3**				< 0.6**	< 0.6**	< 0.6**
Grab	Gross Beta	< 3	3 ± 2						
#8D	Gross Alpha	< 2	< 2						
200 ft.	Gross Beta	< 3	< 3						
#15D	Gross Alpha	< 2	< 2						
275 ft.	Gross Beta	< 3	< 3						
#16D	Gross Alpha	< 2	< 2						
360 ft.	Gross Beta	< 3	< 3						
#18	Gross Alpha	< 2	< 2						
Grab	Gross Beta	< 3	< 3						
#19D	Gross Alpha	< 2	17 ± 4				8.9 ± 2.0	1.0 ± 0.6	9.0 ± 3.0
	Gross Beta	< 3	< 3						
#20D	Gross Alpha	< 2	< 2						
	Gross Beta	< 3	< 3						

Water Samples Received at CEP on 6/11/82 (Cont.)

Sample Identification	Type of Analysis	Suspended pCi/l	Dissolved pCi/l	Suspended U-234 pCi/l	Suspended U-235 pCi/l	Suspended U-238 pCi/l	Dissolved U-234 pCi/l	Dissolved U-235 pCi/l	Dissolved U-238 pCi/l
CP	Gross Alpha	< 2	< 2						
	Gross Beta	< 3	< 3						
Effluent 0.005	Grosss Alpha	< 2	< 2						
	Gross Beta	< 3	< 3						

*Suspended Alpha activity could be attributed to Radium-226.

**Dissolved Alpha activity could be attributed to Radium-226.

Conclusion

Based on the June 1982 sampling, it can be concluded that the sampling method could have been the major factor in the high amounts of radioactivity in the previous collections. Wells numbered 1D, 2D, 5D, 7D, and 19D, could be reduced by purging these wells for a longer period of time. This conclusion can be substantiated by the following data:

Well Location	Date	Analysis	Total pCi/l	Suspended pCi/l	Dissolved pCi/l
#2D	5/4/82	Gross Alpha	34±9		
		Gross Beta	31±4		
#2D	6/11/82	Gross Alpha		< 2	10±4
		Gross Beta		< 3	< 3
#5D	5/4/82	Gross Alpha	14±5		
		Gross Beta	5±2		
#5D	6/11/82	Gross Alpha		< 2	16±4
		Gross Beta		< 3	< 3
#7D	5/4/82	Gross Alpha	21±5		
		Gross Beta	14±3		
#7D	6/11/82	Gross Alpha		< 2	6±3
		Gross Beta		< 3	3±2

Based on the above data it is recommended that numbers 1D, 2D, 5D, 7D, and 19D wells be purged for a longer period of time and that another Gross Alpha and Gross Beta be analyzed on these wells.

APPENDIX A

CONTROLS FOR ENVIORNMENTAL POLLUTION, INC.

QUALITY ASSURANCE PLAN

CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

QUALITY CONTROL PROGRAM

Copy No. _____

QUALITY ASSURANCE PLAN

ENVIRONMENTAL CHEMISTRY, NUCLEAR MEASUREMENTS

RADIOBIOASSAY, AND WATER CHEMISTRY

Date	Rev#	Reviewed by	Approved by mgr. of Q.A.	Comments
1/2/74	0			
12/13/79	1			
12/21/81	2			

CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

QUALITY CONTROL PROGRAM

QUALITY ASSURANCE PLAN

ENVIRONMENTAL CHEMISTRY, NUCLEAR MEASUREMENTS, RADIOBIOASSAY, AND WATER CHEMISTRY

1.0 PLAN DESCRIPTION

1.1 Purpose

The purposes of this Quality Assurance Plan are: (a) to define the nature and extent of Quality Assurance for Environmental Chemistry, Nuclear Measurements, Radiobioassay and Water Chemistry; (b) to set forth the requirements for preparation of Q.A. and Q.C. procedures; and (c) to provide a general description of the methods to be used in carrying out the Quality Assurance Surveillance and audit functions.

1.2 Scope

This Quality Assurance Plan is intended primarily to cover radiochemistry and other chemistry activities associated with providing Controls for Environmental Pollution's clients a quality service.

1.3 Objectives

The overall objective of this Q.A. Plan is to (a) verify that work procedures and practices are adequate to assure that all clients are kept within the limits regulated by the State and federal agencies; (b) to coordinate an in-house Quality Control program independent of external programs to assure that Controls for Environmental Pollution, Inc. is operating at maximum efficiency; including specific objectives as follows:

a. To verify that chemistry activities are documented and coordinated with the client's program so as to preclude surprises or apparent anomalies;

b. To verify that all chemistry procedures and practices are correct and adequate for the intended usage and required accuracy and reliability of results;

c. To verify that the procedures and practices conform to the Client's Specifications with respect to methods and frequency of sampling and analysis;

d. To verify that procedures and practices are appropriate for and consistent with the Client's Specifications and other regulatory criteria;

e. To verify that qualified personnel are provided with continued training, as necessary, for proper performance of the analytical work;

f. To verify that records are completed and maintained for each sample and analysis conducted;

g. To verify that procedures contain adequate Quality Control features and that such Quality Controls are practices as part of normal routine;

h. To verify that equipment is maintained and calibrated to the extent and at the frequency necessary for accurate results.

2.0 RESPONSIBILITIES

Responsible to prepare, review or otherwise assist in developments of Quality Inspection and Quality Assurance procedures, instructions and plans. Responsible to review procedures, specifications and other control or source documents as may be required in the development of surveillance procedures or other quality assurance procedures or requirements. Responsible to perform inspections, write reports and provide follow-up action and to direct and review the analytical efforts in the accomplishment types of quality assurance activities. Responsible to evaluate tests, non-conformances, standard requirements, regulatory requirements and to make recommendations for resolution and/or further evaluations by management, other departments or outside consultants. Responsible to issue or recommend stop work orders for work which is not in compliance with requirements.

3.0 LOCATION OF WORK

Quality Assurance activities associated with Environmental Chemistry, Nuclear Measurements, Radiobioassay, and Water Chemistry work may be performed at any of the following locations as necessary to accomplish the objectives of this Q.A. Plan:

a. Administrative offices of Controls for Environmental Pollution, Inc.

b. Central laboratory facilities of Controls for Environmental Pollution, Inc. located in the Operational Division.

c. Other locations of CEP laboratories.

4.0 SCHEDULING

Quality Control, Quality Assurance Surveillance, and certain activities necessary to prepare for Q.A. Audits, as further defined in Sections 5.0 and 6.0 of this Q.A. Plan, shall be performed regularly. For those types of analysis performed regularly and requiring a high degree of sensitivity and accuracy, as jointly designated by the manager or supervisor or department involved, the director of Quality Control, and Quality Control Officer.

Quality Assurance Audits shall be scheduled and performed as follows:

4.1 Chemistry (Water Quality)

REV.2- a. Internally spiked samples issued monthly by Quality Control officer will be as follows:

Wet Chemistry

Nitrate, Boron, Fluoride, Total Phosphate

Atomic Absorption Spectroscopy

Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Mercury, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Vanadium, Zinc

Spiked samples that will not be introduced into the monthly Quality Control program are as follows:

Total Dissolved Solids, Sulfate

These parameters (Sulfate and Total Dissolved Solids) will be represented by semi-annual Environmental Protection Agency cross-check samples and Environmental Resources Associates certified samples.

Spikes not introduced into the lab should be documented on an Explanation Form.

b. Spiked samples provided by the Environmental Protection Agency as cross-check samples will be submitted semi-annually.

c. Standardization of reagents which are critical to proper results Monthly or prior to use, as appropriate.

d. Results of spiked sample analysis reviewed and evaluated as are received by Quality Control Officer.

e. Prompt review and evaluation of any unusual or unexpected results will be subject to rerun.

4.2 Radiobioassay

a. Blanks and standards run Daily on each instrument in regular use or prior to use, as appropriate.

b. Spiked or split samples issued weekly, biweekly and monthly by Quality Control Officer.

c. Results of analysis of blanks, standards and spiked or split samples reviewed and evaluated by Quality Control Officer.

d. Prompt review and evaluation of any unusual or unexpected analytical results, any such results will be subject to rerun.

e. Reagents, carriers and tracer radionuclides which are in regular use and are critical to proper results standardized Monthly or prior to use, as appropriate.

4.3 Environmental Chemistry

a. Chemistry and radiochemistry methods same as paragraphs 4.1 and 4.2 where applicable.

b. Intercalibration by Controls for Environmental Pollution, Inc.'s laboratory with other laboratory agencies.

c. Quarterly review of results and evaluation of any indicated probable trends.

d. Prompt review and evaluation of any unusual or unexpected analytical results, any such results are subject to rerun.

The requirements stated above shall apply only to those analyses required by the Client's Specifications.

4.4 Gas Chemistry

a. Checks of the gas chromatograph against certified reference standards for all primary system impurities which must be controlled within specified limits, at least Weekly or prior to use, as appropriate.

4.5 Instrument Calibration (Nuclear Measurements)

All laboratory instrumentation and equipment shall be maintained on preventive maintenance programs as appropriate for the nature and frequency of usage.

Except as indicated in paragraph 4.2 (a) of this Q.A. Plan, laboratory instruments in regular use shall be checked Weekly against standards traceable to standards issued by the National Bureau of Standards. Less frequently used instruments shall be similarly calibrated prior to use.

5.0 METHODS

The nature of Environmental Chemistry, Radiobioassay, and Water Chemistry work is such that most Quality Control and Quality Assurance measures must be built into the analytical procedures in order to be effective. Because the sample is almost always consumed or altered during the analytical processes, laboratory personnel must make certain that every step is done correctly to yield valid results.

The work procedures must include the use of standardized practices and equipment which have been demonstrated to adequate for compliance with client's requirements as regards accuracy, sensitivity and reliability of results. Laboratory personnel must be trained on the particular methods and equipment to be used. Equipment, chemicals, samples and instrumentation must be controlled at every step to assure accuracy and reliability.

5.1 General Quality Assurance Methods

To accomplish the objectives of this Q.A. Plan, Quality Control and Quality Assurance requirements shall be implemented, through the analytical procedures and the laboratory administative procedures and controls, utilizing the following general methods.

5.1.1 Quality Control

a. Standardization and qualification of procedures including:

   1. Uniform step-by-step procedures (Cook book form);

   2. Training of personnel in use of procedures and equipment;

b. Uniform instructions for reagent preparation, control, storage, use and shelf life (including appropriate labeling and dating);

c. Proper selection of glassware, plastic containers and other analytical equipment and supplies;

d. Regular calibration of equipment (with standards traceability to National Bureau of Standards where necessary and available);

e. Uniform and consistent procedure for taking, controlling, preserving and using samples (including identification labels with dates and time, type and amount of preservative, and control number for all record purposes);

f. Provisions for control of procurement, storage and use of all chemicals used in analytical procedures;

g. Provisions for analysis of duplicate samples, including standards and blanks where such procedures are required.

h. Independent selective review and checking of calculations, curves or other analysis of results.

i. Standardized logs and analysis record sheets for recording sample identification, procedure used, results, and independent checks where required.

REV-2 5.1.2 Quality Assurance Surveillance

The spiked sampling program and the Q.A. Audit program provides an adequate assurance that the CEP Q.C. Program/Q.A. Plan is being adequately implemented. Therefore, deletion of the Q.A. surveillance requirements has been made from the CEP Q.C. Program/Q.A. Plan.

5.1.3 Quality Assurance Audit

Certain audit-related requirements will be implemented directly in the work procedures; other audit functions will be developed as part of the preparations for conducting Quality Assurance Audits as provided in Section 6.0 of this Q.A. Plan. The following basic methods will be used for auditing:

a. Introduction of spiked samples (contents unknown to Controls for Environmental Pollution, Inc.'s staff);

b. Laboratory intercalibration by use of split samples with client's laboratory;

c. Independent review of results of selected analyses (including spiked samples);

d. Direct inspection of laboratory and audit of work and records.

5.2 Particular Work Methods

The following basic methods shall be followed to accomplish the objectives of this Q.A. Plan.

5.2.1 Chemistry (Water Quality)

All Water Chemistry personnel shall follow the Water Chemistry Procedure Manual approved by management. All analytical results shall be recorded on approved forms after each test and signed by the Laboratory Supervisor.

On a monthly basis, spiked samples of ions commonly tested during the week shall be introduced into the laboratory operations by the Quality Control Officer. On a quarterly basis, water samples with various ion concentrations shall be presented for analyses, from a source independent of Controls for Environmental Pollution, Inc. laboratory. All such monthly and quarterly results shall be reviewed independently and, where necessary, corrective action shall be recommended to the laboratory management, with a copy to the President.

5.2.2 Radiobioassay

All Radiobioassay personnel shall follow the Radiochemistry Procedure Manual approved by management. All analytical results shall be recorded on approved forms after each isotope analysis and signed by the laboratory supervisor.

On a daily basis, all counting equipment in regular use shall be checked using blanks and standards on each instrument. Less frequently used equipment shall be similarly calibrated prior to use. On a monthly basis, unknown spiked samples shall be sent to the Controls for Environmental Pollution, Inc. laboratory for analysis. All such results shall be reviewed independently and, where necessary, corrective action shall be recommended to the laboratory management, with a copy to the Operations Manager and Director of Quality Control.

In addition to preventive maintenance, each instrument in regular use shall be checked weekly. Less frequently used instruments shall be calibrated prior to use. If any irregularity is detected in the calibrations or counting performance of any instrument, no analysis shall be performed on that instrument until it is functioning properly.

5.2.3 Environmental Chemistry

Environmental samples are analyzed in a low background laboratory which deals primarily with trace level radiochemistry.

Environmental samples shall be collected and analyzed in the manner and on a schedule as necessary to comply with the Client's Specifications.

Results shall be formally reported to the management monthly, within ten (10) days following the end of the reporting period. Unusual, unexpected or anomalous results shall be reported immediately to the Quality Control Officer, who shall initiate appropriate action to review and evaluate the results and take corrective action if indicated.

5.2.4 Gas Chemistry

Gas Chemistry analyses shall be conducted in accordance with the Analytical Instruments Procedures Manual approved by the management.

The checks given in paragraph 4.5 of this Q.A. Plan shall be performed at the frequency indicated. Complete records shall be maintained of these checks, including the gas supplier's certification of references standards and the basis for that certification.

5.3 New Procedures

When a procedure is not available, the requirements will be evaluated and a suitable analytical method established. After satisfactory verification that the procedure provides the necessary sensitivity, accuracy and selectivity, a formal procedure will be approved by the supervisor and Director of Quality Control and included in the appropriate Procedure Manual.

6.0 PROCEDURE REQUIREMENTS

As indicated in Section 5.0 of this Q.A. Plan, the Quality Control and Quality Assurance Surveillance procedures are incorporated into the analytical work procedures and laboratory administrative procedures and instructions.

Quality Assurance Audits (QAA's) shall be performed as follows, with the numbering shown to be used for record purposes. Scheduling of these audits will be as deemed necessary by the director of QA.

CEP-QA-3 Quality Assurance Audit, Water and Organic Chemistry

CEP-QA-4 Quality Assurance Audit, Radiobioassay

CEP-QA-2 Quality Assurance Audit, Environmental Chemistry

CEp-QA-5 Quality Assurance Audit, Nuclear Measurements

Reports of these QAA's shall describe the particular activities audited; the basis and procedures for examination and evaluation of records; procedures for verifying validity and consistency of results; procedures for evaluating adequacy of Q.C. and Q.A. Surveillance Activities; and deficiencies and implementing corrective action.

7.0 REPORTS AND RECORD REQUIREMENTS

7.1 Chemistry (Water Quality)

Records and reports of analytical results of the various samples, including quantities and chemical constituency, shall be retained as permanent records.

7.2 Nuclear Measurements

All records and logs relative to data and radioactive materials prepared shall be kept as permanent records.

7.3 Radiobioassay

Records and reports shall be retained as permanent records.

7.4 Environmental Chemistry

Detailed analytical records and quarterly reports shall be retained as permanent records. Records and reports shall be prepared as directed by CEP clients.

7.5 Gas Chemistry

Records and reports shall be retained as permanent records. In addition, records of all certified reference standards, and their correlation with analytical results, shall be retained for the time period established by the client.

7.6 Quality Assurance

Quality Assurance records shall consist of all logs, reports, results, deficiency reports and the like which are generated in the course of carrying out the requirements of the Q.A. Plan. Such Records shall be retained as permanent records in accordance with CEP's administrative requirements.

8.0 ATTACHMENTS

None

9.0 REVIEW, APPROVAL AND DISTRIBUTION

9.1 Quality Assurance Plan and Procedures

The first drafts of the completed Quality Assurance Plan and Procedures for Environmental Chemistry, Nuclear Measurements, Radiobioassay, Water Chemistry, and all subsequent drafts or changes to these Plans and Procedures shall be distributed for review, comment and approval as follows:

Manager of Nuclear Measurements	1 Copy	(For review and comment)
Manager of Radiobioassay	1 Copy	(For review and comment)
Manager of Environmental Monitoring	1 Copy	(For review and comment)
Operations Manager	1 Copy	(For review and comment)
Manager of Water Chemistry	1 Copy	(For review and comment)
Director of Quality Assurance	1 Copy	(For approval)

A marked-up copy of the Plan and Procedures, or a comment letter incorporating all comments from the reviewers, shall be returned to the issuer (Quality Control Officer) within ten to fifteen days.

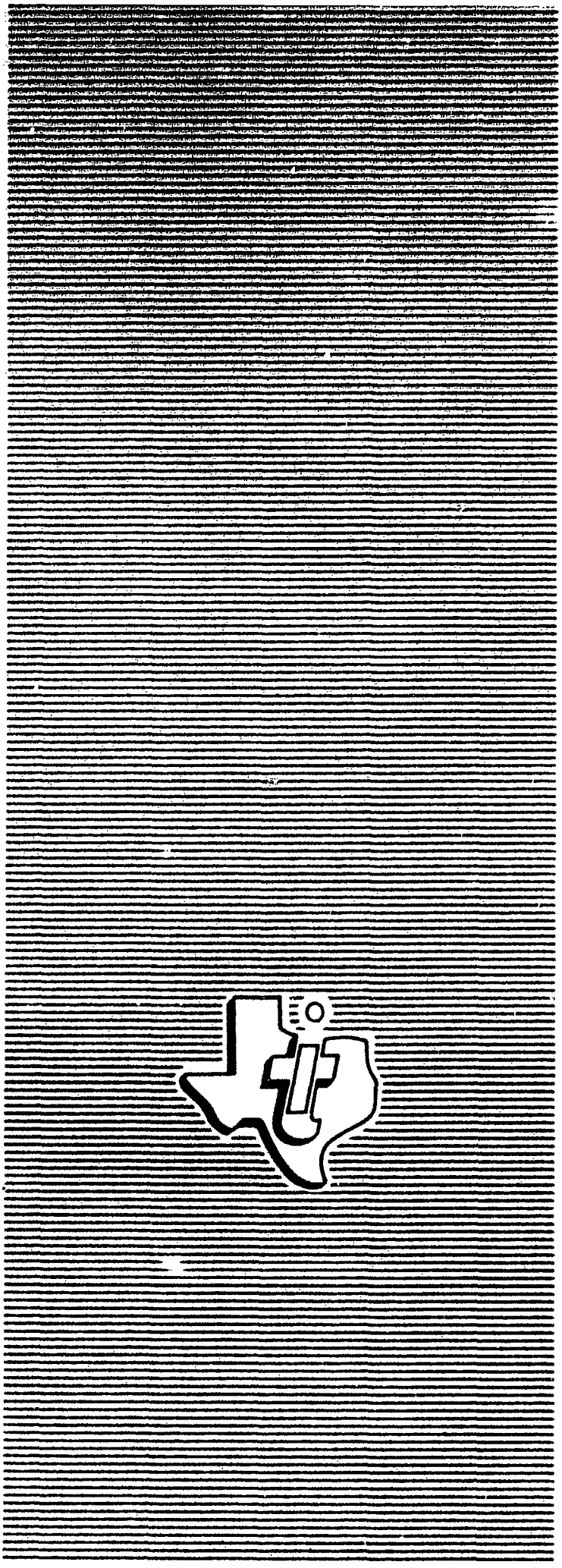
After resolution of all comments, and completion of signatures required on the signature sheet, the Director of Quality Assurance will approve the Plan and Procedures and distribute copies to the controlled distribution.

9.2 Quality Control Inspection Procedures

Any Quality Control Inspection Procedures found to be necessary shall be reviewed by the Director of Quality Assurance, or his assignee.

Applicable, up-to-date QCIP's shall always be available at the Quality Control Office for use by personnel assigned specific QC duties.

A complete set of current QCIP's shall always be readily available at the Quality Control Office.



TEXAS INSTRUMENTS INCORPORATED

ATTLEBORO, MASSACHUSETTS

REQUEST FOR TERMINATION

OF

NUCLEAR REGULATORY COMMISION

LICENSE SNM-23

AMMENDMENT 1

NOVEMBER 1, 1982

REQUEST FOR TERMINATION

OF

NUCLEAR REGULATORY COMMISSION

LICENSE SNM-23

FOREWORD

This submittal presents a request by Texas Instruments Incorporated (TI) for termination of Nuclear Regulatory Commission License SNM-23.

APPROVED BY: _____
W. Goetz, Mgr, Industrial Metals

APPROVED BY: _____
R. Churchill, Contracts Mgr.

APPROVED BY: _____
F. L. Sherman, Mgr. HFIR Project

APPROVED BY: _____
R. J. Schwensfeir, Jr., Mgr.
Nuclear Safety & Nuclear Materials

_____
My Commission Expires May 21, 1987

NOV 10 1982

TABLE OF CONTENTS

1. REQUEST FOR TERMINATION OF NRC LICENSE

Texas Instruments Incorporated is submitting measurements of radioactivity for areas of Building 10 outside the HFIR project area. These measurements, along with the measurements submitted by letter dated May 17, 1982, and supplements dated June 24, and July 9, 1982, provide assurance that the areas of Building 3,4 & 10 formerly used for the manufacture of radioactive materials meets the criteria of Annex C, November 1976, as published by the U.S. Nuclear Regulatory Commission and NRC position paper, "Disposal of Onsite Storage of Residual Thorium as Uranium (Either as Natural Ores or Without Daughters Present) from Past Operations for Radioactivity of Paint & Floor Coatings."

The areas measured were decontaminated and decommissioned in 1955 through 1968, and at those times, all recoverable special nuclear material and other radioactive materials were removed from the areas.

2. HISTORY

During the years 1952 through 1956 small portions of Buildings 3 & 4 and during subsequent years, 1956 through 1968, major portions of Building 10 of Texas Instruments Incorporated, Attleboro, Massachusetts, site were engaged in the manufacture of nuclear reactor fuel for the U.S. Navy and commercial power and research reactors, along with various compenents of natural and depleted uranium. With the exception of the HFIR project, these operations were concluded in 1956 through 1968.

The building areas used for the concluded operations were then decontaminated, surveyed for radioactivity, and released for general use. Since that time, the areas have been used for manufacturing with non-radioactive materials.

This report is being submitted to show that the areas containing the concluded operations were successfully decontaminated and remain so at the termination of the HFIR project in 1982.

3. PROCEDURE

Decommissioning & Decontamination

Small areas of Building 3 & 4 were used for the mechanical forming of reactor fuel. Building 10 was divided into two areas. Those areas were Clad Fuel Manufacturing Area (CFMA) and Unclad Fuel Manufacturing Area (UFMA). All of those areas were decontaminated and decommissioned. For the last 14-26 years, these areas have been used to manufacture products containing non-radioactive materials.

LOCATION OF MEASUREMENTS AND REPORTING OF RESULTS
THE FLOOR OF THE CLAD FUEL MANUFACTURING AREA (CFMA)
(AS SHOWN IN FIGURE 1)

The floor of the CFMA (outside the HFIR project area) was divided into areas defined by building bays and spans as shown in Figure 1. Each area was then identified by grid coordinates. Three measurement locations were chosen within each area on a random basis. The three measurement locations were identified by grid coordinates within the selected area. The average result for each selected area was calculated using the three measurements for that area. The final highest individual measurement and the average for each chosen sample area, along with the original highest measurement and average, are shown in Appendix A, 4.1.

UNCLAD FUEL MANUFACTURING AREA (UFMA) - (AS SHOWN IN FIGURE 1)

WALLS AND CEILING OF VAULT

The walls and ceiling vault of the UFMA (outside the HFIR project area) remaining from the time of decommissioning were divided approximately equal into areas one meter square. Each area was identified separately. Five measured locations were chosen within each area on a random basis. The five measurement locations were identified by grid coordinates within the area. Average result for each area was calculated using the five measurements from that area. The final highest individual measurement and average, are shown in Appendix A, 4.2.1.

FLOORS

The floor of the UFMA (outside the HFIR project area) was divided into areas defined by building bays and spans as shown in Figure 1. Each area was then identified by grid coordinates. Five measurement locations were chosen within each area on a random basis. The five measurement locations were identified by grid coordinates within each area. Average result for each area was calculated, using the five measurements for that area. The highest individual measurement and the average for each area, along with any original highest measurement and average, are shown in Appendix A, 4.2.2.

BUILDINGS 3 AND 4

Buildings 3 and 4 floors previously decontaminated & decommissioned were divided into areas defined by building bays and spans as shown in Figures 2 and 3 respectively. Each area was then identified by grid coordinates. Five measurement locations were identified by grid coordinates within each area. Average results for each area was calculated, using the five measurements for that area, The highest individual measurement to the average for each area along with any original highest measurement and average are shown in Appendix A, 4.3 for the floor of Building 3 and Appendix A, 4.4 for the floor of Building 4.

MEASUREMENTS

Measurements of B/Y and direct α radioactivity were taken at each selected locations. Measurements of removable α radioactivity were taken at all selected locations where the results of the direct radioactivity measurements exceeded approximately one-third the NRC acceptance criteria of Annex C, November 1976, as published by the U.S. Nuclear Regulatory Commission.

When a location was unavailable due to partitions, equipment, etc., the available location closest to the selected locations on the floor, ceiling, walls, and columns was measured for direct α and B/Y radioactivity.

All measurements in Appendix A, unless otherwise noted, are final measurements.

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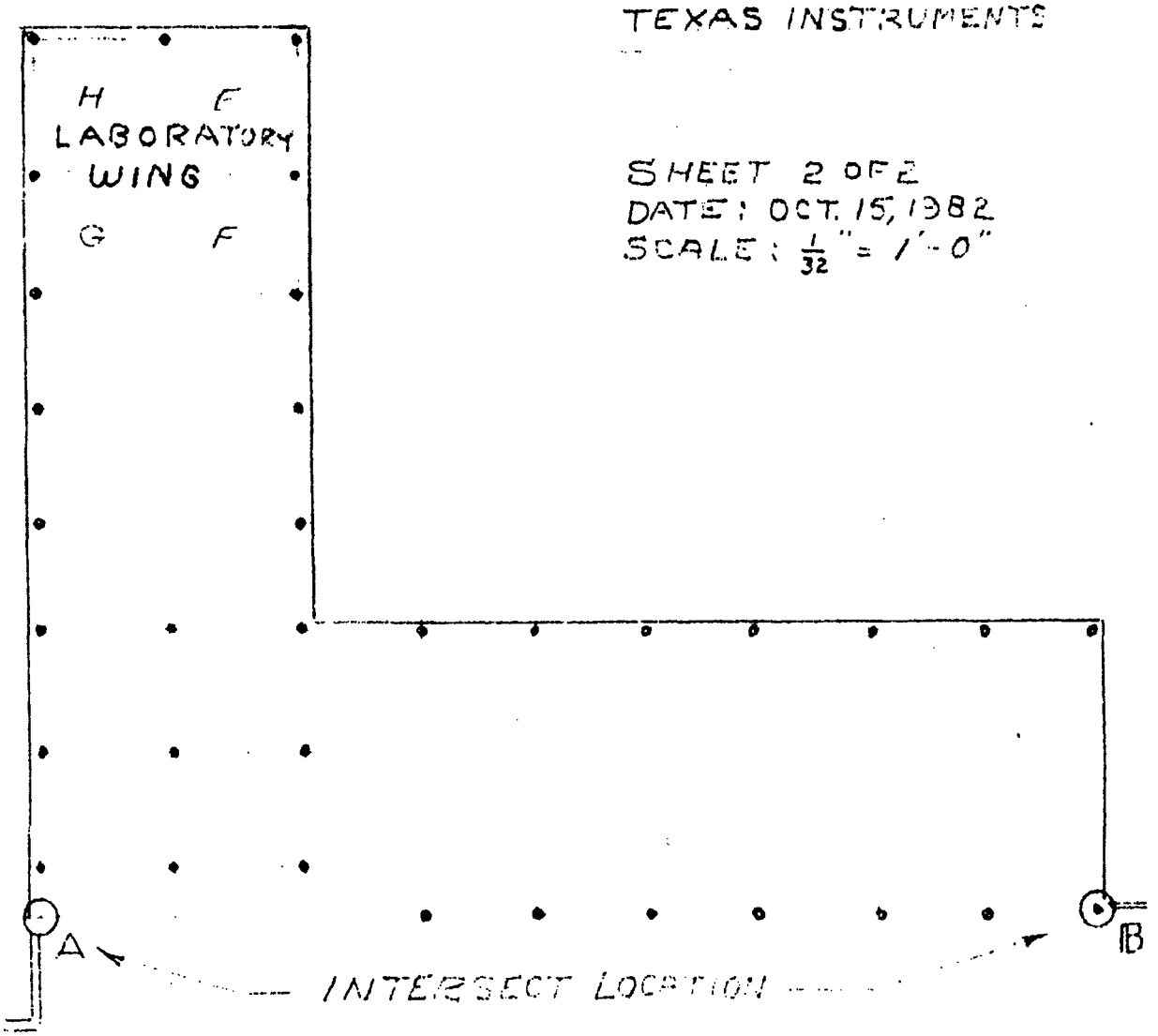
FIGURE 1

BUILDING 10
ATTLEBORO SITE
TEXAS INSTRUMENTS

SHEET 2 OF 2
DATE: OCT. 15, 1982
SCALE: $\frac{1}{32}$" = 1'-0"



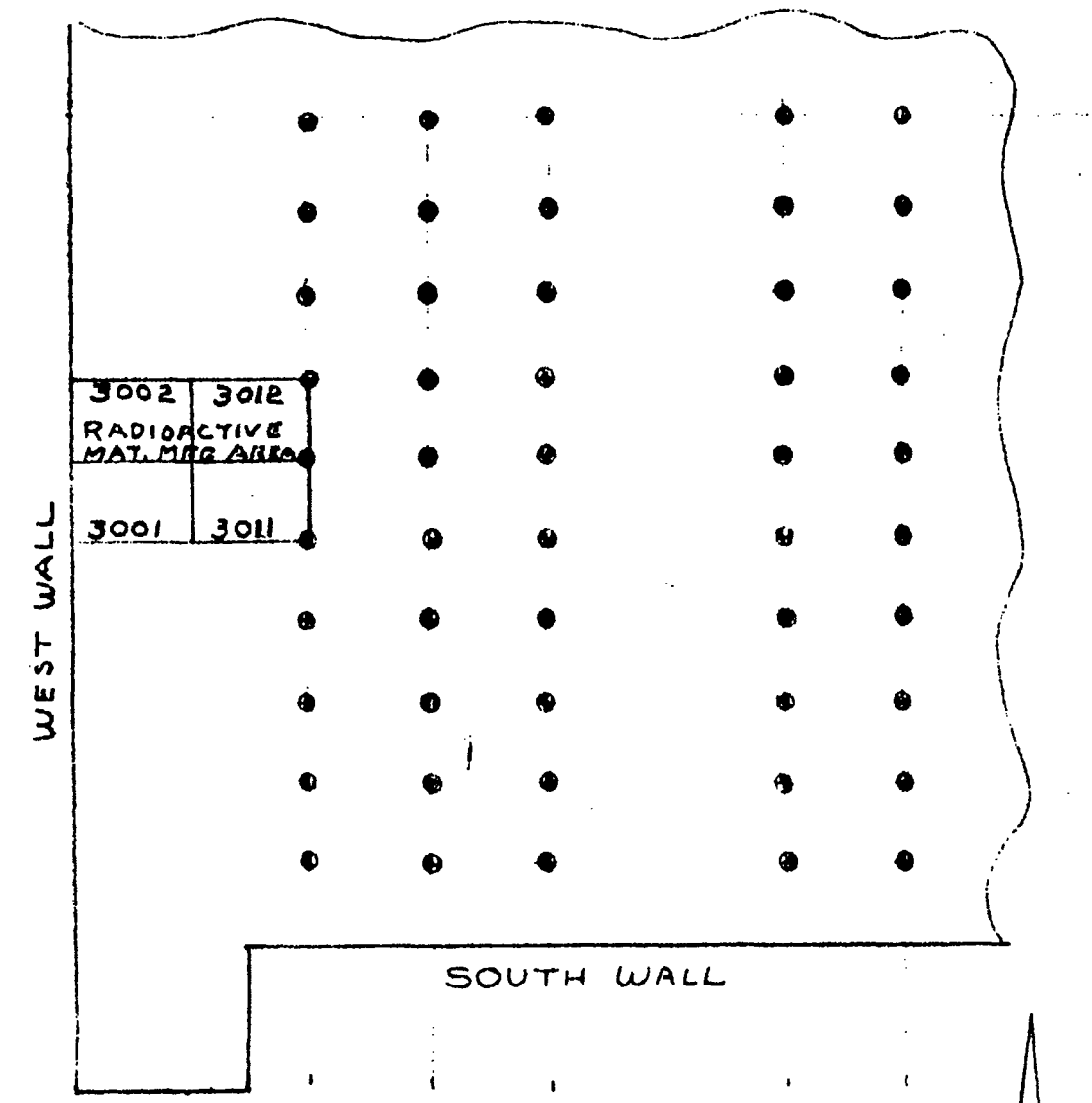
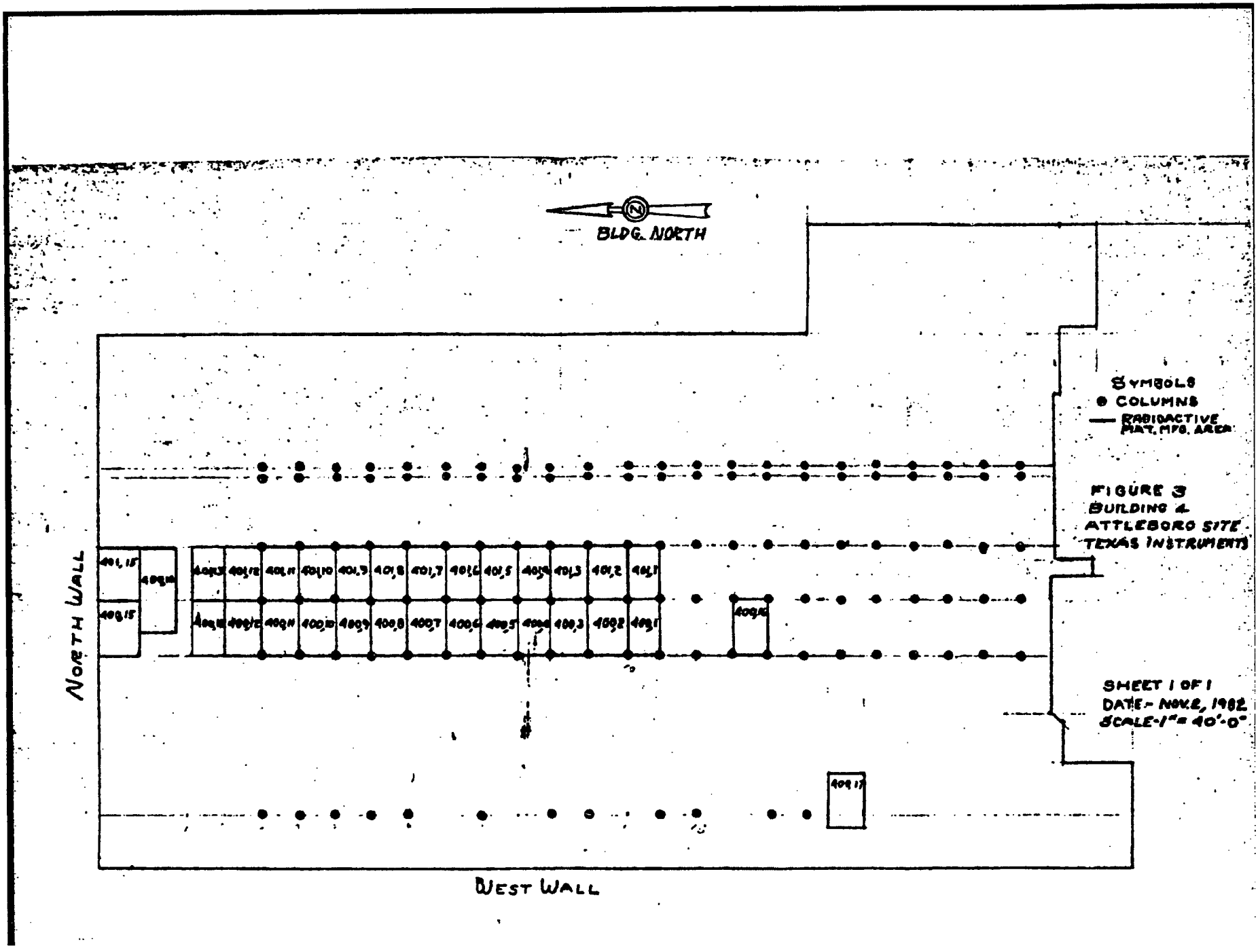


FIGURE 2
BUILDING 3
ATTLEBORO SITE
TEXAS INSTRUMENTS

SHEET 1 OF 1
DATE: NOV. 2, 1982
SCALE 1" = 40'-0"


BLDG. NORTH
SYMBOLS
COLUMNS
RADIOACTIVE MAT. MFG. AREA
FIGURE 3
BUILDING 4
ATTLEBORO SITE
TEXAS INSTRUMENTS
SHEET 1 OF 1
DATE- NOVE, 1982
SCALE-1"= 40'-0"
NORTH WALL
WEST WALL

APPENDIX A
4.1 FLOOR

LOCATION	DIRECT ALPHA (dpm/100 CM^2) Max.	Avg.	BETA/GAMMA MRAD/HR Max.	Avg.	REMOVABLE ALPHA (1) (dpm 100 CM^2) Max.
3,12	19.06	6.35	0.002939	0.002048	----
4,12	38.12	31.76	0.003473	0.004631	----
4,13	38.12	15.24	0.002672	0.002316	----
5,13	38.12	19.06	0.005076	0.002939	----
5,14	38.12	25.41	0.004542	0.003117	----
6,14	38.12	19.06	0.003473	0.002404	----
5,15	57.18	38.12	0.003740	0.002404	----
6,15	19.06	12.70	0.002404	0.001425	----
7,17	95.30	76.24	0.010955	0.005967	----
7,18	133.42	76.24	0.005076	0.004275	----
7,19	133.42	108.00	0.004809	0.003028	----
7,20	171.54	120.71	0.008016	0.006590	----
5,12	228.72	152.48	0.003473	0.003562	----
6,12	133.42	101.65	0.006680	0.005254	----
7,21	190.60	120.71	0.004809	0.003028	----
7,22	209.66	133.42	0.005878	0.003918	----
7,23	209.66	127.06	0.006947	0.004275	----
7,24	171.54	114.36	0.006680	0.004275	----
6,24	114.36	69.88	0.005611	0.003206	----
5,16	133.42	108.00	0.007214	0.005522	----
6,16	190.60	127.06	0.005611	0.003562	----
6,13	228.72	171.54	0.006145	0.004898	----
7,13	247.78	177.89	0.007481	0.006323	----
F	38.12	25.41	0.010668	0.007125	----
G	57.18	38.12	0.008283	0.006145	----
E	38.12	19.06	0.012291	0.014203	----
H	57.18	25.41	0.007214	0.006590	----
8,12	38.12	30.49	0.006412	0.003420	----
8,13	57.18	30.49	0.008016	0.004435	----

(1) ONLY AS REQUIRED.

APPENDIX A
4.1 FLOOR

LOCATION	DIRECT ALPHA (dpm/100 CM^2) Max.	Avg.	BETA/GAMMA MRAD/HR Max.	Avg.	REMOVABLE ALPHA (1) (dpm/100 CM^2) Max.
1,1	76.24	50.82	0.010153	0.007481	----
2,1	57.18	31.76	0.003473	0.002672	----
1,2	76.24	57.18	0.002939	0.001959	----
2,2	57.18	37.76	0.012291	0.010064	----
1,3	57.18	25.41	0.004809	0.002761	----
2,3	76.24	57.18	0.011222	0.007837	----
1,4	76.24	63.53	0.009352	0.007570	----
2,4	57.18	50.82	0.010955	0.008194	----
1,5	38.12	31.76	0.008016	0.006145	----
2,5	57.18	38.12	0.005344	0.003740	----
1,6	38.12	31.76	0.004275	0.003117	----
2,6	76.24	44.47	0.009860	0.008372	----
1,7	57.18	31.76	0.008550	0.007481	----
2,7	57.18	25.41	0.011756	0.008282	----
1,8	38.12	25.41	0.009084	0.006145	----
2,8	57.18	38.12	0.012024	0.008461	----
1,9	76.24	44.47	0.008817	0.006234	----
2,9	57.18	31.76	0.014696	0.012736	----
1,10	76.24	50.82	0.005076	0.004275	----
2,10	38.12	12.70	0.011756	0.010420	----
1,11	38.12	19.06	0.008550	0.007392	----
2,11	57.18	38.12	0.011756	0.006679	----
3,1	57.18	50.82	0.013360	0.012024	---
4,1	38.12	31.76	0.007748	0.006056	----
3,2	76.24	57.18	0.007748	0.005344	----
4,2	38.12	19.06	0.008817	0.006947	----
3,3	57.18	50.82	0.007481	0.005700	----
4,3	76.24	50.82	0.008817	0.006947	----
3,4	57.18	44.47	0.004542	0.003028	----
4,4	76.24	57.18	0.006947	0.004987	----
3,5	57.18	44.47	0.006145	0.005165	----
4,5	76.24	57.18	0.007748	0.005789	----
3,6	38.12	25.41	0.008817	0.007659	----
4,6	38.12	19.06	0.005344	0.004364	----

(1) ONLY AS REQUIRED.

APPENDIX A
4.1 FLOOR

LOCATION	DIRECT ALPHA (dpm/100 CM^2) Max.	Avg.	BETA/GAMMA MRAD/HR Max.	Avg.	REMOVABLE ALPHA (1) (dpm 100 CM^2) Max.
3,7	38.12	25.41	0.007481	0.006590	----
4,7	57.18	31.76	0.003740	0.002493	----
3,8	38.12	25.41	0.011222	0.009975	----
4,8	57.18	50.82	0.005344	0.003562	----
3,9	57.18	44.47	0.006947	0.004631	----
4,9	38.12	25.41	0.007214	0.005967	----
3,10	57.18	31.76	0.004275	0.003918	----
4,10	57.18	50.82	0.006680	0.005433	----
3,11	76.24	57.18	0.007481	0.004809	----
4,11	76.24	50.82	0.005611	0.004186	----
5,4	38.12	31.76	0.005344	0.003651	----
6,4	57.18	38.12	0.005344	0.003651	----
5,5	95.30	63.53	0.004542	0.003384	----
6,5	76.24	57.18	0.006947	0.004809	----
5,6	38.12	31.76	0.005076	0.004008	----
6,6	76.24	50.82	0.008283	0.005344	----
5,7	38.12	25.41	0.004809	0.002226	----
6,7	19.06	6.35	0.006145	0.002315	----
5,8	38.12	25.41	0.002137	0.001157	----
6,8	38.12	31.76	0.003473	0.002850	----
5,9	38.12	19.06	0.003473	0.002048	----
6,9	38.12	31.76	0.006947	0.005076	----
5,10	57.18	38.12	0.007481	0.004186	----
6,10	38.12	31.76	0.000534	0.000178	----
5,11	57.18	44.47	0.006145	0.004987	----
6,11	38.12	44.47	0.005878	0.004275	----
7,1	57.18	38.12	0.004275	0.003028	----
8,1	38.12	19.06	0.005344	0.003384	----
7,2	19.06	12.70	0.005076	0.004364	----
8,2	38.12	25.41	0.005878	0.004542	----
7,3	57.18	44.47	0.003473	0.001959	----
8,3	57.18	38.12	0.002404	0.001781	----
7,4	57.18	44.47	0.005344	0.004097	----
8,4	19.06	6.35	0.001336	0.000890	----

(1) ONLY AS REQUIRED.

APPENDIX A
4.1 FLOOR

LOCATION	DIRECT ALPHA (dpm 100/CM^2) Max.	Avg.	BETA/GAMMA MRAD/HR Max.	Avg.	REMOVABLE ALPHA (1) (dpm 100 CM^2) Max.
7,5	57.18	38.12	0.005878	0.003740	----
8,5	38.12	38.12	0.005611	0.004631	----
7,6	57.18	31.76	0.008817	0.006680	----
8,6	57.18	38.12	0.004809	0.003740	----
7,7	57.18	38.12	0.006412	0.004809	----
8,7	19.06	6.35	0.007748	0.006412	----
7,8	57.18	38.12	0.005878	0.004186	----
8,8	57.18	57.18	0.012291	0.010064	----
7,9	57.18	50.82	0.003473	0.002582	----
8,9	38.12	19.06	0.008016	0.004186	----
7,10	38.12	25.41	0.004275	0.002761	----
8,10	114.36	82.59	0.006145	0.004453	----
7,11	57.18	44.47	0.005344	0.004364	----
8,11	57.18	44.47	0.005076	0.003651	----
7,12	57.18	38.12	0.006412	0.005076	----
A	38.12	25.41	0.003473	0.002582	----
B	38.12	31.76	0.005611	0.002351	----
C	38.12	25.41	0.004008	0.003473	----
D	38.12	19.06	0.003206	0.001781	----
5,1	38.12	25.41	0.002137	0.001336	----
6,1	57.18	38.12	0.004275	0.002850	----
5,2	57.18	31.76	0.004542	0.002493	----
6,2	38.12	19.06	0.004008	0.002672	----
5,3	57.18	31.76	0.004542	0.003562	----
6,3	38.12	19.06	0.005076	0.003028	----

(1) ONLY AS REQUIRED.

APPENDIX A
4.2.1 WALL/CEILING

LOCATION	DIRECT ALPHA (dpm/100 CM^2) Max.	Avg.	BETA/GAMMA (MRAD/HR) Max.	Avg.	REMOVABLE ALPHA (1) (dpm/100 CM^2) Max.
6,19 (2)	38.12	11.43	0.004809	0.002832	----
6,20 (3)	57.18	30.49	0.006680	0.003901	---
6,19 (4)	38.12	11.43	0.007214	0.004008	----
6,20 (5)	38.12	15.24	0.003473	0.001336	----
6,20 (6)	19.06	7.62	0.004542	0.003152	----
6,19 (7)	57.18	30.49	0.004008	0.002191	----
6,20 (8)	57.18	26.68	0.004008	0.002832	----
6,19 (9)	57.18	38.12	0.005344	0.003420	----
6,20 (10)	57.18	22.87	0.007214	0.003259	----
6,20 (11)	57.18	26.68	0.005611	0.004382	----

(1) ONLY AS REQUIRED.
(2) SOUTH WALL INSIDE.
(3) NORTH WALL INSIDE.
(4) EAST WALL INSIDE.
(5) WEST WALL INSIDE.
(6) CEILING INSIDE.
(7) SOUTH WALL OUTSIDE.
(8) NORTH WALL OUTSIDE.
(9) EAST WALL OUTSIDE.
(10) WEST WALL OUTSIDE.
(11) CEILING OUTSIDE.

APPENDIX A
4.2.2 FLOOR

LOCATION	DIRECT ALPHA (dpm/100 CM^2) Max.	Avg.	BETA/GAMMA (MRAD/HR) Max.	Avg.	REMOVABLE ALPHA (1) (dpm/100 CM^2) Max.
3.13	19.06	4.77	0.005344	0.004168	----
3,14	19.06	7.62	0.006145	0.003740	----
4,14	0	0	0.004275	0.003366	----
3,15	38.12	26.68	0.007214	0.004757	----
4,15	38.12	11.43	0.002137	0.005076	----
3,16	38.12	19.06	0.003473	0.001923	----
4,16	19.06	3.81	0.003740	0.001923	----
3,17	19.06	7.62	0.002672	0.001229	----
4,17	171.54	83.86	0.005076	0.003046	----
5,17	228.72	144.85	0.082832	0.020895	----
6,17	38.12	15.24	0.006947	0.003954	----
3,18	19.06	3.81	0.006680	0.003047	----
4,18	38.12	12.19	0.005611	0.002565	----
5,18	285.9	144.85	0.005076	0.002565	----
6,18	247.78	148.66	0.003740	0.001656	----
3,19	114.36	49.55	0.004275	0.003366	----
4,19	57.18	22.87	0.005344	0.002778	----
5,19	114.36	57.18	0.004809	0.002939	----
6,19	209.66	102.92	0.008817	0.005557	----
3,20	209.66	95.3	0.005076	0.003206	----
4,20	38.12	15.24	0.005878	0.003740	----
5,20	171.54	114.36	0.008817	0.007000	----
6,20	343.08	270.65	0.006412	0.005183	----
3,21	209.66	129.60	0.004275	0.002404	----
4,21	95.30	41.93	0.004809	0.003046	----
6,21	247.78	118.17	0.012024	0.007855	----

(1) ONLY AS REQUIRED.

APPENDIX A
4.2.2 FLOOR

LOCATION	DIRECT ALPHA (dpm/100 CM^2) Max.	Avg.	BETA/GAMMA (MRAD/HR) Max.	Avg.	REMOVABLE ALPHA (1) (dpm/100 CM^2) Max.
3,22	190.60	110.54	0.005878	0.003633	----
4,22	114.36	45.74	0.008016	0.005450	----
5,22	266.84	114.36	0.007214	0.004756	----
6,22	171.54	83.86	0.009619	0.007107	----
3,23	362.14	167.72	0.082832	0.020734	----
4,23	38.12	15.24	0.007481	0.018971	----
5,23	190.60	114.36	0.009619	0.008122	----
6,23	133.42	99.11	0.008550	0.006305	----
3,24	76.24	41.93	0.003740	0.002244	----
4,24	247.78	133.42	0.004542	0.002191	----
5,24	171.54	53.36	0.005878	0.004168	----
5,21 (2)	686.16	232.53	0.122110	0.033987	1.1
5,21 (3)	1257.96	625.16	0.122644	0.071181	----
5,21 (4)	285.9	198.22	0.149097	0.049698	----

(1) ONLY AS REQUIRED.
(2) RESULTS OF FIRST FIVE LOCATIONS
(3) RESULTS OF SECOND FIVE LOCATIONS
(4) RESULTS OF THIRD FIVE LOCATIONS

APPENDIX A
4.3 FLOOR

LOCATION	DIRECT ALPHA (dpm/100 CM^2) Max.	Avg.	BETA/GAMMA (MRAD/HR) Max.	Avg.	REMOVABLE ALPHA (1) (dpm/100 CM^2) Max.
300,1	76.24	49.55	0.005611	0.003687	----
300,2	38.12	22.87	0.006947	0.004328	----
301,1	76.24	49.55	0.008550	0.006519	----
301,2	57.18	45.74	0.009352	0.005878	----

(1) ONLY AS REQUIRED.

APPENDIX A
4.4 FLOOR

LOCATION	DIRECT ALPHA (dpm/100 CM^2) Max.	Avg.	BETA/GAMMA (MRAD/HR) Max.	Avg.	REMOVABLE ALPHA (1) (dpm/100 CM^2) Max.
400,1	57.18	30.49	0.012024	0.009031	----
400,2	57.18	38.12	0.015764	0.008603	----
401,1	95.30	60.99	0.028590	0.010367	----
401,2	133.42	76.24	0.013894	0.010848	----
400,3	324.02	217.28	0.013092	0.009726	----
400,4	95.30	60.99	0.012558	0.008764	----
401,3	38.12	22.87	0.008283	0.005076	----
401,4	57.18	30.49	0.007481	0.004756	----
400,5	57.18	41.39	0.014696	0.012291	----
400,6	76.24	49.55	0.015497	0.011809	----
401,5	76.24	49.55	0.009619	0.006894	----
401,6	57.18	30.49	0.013894	0.008443	----
400,7	76.24	41.93	0.010955	0.009619	----
400,8	57.18	30.49	0.012291	0.009458	----
401,7	57.18	30.49	0.009886	0.007535	----
401,8	57.18	34.30	0.007481	0.005183	----
400,9	57.18	22.87	0.004542	0.002084	----
400,10	38.12	22.87	0.008283	0.005183	----
401,9	57.18	22.87	0.004275	0.002511	----
401,10	57.18	41.93	0.006947	0.005130	----
400,11	76.24	53.36	0.009886	0.006840	----
400,12	57.18	34.30	0.012024	0.007321	----
401,11	76.24	38.12	0.010153	0.007695	----
401,12	95.30	53.36	0.007214	0.005397	----
400,13	57.18	34.30	0.007214	0.003420	----
400,14	57.18	22.87	0.009084	0.004649	----
401,13	38.12	19.06	0.006412	0.004061	----
401,15	57.18	26.68	0.008550	0.006359	----
400,15	57.18	34.30	0.005334	0.002992	----
400,16	76.24	45.75	0.012558	0.007802	----
400,17	76.24	49.55	0.007214	0.004275	----

(1) ONLY AS REQUIRED.

LUDLUM MODEL 2100-1
CALIBRATION PROCEDURE

Procedure:

Note: Use Ludlum Measurements, Inc. Model 2100 Scaler Ratemeter Instruction Manual, Appendix A, pages 3 through 4. Circuit adjustments to be made by contracted radiation instrument repair personnel. The Model 2100-1 is equipped with two HV supplies, two preamplifiers, two probe connectors, and a selector toggle switch. This feature permits, the instrument panel controls to be adjusted for two different probes and selection of either probe for use may be accomplished with the selector toggle switch without performing panel control adjustments. Both HV supplies and preamplifiers are electronically aligned to provide consistent circuit response with identical adjustments; therefore, selected HV and DISCR settings for a given probe may be used for either HV and preamplifier circuit selected by the toggle switch. Utilize Calibration Record Sheets (pages 3 throuth) as necessary for each type probe.

Probes requiring calibration with the Ludlum Model 2100-1 are:

* MODEL 43-2 Alpha Scintillator (small)

Multiplier Tube: RCA-6199
Scintillator: 1 mg/cm^2 aluminized mylar
Window: 1 mg/cm^2 aluminized mylar
Counting Area: 1-1/2" diameter (11.6 cm^2)
Dimensions: 6-1/2" X 2"
Weight: 14 oz.
Mounted in sample holder drawer.

LUDLUM MODEL 2100-1
CALIBRATION PROCEDURE

*MODEL 43-5 Alpha Scintillator

Multiplier Tube: RCA 6199
Scintillator: ZnS (Ag)
Window: 1 mg/cm^2 aluminized mylar
Counting Area: 50 cm^2 active area
Dimensions: Outside window 7-3/4"
X 2-1/4" Length including handle 15"
Weight: 2 pounds

*MODEL 44-6 Thin Wall GM

Detector: LND 725
Wall Thickness: 30 mg/cm^2 Stainless Steel
Rotary Beta Shield: 1000 mg/cm^2 Stainless Steel
Dimensions: 1-3/16" X 6-1/2"
Efficiency for Radium 1700 CPM per MR/Hr.
Weight: 12 ozs.

*Note: All probes have maximum voltage rating of 0.9 kv.

CALIBRATION RECORD SHEET
FOR LUDLUM MODEL 43-2
(Alpha Scintillator, Sample Counter)

Equipment Identification:

Ludlum Model 2100-1 Serial No. _____
Ludlum Model 43-2 Serial No. _____
Th-230 Alpha Standard Source ID No. _____
Th-230 Alpha Standard Source ID No. _____

Calibrate as follows (applies to either input/amplifier):

1. Adjust DISCR. control as per Appendix A, page 3, under limitation of controls.

2. Follow Appendix A, pages 3 and 4, "DETERMINING INSTRUMENT PLATEAU AND SELECTING OPERATING POINT" (HV Setting not to exceed 900 volts.

   Utilize:
   Figure 1 for plot of background count rate and standard source count rate versus HV Settings.
   Note: Perform 1-minute counts.

3. Indicate selected instrument operating settings on Figure 1.

4. With instrument control settings as per item 3 above, obtain one five-minute scaler count for each item as follows:

   A. Th-230 ID No. _____, Certified activity,
   S_1 = _____ dis/min.

   (1) Five minute background count rate (A)= _____ cnts/5 min.

   (2) Five minute Th-230 std. count rate(B)= _____ cnts/5 min.

   B. Th-230 ID No._____, Certified activity,

   S_2 = _____ dis/min.

   (1) Five minute background count rate(C)= _____ cnts/5 min.

   (2) Five minute Th-230 std. count rate(D)= _____ cnts/5 min.

Note: Handle alpha standard source with tweezers on unplated portion of metal (nothing to touch plated area of source).

FIGURE 1
Plots of Count Rates Verses HV Settings
and Selection of Operating HV
Probe Model No. _____
DISCR Setting (% of Full Clockwise _____
Selected Operating HV Setting _____
HV Meter Reading _____kv

5. Determine Calibration Factor (CF) for each Th-230 standard source.

$$CF_1 = \frac{5\ S_1}{[4.A.\ (2) - 4.A.\ (1)]} \quad \frac{\text{Disintegrations}}{\text{Count}}$$

$$= \frac{5(\qquad)}{[(\qquad) - (\qquad)]} \quad \frac{\text{Disintegrations}}{\text{Count}}$$

$$= \underline{\qquad\qquad\qquad\qquad}. \quad \frac{\text{Disintegrations}}{\text{Count}}$$

$$CF_2 = \frac{5\ S_2}{[4.B.\ (2) - 4.B.\ (1)]} \quad \frac{\text{Disintegrations}}{\text{Count}}$$

$$= \frac{5(\qquad)}{[(\qquad) - (\qquad)]} \quad \frac{\text{Disintegrations}}{\text{Count}}$$

$$= \underline{\qquad\qquad\qquad\qquad} \quad \frac{\text{Disintegrations}}{\text{Count}}$$

6. Determine 2σ limits of each CF

$$\sigma_{CF_1} = CF_1 \frac{(A + B)}{B - A}^{1/2}$$

$$\sigma_{CF_1} = (\qquad) \frac{[(\qquad) + (\qquad)]}{(\qquad) - (\qquad)}^{1/2}$$

$$= (\qquad) \quad \frac{\text{Disintegrations}}{\text{Count}}$$

$$CF_1 + 2\sigma_{CF_1} = (\qquad) + 2\ (\qquad)$$

$$= (\qquad) \quad \frac{\text{Disintegrations}}{\text{Count}}$$

$$CF_1 - 2\sigma_{CF_1} = (\qquad) - 2\ (\qquad)$$

$$= (\qquad) \quad \frac{\text{Disintegrations}}{\text{Count}}$$

$$\sigma_{CF_2} = CF_2 \frac{(C + D)^{1/2}}{D - C}$$

$$\sigma_{CF_2} = (\quad) \frac{[(\quad) + (\quad)]^{1/2}}{(\quad) - (\quad)}$$

$$= (\quad) \frac{\text{Disintegrations}}{\text{Count}}$$

$$CF_2 + 2\sigma_{CF_2} = (\quad) + 2 (\quad)$$

$$= (\quad) \frac{\text{Disintegrations}}{\text{Count}}$$

$$CF_2 - 2\sigma_{CF_2} = (\quad) - 2 (\quad)$$

$$= (\quad) \frac{\text{Disintegrations}}{\text{Count}}$$

Derivation of σ_{CF}

$$\frac{\text{Var CF}}{CF^2} = \frac{\text{Var A + Var B}}{(B - A)^2}$$

$$\sigma_{CF} = CF \frac{(\text{Var A + Var B})^{1/2}}{B - A} = CF \frac{(A + B)^{1/2}}{B - A}$$

7. Determine average Calibration Factor ($\overline{CF}$) and 2σ limits

$$\overline{CF} = \frac{CF_1 - CF_2}{2} \qquad \frac{\text{Disintegrations}}{\text{Count}}$$

$$= \frac{(\quad) - (\quad)}{2}$$

$$= \underline{\qquad\qquad\qquad} \quad \frac{\text{Disintegrations}}{\text{Count}}$$

$$\overline{CF} + 2\sigma = \frac{(CF_1 + 2\sigma_{CF_1}) + (CF_2 + 2\sigma_{CF_2})}{2} \quad \frac{\text{Disintegrations}}{\text{Count}}$$

$$= \frac{(\qquad) + (\qquad)}{2} \quad \frac{\text{Disintegrations}}{\text{Count}}$$

$$= \underline{\qquad\qquad} \quad \frac{\text{Disintegrations}}{\text{Count}}$$

8. Assure that calibrated response is within ±10% of the calculated expected response for the two alpha standard sources as follows:

$$(0.9)(S_1 - 2\sqrt{S_1}) \leq [\frac{B - A}{5}]CF_1 \leq (1.1)(S_1 + 2\sqrt{S_1})$$

$$(\quad)[(\quad) - 2(\quad)] \leq [\frac{(\quad) - (\quad)}{5}](\quad) \leq (1.1)[(\quad) + 2(\quad)]$$

$$\underline{\qquad\qquad} \leq \underline{\qquad\qquad} \leq \underline{\qquad\qquad}$$

$$(0.9)(S_2 - 2\sqrt{S_2}) \leq [\frac{D - C}{5}]CF_2 \leq (1.1)(S_2 + 2\sqrt{S_2})$$

$$(\quad)[(\quad) - 2(\quad)] \leq [\frac{(\quad) - (\quad)}{5}](\quad) \leq (1.1)[(\quad) + 2(\quad)]$$

$$\underline{\qquad\qquad} \leq \underline{\qquad\qquad} \leq \underline{\qquad\qquad}$$

9. Complete "Instrument Calibration" sticker with the following information for the average CF and 2σ limits:

Calib. Date: _____ Calib. Due Date: _____

Instrument ID: Ludlum Model 2100-1

DISCR: _____% of Full Clockwise Movement

HV Setting _____

$CF =$ _____ $\frac{\text{dis.}}{\text{cnt.}}$

_____ $\leq CF \leq$ _____ $\frac{\text{dis.}}{\text{cnt.}}$

Initials _____

10. Apply "Instrument Calibration" sticker to sample counter housing.

11. Document calibration below and file completed "Calibration Record Sheets" in N.S. Record File number N.S. 3.2.3.2.3.

Signature _____

Date of Calibration _____

CALIBRATION RECORD SHEET
FOR LUDLUM MODEL 44-6
(Thin Wall GM)

Equipment Identification:

Ludlum Model 2100-1 Serial No. _____
Ludlum Model 44-6 Serial No. _____
Cs-137 Standard Source ID No. _____

Calibrate as follows (applies to either input/amplifier):

1. Follow Appendix A, Section VI, pages 3 and 4, "DETERMINING INSTRUMENT PLATEAU AND SELECTING OPERATING POINT")HV Setting not to exceed).

   Note: Adjust DISCR control as per Appendix A, page 3, under limitation of controls (counter clockwise until scaler double counting ceases).

2. Indicate selected instrument operating settings on Figure 2.

3. With instrument settings of item 2 above, position Cs-137 standard source at varying distances from probe to obtain count rate meter responses tabulated in Table 2 and complete required information of Table 2.

TABLE 2
Meter Response Record

A	B	C	D	E
"Range" Position	"Rate" Meter Response cnts/min.	Cs-137 Distance To Probe (inches)	One Minute Scaler Count Result (cnts/min.)	Ratio of Meter Response To Scaler Result (Col. B/Col. D)
X 1	100 400			
X 10	1000 3850			
X 100	10000 40000			
X 1K	100000 400000			

4. Assure that ratios recorded in Col. E of Table 2 have values between 0.9 and 1.1.

FIGURE 2
Plots of Count Rates Versus HV Settings
and Selection of Operating HV
Prob Model No. _____
DISCR Setting (% of Full Clockwise) _____.
Selected Operating HV Setting _____,
HV Meter Reading _____kv

5. Obtain dose-rate calibration data as follows:

   a. With ^{137}Cs standard source shielded or removed from probe, record instrument/probe scaler background count.

      Background count rate, (A) = _____ cnts/min.

   b. With ^{137}Cs standard source at 7 inches from center line of probe, record instrument/probe scaler count.

      ^{137}Cs standard source count rate at 7 inches, (B) = _____ cnts/min.

      Ci of ^{137}Cs standard (Ci).

6. Determine Calibration Factor (CF) and $2\sigma_{CF}$ limits

$$CF = \frac{(10439)(\text{Ci of } ^{137}Cs \text{ Standard})}{B - A}$$

$$CF = \frac{10439\ (\quad)}{(\quad)-(\quad)} = (\quad)\frac{mR/hr}{cnts/min.}$$

$$\sigma_{CF} = CF\ \frac{(A + B)^{1/2}}{B - A}$$

$$= (\quad)\frac{[(\quad) + (\quad)]^{1/2}}{(\quad) - (\quad)}$$

$$= (\quad)\ \frac{mR/hr}{cnts/min.}$$

$$CF + 2\sigma_{CF} = (\quad) + 2\ (\quad)$$

$$= (\quad)\ \frac{mR/hr}{cnts/min.}$$

$$CF - 2\sigma_{CF} = (\quad) - 2\ (\quad)$$

$$= (\quad)\ \frac{mR/hr}{cnts/min.}$$

Derivation of σ_{CF}

$$\frac{\text{Var CF}}{(CF)^2} = \frac{\text{Var A} + \text{Var B}}{(B - A)^2}$$

$$\sigma_{CF} = CF\ \frac{(\text{Var A} + \text{Var B})^{1/2}}{B - A} = CF\frac{(A + B)^{1/2}}{B - A}$$

7. Complete "Instrument Calibration" sticker with the following information.

   Calib. Date: _____ Calib. Due Date: _____

   Instrument ID Ludlum Model 2100-1

   DISCR: _____% of full clockwise movement.

   HV Setting: _____

   CF = _____ $\frac{\text{mR/hr}}{\text{cnts/min.}}$

   _____ $\leq$ CF $\leq$ _____ $\frac{\text{mR/hr}}{\text{cnts/min.}}$

   Initials: _____

8. Apply "Instrument Calibration" sticker to probe.

9. Document calibration below and file completed "Calibration Record Sheets" in N.S. Record File number N.S. 3.2.3.2.3

   Signature: _____

   Date of Calibration: _____

For CS-137 (cesuim-137):

The gamma radiation level (Γ) for a certain source strength will be:

$$\frac{\Gamma}{10} = \text{R/hr at 1m/Ci}$$

Where Γ - gamma radiation level
R - Rad. (measure of absorded dose x Quality Factor = Rem)
C - activity of radiation source (Cs-137)

From Radiological Health Handbook Page 131.

Γ = 3.3 R/hr. at 1m/Ci therefore, $\frac{\Gamma}{10}$ = 330 mR/hr. -Ci at 1 meter.

At 7" then,

$$F = (330 \text{ mR/hr -Ci})\left(\frac{100 \text{ cm}}{7" \times 2.54 \frac{\text{cm}}{\text{inch}}}\right)^2 = (10{,}439 \text{ mR/hr -Ci})$$

Where F = gamma radiation field at 7" from source.

CALIBRATION RECORD SHEET
FOR LUDLUM MODEL 43-5
(Alpha Scintillator, Survey Probe)

Equipment Identification:

Ludlum Model 2100-1 Serial No. _____
Ludlum Model 43-5 Serial No. _____
Th-230 Alpha standard source ID No. _____

Calibrate as follows:

1. Adjust DISCR control as per Appendix A, page 3, Section V, under limitation of controls.

2. Follow Appendix A, pages 3 and 4, "DETERMINING INSTRUMENT PLATEAU AND SELECTING OPERATING POINT" (HV setting not to exceed .

   Utilize:

   Figure 3 for plot of background count rate and standard source count rate versus HV settings.

3. Indicate selected instrument operating settings on Figure 3.

4. With instrument control settings as per item 3 above, obtain one minute scaler counts for required items as follows with each standard source located at three different locations on probe face (far end, middle, near end)*.

   A. Th-230 ID No. _____, Certified activity,

   S_1 = _____dis/min.

   (1) Background count rate (no source) _____ cnts/min.

   (2) Th-230 source at far end of probe count rate _____cnts/min.

   (3) Background count rate (no source) _____ cnts/min.

   (4) Th-230 source at middle of probe count rate _____cnts/min.

   (5) Background count rate (no source) _____ cnts/min.

   (6) Th-230 source at near end of probe count rate _____cnts/min.

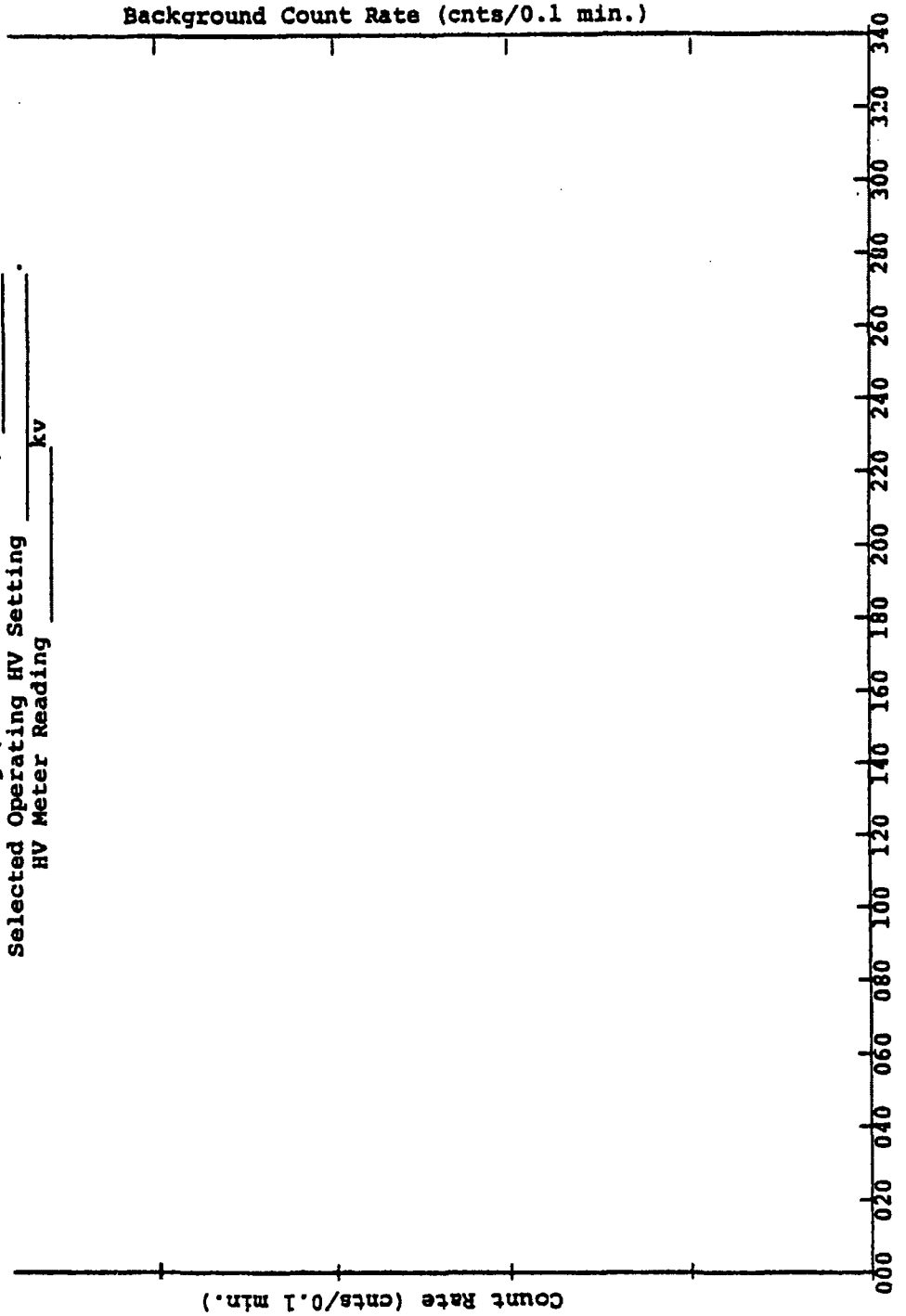


FIGURE 3
Plots of Count Rates Versus HV Settings and Selection of Operating HV

Probe Model No. _____

DISCR Setting (% of Full Clockwise) _____.

Selected Operating HV Setting _____kv

HV Meter Reading _____

Standard Source Activity _____ (uCi or dis/min)

B. Th-230 Id. No. _____, Certified activity, S_2 = _____ dis/min.

(1) Background count rate (no source) _____cnts/min.

(2) Th-230 source at far end of probe count rate _____cnts/min.

(3) Background count rate (no source) _____cnts/min.

(4) Th-230 source at middle of probe count rate _____cnts/min.

(5) Background count rate (no source) _____cnts/min.

(6) Th-230 source at near end of probe count rate _____cnts/min.

5. Sum 4.A.(2)_____cnts/min. 4.B.(2)_____cnts/min.
4.A.(4)_____cnts/min. 4.B.(4)_____cnts/min.
4.A.(6)_____cnts/min. 4.B.(6)_____cnts/min.
X_{1c}_____cnts/3 min. X_{2c}_____cnts/3 min.

6. Sum 4.A.(1)_____cnts/min. 4.B.(1)_____cnts/min.
4.A.(3)_____cnts/min. 4.B.(3)_____cnts/min.
4.A.(5)_____cnts/min. 4.B.(5)_____cnts/min.
X_{1b}_____cnts/3 min. X_{2b}_____cnts/ 3 min.

7. Determine average net counts of probe for alpha standard source S_1, $\bar{X}_{s1}$, and alpha standard source S_2, $\bar{X}_{s2}$ as:

$$\bar{X}_{s1} = \frac{(X_{1c} - X_{1b})}{3}$$

$$= \frac{(\quad)-(\quad)}{3} = \quad \text{cnts/min.}$$

$$\bar{X}_{s2} = \frac{(X_{2c} - X_{1b})}{3}$$

$$= \frac{(\quad)-(\quad)}{3} = \quad \text{cnts/min.}$$

8. Determine calibration factors (CF) and 2σ limits of probe (compensating for 50 cm^2 active probe area to 100 cm^2 reporting area) for 4π activity.

$$\underline{CF_1} = \frac{2S_1}{\bar{X}_{s_1}} = \frac{2(\quad)}{(\quad)} = (\quad) \ \frac{\text{Disintegrations}}{\text{cnt - 100 cm}^2}$$

$$\sigma_{CF_1} = \frac{CF_1}{(\bar{X}_{s_1})} = \frac{(\quad)}{(\quad)} = (\quad) \ \frac{\text{Disintegrations}}{\text{cnt - 100 cm}^2}$$

$$CF_1 + 2\sigma_{CF_1} = (\quad) + 2 (\quad)$$

$$= (\quad) \ \frac{\text{Disintegrations}}{\text{cnt - 100 cm}^2}$$

$$CF_1 - 2\sigma_{CF_1} = (\quad) - 2 (\quad)$$

$$= (\quad) \ \frac{\text{Disintegrations}}{\text{cnt - 100 cm}^2}$$

$$\underline{CF_2} = \frac{2S_2}{\bar{X}_{s_2}} = \frac{2(\quad)}{(\quad)} = (\quad) \ \frac{\text{Disintegrations}}{\text{cnt - 100 cm}^2}$$

$$\sigma_{CF_2} = \frac{CF_2}{(\bar{X}_{s_1})} = \frac{(\quad)}{(\quad)} = (\quad) \ \frac{\text{Disintegrations}}{\text{cnt - 100 cm}^2}$$

$$CF_2 + 2\sigma_{CF_2} = (\quad) + 2 (\quad)$$

$$= (\quad) \ \frac{\text{Disintegrations}}{\text{cnt - 100 cm}^2}$$

Derivation of σ_{CF}

$$\frac{\text{Var } CF}{CF^2} = \frac{\text{Var } \bar{X}_s}{(\bar{X}_s)^2}$$

$$\sigma_{CF} = CF \frac{(X_s)}{(\bar{X}_s)^2} = \frac{CF}{(\bar{X}_s)} \qquad 100.$$

9. Assure that calibrated response is within ±10% of the calculated expected response for the two alpha standard sources as follows:

$$(0.9)(S_1 - 2\sqrt{S_1}) \leq (\bar{X}_{s1})(CF_1) \leq (1.1)(S_1 + 2\sqrt{S_1})$$

$$(0.9)[(\quad) - 2\sqrt{(\quad)}] \leq (\quad)(\quad) \leq$$

$$(1.1)[(\quad) + 2\sqrt{(\quad)}]$$

$$\underline{\qquad} \leq \underline{\qquad} \leq \underline{\qquad}$$

$$(0.9)(S_2 - 2\sqrt{S_2}) \leq (\bar{X}_{s2})(CF_2) \leq (1.1)(S_2 + 2\sqrt{S_2})$$

$$(0.9)[(\quad) - 2\sqrt{(\quad)}] \leq (\quad)(\quad) \leq$$

$$(1.1)[(\quad) + 2\sqrt{\qquad}]$$

$$\underline{\qquad} \leq \underline{\qquad} \leq \underline{\qquad}$$

10. Determine average CF and 2 limits as:

$$CF = \frac{CF_1 + CF_2}{2} \quad \frac{\text{Disintegrations}}{\text{cnt - 100 cm}^2}$$

$$= \frac{(\quad) + (\quad)}{2}$$

$$= \underline{\qquad} \quad \frac{\text{Disintegrations}}{\text{cnt - 100 cm}^2}$$

$$CF + 2 = \frac{(CF_1 + 2_{CF_1}) + (CF_2 + 2\,CF_2}{2} \quad \frac{\text{Disintegrations}}{\text{cnt - 100 cm}^2}$$

$$= \frac{(\quad) + (\quad)}{2}$$

$$= \underline{\qquad} \quad \frac{\text{Disintegrations}}{\text{cnt - 100 cm}^2}$$

10. (Cont) $CF - 2\sigma = \frac{(CF_1 - 2\sigma_{CF_1}) + (CF_2 - 2\sigma_{CF_2})}{2}$ $\frac{\text{Disintegrations}}{\text{cnt} - 100\ \text{cm}^2}$

$= \frac{(\qquad) + (\qquad)}{2}$

$= \underline{\qquad\qquad\qquad}$ $\frac{\text{Disintegrations}}{\text{cnt} - 100\ \text{cm}^2}$

11. Complete "Instrument Calibration" sticker with the following information for the average CF and 2σ limits:

Calib. date: _____ Calib. due date: _____

Instrument ID: Ludlum Model 2100-1

DISCR: _____% of full clockwise movement

HV Setting: _____

CF = _____ $\frac{\text{Disintegrations}}{\text{cnt} - 100\ \text{cm}^2}$

_____ ≤ CF ≤ _____ $\frac{\text{Disintegrations}}{\text{cnt} - 100\ \text{cm}^2}$

Signature: _____

Date of Calibration: _____

INSTRUCTION MANUAL

MODEL 2100

SCALER RATEMETER

GENERAL:

The Model 2100 provides all electronic circuitry required for scintillation, proportional, or GM detectors. The unit may be operated from four flashlight batteries or line power.

PREPARING FOR OPERATION:

BATTERY OPERATION:

1. Slide battery lid knob down, open lid (at rear of instrument) and place four "D" cells in instrument; two in, two out. Note polarity on battery door.

2. Turn power switch to BAT. Press red BAT button to test batteries. A down scale reading indicates batteries in backward.

3. Read detector operating point section to set up detector.

RECHARGEABLE BATTERY OPERATION:

1. Place batteries in instrument as noted above. Turn power switch to BAT. Press BAT test button to insure batteries are installed with proper polarity.

2. Connect instrument to line power. Turn selector switch to CHG. Allow batteries to charge 24 hours (or longer if desired).

3. Upon completion of the charge, turn power switch to BAT and proceed.

LINE OPERATION:

Connect instrument to line power of 115 volts 50-60 Hz. Turn power switch to LINE and proceed to use the instrument.

NOTE: With the instrument on line power, a small trickle charge is connected to the battery pack to maintain a high state of charge.

NOTE ON BATTERY LIFE:

Battery life is a function of lamp illumination level and H.V. Power supply loading. With all digits on 888888, maximum brightness and the power supply set at 1000 volts, four new Ray-O-Vac "C" cells purchased at a local supermarket exhibited a useful battery life of 2 hours. With the instrument off for 4 hours, the batteries recovered enough for some additional usage.

Under the same conditions as above, only with the dimmer control set for "just barely readable" 20 hours of battery life can be obtained.

Turning the lamps off except when reading will result in significant increase in battery life to an excess of 50 hours.

For normal operation, with the lamps at half brightness and reasonable discipline in keeping a minimum number of digits on, battery life of 20 - 30 hours can be realized.

DESCRIPTION OF CONTROLS:

COUNT SWITCH: Depress this switch to reset scaler and timer. Note that count lamp (not labeled) is on while scaler is counting. Count lamp turns off at end of preset time.

HOLD SWITCH: Depress this switch to manually stop scaler count.

DIM: Lamp illumination control. Turn to minimum brightness for maximum battery life.

RESP.: Toggle Switch labeled F-S. Set on F for fast response and large meter deviation. Set on S for slow response and damped meter deviation.

RANGE SWITCH: Four position switch labeled 1K; 100; 10; 1. This control is used to select the ratemeter counting range. Multiply this reading by the meter reading for proper count rate.

RATEMETER CALIBRATION CONTROLS: 4 subsurface controls labeled 1, 10, 100, 1K utilized to calibrate the ratemeter. Each control is independent.

H.V.: A ten turn control for adjusting detector high voltage.

MINUTES: Two decade thumb switch utilized to set preset time.

1 - 0.1: Toggle switch utilized to set the time base of the thumb switch at 1 minute or 0.1 minute.

POWER SWITCH: Four position control utilized to select battery charge, line operation or battery operation.

H.V.: Push button switch. Depress to read high voltage output.

BAT: Push button switch. Depress to read battery voltage.

DISCR: A one turn control utilized to set detector discrimination.

FUSE: At rear of instrument. Replace with 3AG Type, 1 amp.

LINE CORD: Hubble #7484 twist lock.

CABLE CONNECTOR: Series SHV connector for H.V. connection to remote preamp.

INTERNAL CONTROLS: The clock time and temperature calibration controls are internally located.

REMOTE CONNECTOR: This connector on the front panel provides B+, signal transmission, and ground to and from the remote preamplifier through pins A, B, and D, respectively.

RECORDER CONNECTOR: This connector on the rear panel provides output for 0-10MV recorder through pins C(+) and E(-).

MODEL 2100 - SCALER RATEMETER OPERATION OF INSTRUMENT

1. Select either line or battery operation with power switch.

2. Press COUNT, press HOLD. (This resets and stops the scaler)

3. Turn DISCR clockwise, back off 1/4 turn.

OPERATING POINT:

Instrument and detector operating point is established by setting the probe voltage (HV) and instrument sensitivity (Discriminator). For a given detector system, efficiency, background and noise are fixed by the physical make-up of the detector and rarely vary from unit to unit. However, the selection of the operating point makes a marked difference in the apparent contribution of these three sources of count.

In the singular case of the GM detector, a minimum operating voltage is required to establish the GM operating region. (At lower voltages, the detector operates as a very insensitive proportional counter). This detector is not capable of energy discrimination (pulse height discrimination).

For gain sensitive detectors (proportional or scintillation), the most straightforward method of selecting the operating point is to develop a graph relating count rate to system gain. This relationship is commonly referred to as a plateau or instrument plateau curve. System gain may be changed by adjusting detector high voltage, or discriminator.

LIMITATION OF CONTROLS:

H.V. Control: The high voltage control provides a linear adjustment of the detector voltage supply. The range is approximately 200 to 2400 volts thru the full potentiometer. Changing the detector voltage will cause the detector gain to change. It should be remembered that a linear change in voltage will cause an exponential change in detector gain.

DISCRIMINATOR: The gain control is a non-indicating control, allowing a wide selection of operating point without exceeding the linear ranges of the amplifier. Maximum amplifier sensitivity occurs at maximum clockwise setting. For proportional and scintillation detectors, set this control fully clockwise.

For GM detectors, set this control counter clockwise to insure that the 2100 does not double pulse. Check this by observing the scaler while counting at a very low rate. The scaler count will advance by two counts per pulse in the double pulse region.

DETERMING INSTRUMENT PLATEAU AND SELECTING OPERATING POINT:

1. Set X0.1-X1 to X0.1 and Minutes to 01. This gives a 1/10 minute count.

2. Set DISCR as indicated before.

DISTRIBUTION LIST:

NRC

8 copies to R. G. Page

1 copy to J. Roth

TI

1 copy to R. Churchill

1 copy to W. Goetz

1 copy to R. Murrill-Dallas

1 copy to T. Snyder

1 copy to File

DETERMINING INSTRUMENT PLATEAU AND SELECTING OPERATING POINT: Cont'd

3. With detector shielded from source, turn up high voltage control in relatively large increments (1/2 turn at a time), and take a plot of HV position versus count rate until the detector voltage rating (or obvious breakdown) is reached. Return contol to 0.0.

4. Expose detector to source and again make a plot of voltage versus count.

5. Plot both sets of data and select the operating point to correspond with maximum source count and minimum background count. Always try for center of "plateau" setting and avoid areas of very fast count rate changes with small changes in detector voltage.

6. Record H.V. control setting, or check and record H. V. meter setting.

CALIBRATION

COUNT RATE METER:

Connect instrument to a pulser. Set time to 1.0 minute and count incoming pulse rate in the range of 300 to 450 counts per minute. Set range switch to 1 and adjust subsurface control labeled "1" so that rate meter corresponds to scaler reading. Repeat for each scale.

CLOCK:

Refer to clock board section.

NOTE: This instrument is supplied with a charge sensitive preamplifier. In that most pulsers have a variation in output impedance with changes in pulse height, place a 10,000 ohm resistor in series with the pulser output. This will convert the pulser from a voltage output to a current output and will allow linear operation with the Model 2100.

APPENDIX B

5.2 RADIATION INSTRUMENTS CALIBRATION STICKER

Calib. Date: _____ Calib Due Date: _____

Instrument ID: _____

DISCR: _____ % of Full Clockwise Movement

HV Setting _____ WINDOW Setting _____ -Off

THRESHOLD Setting _____ CF = _____

_____ ≤ CF ≤ _____

Initials _____

APPENDIX B

(1)
5.3 RADIATION INSTRUMENTS CALIBRATION DATES

INSTRUMENTS	PROBE		
	MODEL 43-2 SERIAL NO. 146 (ALPHA)	MODEL 44-9 SERIAL NO. PR2351 (BETA/GAMMA)	MODEL 43-5 SERIAL NO. PR2242 (ALPHA)
LUDLUM SCALER RATE METER MODEL 2100-1 SERIAL NO. 10175	9-25-82		
LUDLUM SCALER RATE METER MODEL 2200 SERIAL NO. 10647			9-25-82
LUDLUM SCALER RATE METER MODEL 2200 SERIAL NO. 17462		9-25-82	

(1) During Decommissioning

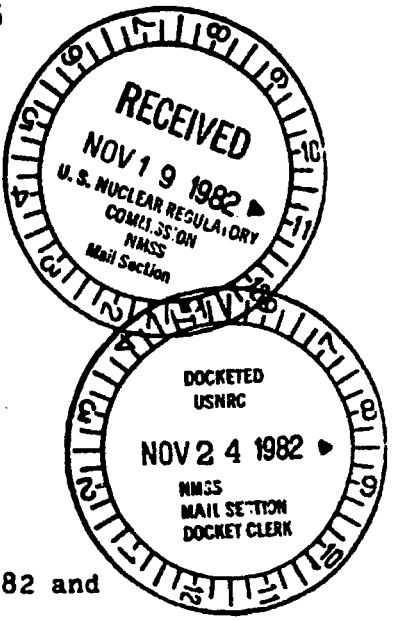
Table 2 Summary of SGNH modifications implemented at all W and CE operating plants

Operating Plants	J-Tubes on Feedring	Early Feedwater Flow into SG	Short Horizontal Feedwater Pipe at SG Inlet	Limited Flow to Recover Feedring	Other (See Remarks)	Test Conducted	References	Remarks
1. Arkansas 2	x	x	x			x	13,14	
2. Beaver Valley 1	x	x	x				16	
3. Calvert Cliffs 1	x	x		x	x		17,18	Separate auxiliary feedring
4. Calvert Cliffs 2	x	x		x	x		17,18	Same as Unit 1
5. Cook 1	x	x	x	x			20,22	
6. Cook 2	x	x	x	x		x	20,22	
7. Farley 1	x	x	x			x	23	
8. Farley 2	x	x	x				23	
9. Ft. Calhoun		x	x		x		24	Separate auxiliary feedwater injection nozzle
10. Ginna	x	x	x	x			25	
11. Haddam Neck			x		x		26	Slow change of feedwater flowrate
12. Indian Point 2	x	x	x	x		x	27	
13. Indian Point 3	x	x	x				28	
14. Kewaunee		x			x		29	Proximity of auxiliary feedwater injection point from SG
15. Maine Yankee			x				30	
16. McGuire 1			x		x	x	31,32,33	W preheat SG using injection nozzles
17. Millstone Point 2	x	x	x			x	33,34	
18. North Anna 1	x	x	x			x	35,37	
19. North Anna 2	x	x	x			x	35,37	
20. Palisades*				x	x		38,39	Separate auxiliary feedwater line, tests yet to be conducted
21. Point Beach 1		x	x	x	x		40	See Kewaunee
22. Point Beach 2		x	x	x	x		40	See Kewaunee
23. Prairie Island 1		x	x	x	x		41	See Kewaunee
24. Prairie Island 2		x		x	x		41	See Kewaunee
25. Robinson 2			x		x		42	400 gpm per SG for steam line break
26. St. Lucie 1	x	x	x			x	43,44	
27. Salem 1	x	x	x	x			45,46	
28. Salem 2	x	x	x			x	46,47	
29. San Onofre 1			x		x		48	Main feedwater is used whenever possible
30. Sequoyah 1	x	x	x			x	49-51	
31. Surry 1	x	x	x				52	
32. Surry 2	x	x	x				52	
33. Trojan	x	x	x			x	53,54	
34. Turkey Point 3			x				55	
35. Turkey Point 4			x				55	
36. Yankee-Rowe			x		x		56	Main feedwater is preheated even at low power operations
37. Zion 1*	x	x	x	x		x	57	One SG feedring is yet to have J-tubes installed
38. Zion 2	x	x	x	x			57	

* Implementation is yet to be completed (per Remarks).

70-33
PDR
Return to
3965S

TEXAS INSTRUMENTS
INCORPORATED
ATTLEBORO, MASSACHUSETTS 02703
Metallurgical Materials Division



November 2, 1982

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

Attention: Mr. R.G. Page, Chief
Uranium Fuel Licensing Branch
Division of Fuel Cycle & Material
Safety, M SS

Reference: NRC License SNM-23
Texas Instruments Incorporated
Letters dated May 15, 1982, June 24, 1982 and
July 9, 1982

Gentlemen:

Please find enclosed eight copies of "Request for Termination of Nuclear Regulatory Commission License SNM-23, Ammendment 1" dated November 2, 1982.

This submittal is being made to:

Support the request for termination of NRC License SNM-23 as presented in Texas Instruments Inborporated (TI) letters listed by reference.

Present measurements of radioactivity demonstrating that areas of Buildings 3, 4, and 10 used many years previously for radioactive material processing at the TI Attleboro site conform to NRC requirements for release for general use.

Present instrument calibration procedures and instrument calibration dates that demonstrate that the measurements are reliable.

TI selected the floors of areas identified as processing unclad materials for these measurements because floors represent the worst condition for holding residual radioactivity. The low resultant readings demonstrate that no other associated areas will have residual radioactivity.

FEE EXEMPT

Texas Instruments Incorporated requests that the NRC review the presented information and proceed with the full release of building interiors under the license termination process.

If you desire any additional information, please feel free to call R.L. Churchill, Dr. R.J. Schwensfier, Jr., or me.

Very truly yours,

F.L. Sherman

F.L. Sherman
Manager, HFIR Project
FLS:sjh

R.J. Schwensfier, Jr.

Dr. R.J. Schwensfier, Jr.
Manager, Nuclear Safety & Nuclear Materials

16 FEB 1982

Docket No. 70-33

Texas Instruments Incorporated
ATTN. Mr. William K. Goetz
Manufacturing Manager,
Metal Systems Department
34 Forest Street
Attleboro, Massachusetts 02703

Gentlemen:

Subject: Inspection No. 70-33/81-11

This refers to the routine safety inspection conducted by Mr. P. Clemons of this office on December 22-23, 1981 of activities authorized by NRC License No. SNM-23 and to the discussions of our findings held by Mr. Clemons with Mr. Sherman and Dr. Schwensfeir of your staff at the conclusion of the inspection.

Areas examined during this inspection are described in the Office of Inspection and Enforcement Inspection Report which is enclosed with this letter. Within these areas, the inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations by the inspector.

Within the scope of this inspection, no items of noncompliance were observed.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosed inspection report will be placed in the NRC's Public Document Room. If this report contains any information that you (or your contractors) believe to be exempt from disclosure under 10 CFR 9.5(a)(4), it is necessary that you (a) notify this office by telephone within ten (10) days from the date of this letter of your intention to file a request for withholding; and (b) submit within 25 days from the date of this letter a written application to this office to withhold such information. Consistent with section 2.790(b)(1), any such application must be accompanied by an affidavit executed by the owner of the information which identifies the document or part sought to be withheld, and which contains a full statement of the reasons on the basis which it is claimed that the information should be withheld from public disclosure. This section further requires the statement to address with specificity the considerations listed in 10 CFR 2.790(b)(4). The information sought to be withheld shall be incorporated as far as possible into a separate part of the affidavit. If we do not hear from you in this regard within the specified periods noted above, the report will be placed in the Public Document Room. The telephone notification of your intent to request withholding, or

RI:DETI	RI:DETI	RI:DETI	RI:DETI
Clemons/gwc	Knapp	Joyner	Martin
2/3/82 2/5/82	2/5/82	2/14/82	

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any request for an extension of the 10 day period which you believe necessary, should be made to the Supervisor, Files, Mail and Records, USNRC Region I, at (215) 337-5223.

Your cooperation with us in this matter is appreciated.

Sincerely,

for Thomas T. Martin, Director
Division of Engineering and Technical
Inspection

Enclosure: Office of Inspection and Enforcement Inspection
Report Number 70-33/81-11

cc w/encl:
W. Quimby, Assistant Vice President and Manager,
Metallurgical Materials Division
F. L. Sherman, Manager, HFIR Project
Public Document Room (PDR)
Local Public Document Room (LPDR)
Nuclear Safety Information
Commonwealth of Massachusetts (2)

bcc w/encl:
Region I Docket Room (with concurrences)
Chief, Operational Support Section (w/o encl)
Director, Division of Resident and Project Inspection

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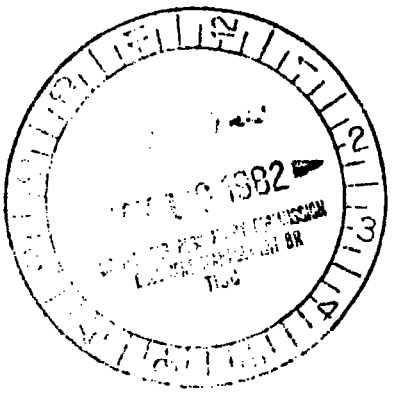
APR 26 1982

Docket No. 70-33



Texas Instruments Incorporated
ATTN: Mr. William K. Goetz
Manufacturing Manager,
Metal Systems Department
34 Forest Street
Attleboro, Massachusetts 02703

Gentlemen:

Subject: Inspection No. 70-33/82-01

This refers to the routine safety inspection conducted by Mr. J. Roth of this office on April 13-14, 1982 of activities authorized by NRC License No. SNM-23 and to the discussions of our findings held by Mr. J. Roth with Mr. R. L. Churchill and other members of your staff at the conclusion of the inspection.

Areas examined during this inspection are described in the NRC Region I Inspection Report which is enclosed with this letter. Within these areas, the inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations by the inspector.

Within the scope of this inspection, no violations were observed.

In accordance with 10 CFR 2.790(a), a copy of this letter and the enclosure will be placed in the NRC Public Document Room unless you notify this office, by telephone, within ten days of the date of this letter and submit written application to withhold information contained therein within thirty days of the date of this letter. Such application must be consistent with the requirements of 2.790(b)(1). The telephone notification of your intent to request withholding, or any request for an extension of the 10 day period which you believe necessary, should be made to the Supervisor, Files, Mail and Records, USNRC Region I, at (215) 337-5223.

No reply to this letter is required. Your cooperation with us in this matter is appreciated.

Sincerely,
Original Signed By:

R. R. Keimig for

Richard W. Starostecki, Director,
Division of Project and Resident
Programs

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cc w/encl:
W. Quimby, Assistant Vice President and Manager,
Metallurgical Materials Division
F. L. Sherman, Manager, HFIR Project
Public Document Room (PDR)
Local Public Document Room (LPDR)
Nuclear Safety Information
Commonwealth of Massachusetts (2)

bcc w/encl:
Region I Docket Room (with concurrences)
Chief, Operational Support Section (w/o encls)
N. Ketzlach NRC-NMSS

RI:DETP	RI:DETP	RI:DETP	RI:DETP
Roth:as	Jang	Kelmig	Starostecki
4/23/82	4/26/82	4-26-82	4-26-82

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U.S. NUCLEAR REGULATORY COMMISSION

REGION I

Report No. 70-33/82-01

Docket No. 70-33

License No. SNM-23 Priority 1 Category UR

Licensee: Texas Instruments Incorporated

34 Forest Street

Attleboro, Massachusetts 02702

Facility Name: HFIR Project

Inspection at: Attleboro, Massachusetts

Inspection conducted: April 13-14 1982

Inspector: J. Roth 4/23/82

J. Roth, Project Inspector — date signed

J. Jang 4/26/82

J. Jang, Radiation Specialist — date signed

date signed

date signed

Approved by: R. Keimig 4-26-82

R. R. Keimig, Chief, Project Branch #2, DPRP — date signed

Inspection Summary:

Inspection on April 13-14 1982 (Report No. 70-33/82-01)

Areas Inspected: Routine, unannounced inspection by two region-based inspectors (21 hrs.) of: organization; Part 21; facility changes and modifications; internal review and audit; training; review of operations; environmental evaluations; transportation activities; and, licensee action on previously identified enforcement items.

Results: No violations were identified.

Region I Form 12
(Rev. April 77)

DETAILS

1. Persons Contacted

*R. L. Churchill, Program Manager, Metal Systems Department
*F. L. Sherman, Manager, HFIR Project
*F. J. Veale, Jr., Manager, Environmental Engineering
*R. J. Schwensfeir, Manager, Nuclear Safety and Nuclear Material Control

The inspector also interviewed 7 other licensee employees during this inspection.

* denotes those present at the exit interview.

2. Licensee Action on Previously Identified Enforcement Items

(Closed) Unresolved (33/78-10-04) Compensating for a design weakness in the alarm annunciator panel. The inspector verified that as a result of the decontamination and decommissioning activities at this facility, the annunciator panel referred to has been removed from the facility. No additional actions are required to resolve this item.

3. Organization

The inspector verified through discussions with licensee representatives that the staff had been reduced to a total of 8. Reporting to F. L. Sherman, Manager, HFIR Project are:

R. J. Schwensfeir, Manager, Nuclear Safety and Nuclear Material Control
H. Ortelt, Nuclear Material Control Representative
D. Collins, Engineering
W. Daft, Group Leader
G. Araugio, Operator
K. Rogers, Operator
J. Lecuelli, Operator

The staff indicated above will complete the decommissioning activities at this facility.

No violations were identified.

4. Facility Examination

The inspector examined the facility to observe operations in progress and to determine the extent to which facility decommissioning had progressed.

The inspector observed that all walls within the HFIR Project boundary had been removed and packaged for burial. All equipment with the exception of the waste water boildown unit and the waste barrel counter had been removed. The surface of the concrete floor had been removed to a depth of about 0.25 inches in those areas where contamination was suspected. All remaining walls and the ceilings have been high pressure steam cleaned. The licensee dug out portions of the facility floor where contamination in cracks occurred. All sealed floor drains in the area have been opened and the licensee was in the process of probing the drain lines to assure that they were not contaminated. The licensee was also in the process of surveying the facility floor, walls and ceiling for radioactive contamination. In addition, paint samples were taken from painted surfaces and analyzed to assure that the surfaces had not been repainted to cover previously contaminated areas.

The inspector discussed, with licensee representatives, the content and format of the facility decontamination and decommissioning survey report which must be submitted to NRC-NMSS along with the request to terminate the facility license.

No violations were identified.

5. Environmental Evaluations

Discussions were held with licensee representatives concerning the status of programs being conducted to characterize the extent, distribution and type of radioactivity found in a 10CFR20.304 burial site located in a lawn area approximately 100 yards north-northeast of Building 11. The licensee originally installed monitoring wells to a maximum depth of 10 feet at a distance of no closer than 50 feet to the perimeter of the burial site. Since the last inspection, the licensee installed additional wells around the burial site at a distance of about 100 feet from the original line of wells.

The inspector stated that the environmental evaluation of this site and any other suspect sites must also be incorporated into the final facility decontamination and decommissioning survey report. Subsequent to these discussions, the inspectors examined the burial site area and were shown the location of several of the new wells.

No violations were identified.

6. 10 CFR Part 21

The inspector verified that the licensee had posted the notices and information required by 10CFR21.6 and had prepared the procedures required by 10CFR21.21. All defects are to be reported to the Manager, HFIR Project for review.

No violations were identified.

7. Internal Review and Audit

a. Internal Audits

The inspector examined licensee records of 61 weekly equipment audits conducted between January 5, 1981 and March 22, 1982 and 15 monthly nuclear safety audits conducted between January 20, 1981 and March 22, 1982. The audit reports indicated the status of processes and equipment and reviewed the nuclear safety aspects of the facility. No discrepancies were identified in these reports.

No violations were identified.

b. External Audits

The inspector examined the records of 6 quarterly nuclear safety audits conducted by a qualified individual from the Oak Ridge National Laboratory (ORNL) from April 21-23, 1980 through September 24, 1981. The inspector also examined the records of 9 quarterly health physics program audits conducted by a qualified individual from ORNL from March 20, 1980 through March 25, 1982. These records indicated that the nuclear safety and health physics programs were being conducted in a satisfactory manner. Program weaknesses identified during these audits were immediately corrected by the licensee.

No violations were identified.

8. Transporation Activities

a. Shipping

The inspector examined the records of one waste shipment made on April 20, 1981 and 10 special nuclear material (SNM) shipments made between August 21, 1981 and October 23, 1981. The records indicated that the containers were properly marked, labeled, surveyed, inspected, and sealed prior to shipment. In addition, the Manager, Nuclear Safety had also approved each container for shipment prior to release from the facility.

No violations were identified.

1 SEP 1982

Docket No. 70-33

Texas Instruments Incorporated
ATTN: Mr. William K. Goetz
Manfacturing Manager,
Metal Systems Department
34 Forest Street
Attleboro, Massachusetts 02703

Gentlemen:

Subject: Inspection No. 70-33/82-02

This refers to the safeguards inspection conducted by Mr. E. Woltner of this office on July 27, 1982 of activities authorized by NRC License No. SNM-23 and to the discussions of our findings held by Mr. Woltner with Mr. F. Sherman of your staff at the conclusion of the inspection.

Areas examined during this inspection are described in the NRC Region I Inspection Report which is enclosed with this letter. Within these areas, the inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations by the inspector.

Within the scope of this inspection, no violations were observed.

In accordance with 10 CFR 2.790(a), a copy of this letter and the enclosure will be placed in the NRC Public Document Room unless you notify this office, by telephone, within ten days of the date of this letter and submit written application to withhold information contained therein within thirty days of the date of this letter. Such application must be consistent with the requirements of 2.790(b)(1). The telephone notification of your intent to request withholding, or any request for an extension of the 10 day period which you believe necessary, should be made to the Supervisor, Files, Mail and Records, USNRC Region I, at (215) 337-5223.

No reply to this letter is required. Your cooperation with us in this matter is appreciated.

Sincerely,

Original Signed By:
James H. Joyner
Thomas T. Martin, Director
Division of Engineering and Technical
Programs

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IE05

Enclosure: NRC Region I Inspection Report No. 70-33/82-02

cc w/encls:
W. Quimby, Assistant Vice President and Manager
Metallurgical Materials Division
F. L. Sherman, Manager, HFIR Project
Public Document Room (PDR)
Local Public Document Room (LPDR)
Nuclear Safety Information Center (NSIC)
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9/07/82	9/8/82	9/10/82	

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U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 70-33/82-02

Docket No. 70-33 License No. SNM-23 Safeguards Group V

Licensee: Texas Instruments, Inc.

34 Forest Street

Attleboro, MA 02703

Facility Name: Texas Instruments, Inc.

Inspection At: Attleboro, Massachusetts

Inspection Conducted: July 27, 1982

Date of Last Material Control and Accounting Inspection: October 29, 1981

Type of Inspection: Unannounced Material Control & Accounting

Inspectors: A. Della Ratta, Auditor — 9/9/82 date

E. Woltner, Auditor — 9/8/82 date

Approved by: A. Gody, Chief, Safeguards Section, Technical Programs Branch — 9/9/82 date

Inspection Summary:
Inspection on July 27, 1982 (Report No. 70-33/82-02)
Areas Inspected: Status of Decommissioning activities. The inspection involved 16 inspector hours on site by two NRC inspectors and was begun during the regular hours.
Results: The licensee was found to be in compliance with NRC requirements in the area inspected.

DETAILS

1. Persons Contacted

*F. Sherman, Manager, HFIR Project
*W. Daft, ICA Custodian

*denotes those present at exit interview.

2. 30703 - Exit Interview

The inspectors met with the licensee representatives (denoted in paragraph 1) on July 27, 1982. The inspectors summarized the scope and findings of the inspection.

3. 92713 - Status of Decommissioning Activities

No violations were identified. The inspectors toured the fuel processing area of the facility and held discussions with the licensee with regard to the status of decommissioning activities. The processing area was stripped of all equipment and final cleaning of the facility was completed. The licensee had removed all accessible SNM, with the exception of 7 grams U-235 awaiting shipment, from the facility in preparation for the final closeout of material control and accountability.

4. 85216 - Records and Reports

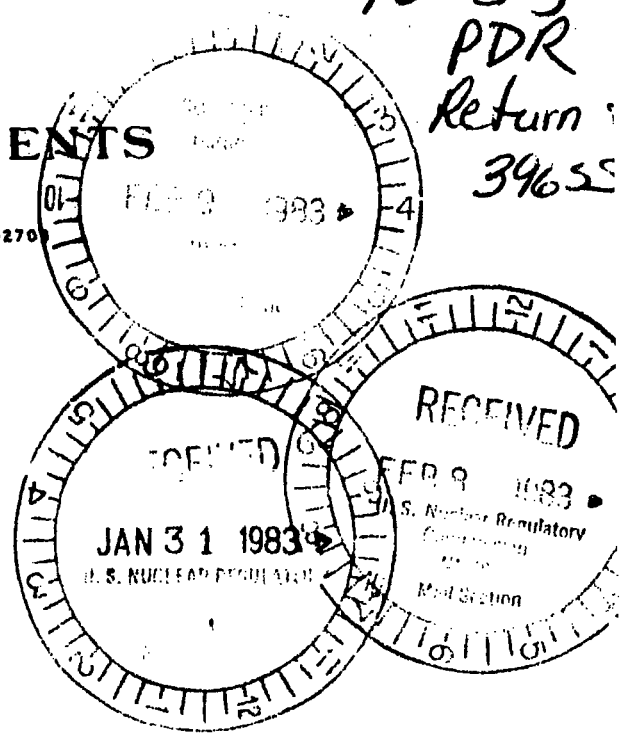
No violations were identified. The inspection results were attained through an audit of the licensee's records and reports from November 1, 1981, through the date of the inspection. One final shipment of SNM remains to be made during August 1982, consisting of 7 grams U-235 in enriched uranium. Nuclear Material Transaction Report Form (NRC 741) FBT-PZA-1 will be issued for the shipment. Upon completion of this shipment, the licensee will have zeroed out the inventory of SNM in its possession. A final Material Balance Report Form (NRC 742) will be issued stating a zero balance.

Records requiring retention for five years will be maintained by the Control & Finance Department, Planning & Forecasting Manager, Texas Instruments, Incorporated, in Attleboro, Massachusetts.

10-33
PDR
Return
3465

TEXAS INSTRUMENTS
INCORPORATED
ATTLEBORO, MASSACHUSETTS 02703

Materials & Controls Group
January 27, 1983



Nuclear Regulatory Commission
Washington, DC 20555

Attention: Mr. R. G. Page, Chief
Uranium Fuel Licensing Branch
Division of Fuel Cycle & Material
Safety, MSS

Reference: NRC License SNM-23

Gentlemen:

Please find enclosed eight copies of the Environemntal Report "Radiological Survey and Review of the Texas Instruments Complex, Attleboro, Massachusetts", dated 17 January 1983.

The purposes of this report are:

1. To request termination of NRC License SNM-23 as issued to Texas Instruments Incorporated (TI).

2. To demonstrate that the sampling and analysis of the study areas have been carried out in conformance to your requirements.

3. To present measurements and analytical methodologies used to analyze Texas Instruments' soil samples. This includes calculation methods, counting techniques, instrumentation and quality assurance plan.

4. To document the conclusion that contaminated material was disposed of only in the study area presented. Employees involved with the Nuclear fuel production including the Health Physicist, have verified this conclusion.

If you desire additional information, please contact Francis J. Veale Jr., at (Tel. 617-699-1804).

Sincerely,

Francis J. Veale

Francis J. Veale Jr.
Manager Environmental Eng., Attleboro

Copy: Gil Perkins
Bob Sorgel

21887

U. S. NUCLEAR REGULATORY COMMISSION

REGION I

Report No. 70-33/83-01

Docket No. 70-33

License No. SNM-23 Priority 1 Category UR

Licensee: Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02703

Facility Name: HFIR Project

Inspection At: Attleboro, Massachusetts

Inspection Conducted: January 31 - February 2, 1983

Inspectors: J. Roth — 3/1/83
J. Roth, Project Inspector — date

J. Roth for — 3/1/83
G. C. Smith, Security Inspector — date

Approved by: A. T. Gody — 3/2/83
A. T. Gody, Chief, Safeguards and Fuel Facilities Section, Nuclear Materials and Safeguards Branch, DETP — date

Inspection Summary:

Inspection on January 31 - February 2, 1983 (Report No. 70-33/83-01)

Areas Inspected: Special, announced, closeout inspection of facilities formerly engaged in the manufacture of reactor fuel elements including: review of the licensee's survey report and independent measurements in Buildings 3, 4, and 10; and review of the licensee's environmental survey report concerning a 10 CFR 20 burial site located between Buildings 11 and 12. The inspection involved 43 direct inspection hours by two NRC region-based inspectors.

Results: No violations were identified. Measured fixed and removable contamination levels were comparable with the licensee's survey results and were within acceptable limits specified in Annex C to the facility license.

Details

1. Persons Contacted

   * W. K. Goetz, Manufacturing Manager, Metal Systems Department
   * R. J. Schwensfeir, Manager, Nuclear Safety and Materials
   * W. H. Daft, Health Physics Technician
   * R. Churchill, Contracts Manager

   *Denotes those present at the exit interview.

2. Background

   During the years 1952 through 1956 small portions of Buildings 3 and 4 and during subsequent years 1956 through 1968, major portions of Building 10 of the Texas Instruments Incorporated, Attleboro, Massachusetts, site were engaged in the manufacture of nuclear reactor fuel for the U. S. Navy and commercial power and research reactors, along with various components of natural and depleted uranium. With the exception of the HFIR project, these operations were concluded in 1966 through 1968.

   The building areas used for the concluded operations were then decontaminated, surveyed for radioactivity, and released for general use between 1966 and 1968. Since that time, the areas have been used for manufacturing with non-radioactive materials.

   The HFIR project area was previously released for unrestricted use following a closeout survey conducted by NRC from August 31 through September 2, 1982 (see Inspection Report 70-33/82-03).

   Since the licensee could not locate documentation verifying that Buildings 3, 4, and the remainder of Building 10 had been successfully decontaminated between 1966 and 1968, verification surveys of the effected areas were performed by the licensee; and a report was submitted to the NRC by letter dated November 2, 1982.

3. Areas Surveyed

   Surveys were limited to 67 of 214 grid blocks, outside the HFIR area, located in Building 10 (see Figure 1); two of four grid blocks located in Building 3 (see Figure 2); and 9 of 31 grid blocks located in Building 4 (see Figure 3). All surveys were conducted on floor areas with the exception of the former fuel vault ceiling, north and west inside wall and east outside wall (grid blocks 6-19 and 6-20). In addition, the floor of the second floor corrosion laboratory and the concrete pads outside the HFIR area emergency and rollup doors were also surveyed.

4. Methodology and Instruments

   a. Methodology

Direct alpha, beta-gamma, and gamma radiation measurements were made at a minimum of four locations within each grid block. In addition, at least one wipe for removable alpha and beta-gamma contamination were taken in each surveyed grid block.

b. Instruments

The following instruments were used for direct measurements:

(1) Eberline Geiger Counter, Model E-120, Serial No. 1268, calibrated December 14, 1982.

*(2) Eberline scintilation type alpha counter, Model PAC-1SA, Serial No. 720, calibrated August 25, 1982.

(3) Ludlum Micro R Meter, Model 12S, Serial No. 15482, calibrated December 14, 1982.

*Determined to be 47.7% efficient in counting against a Th-230 certified standard of 12,570 dpm.

All wipes were taken to Region I and were counted for one minute in a TENNELEC LB 1000 series low background alpha, beta gas flow counting system having an alpha background of 0.55 cpm and a beta background of 2.7 cpm with an alpha efficiency of 21.9% and a beta efficiency of 25.7% as of February 8, 1982.

5. Independent Measurements

Nine hundred thirty-eight individual, direct alpha, beta-gamma and gamma radiation measurements were taken in the facility areas identified in paragraph 3. Direct alpha measurements did not exceed 175 dpm/100cm^2 (92.6% ≤ 50 dpm) except for Building 4 floor location 400-3 (350 dpm) as shown in Figure 3. Direct gamma measurements did not exceed 10 microR per hour above background (6 microR per hour) except off the north edge of the concrete pad located outside the HFIR area rollup door (700 microR per hour on contact with the soil). Direct beta-gamma measurements did not exceed 500 dpm except for Building 10 floor grid floor location 5/21 (2400 dpm maximum, 1140 dpm average) as shown in Figure 1. This area corresponds with the highest area identified by the licensee. A total of 81 wipes for removable alpha and beta contamination were taken. All wipes for removable alpha and beta contamination were less than 10 dpm/100cm^2 alpha except Building 4 floor grid 401-8 (11.2 dpm) and Building 10 floor grids 6/20 (20.3 dpm) and 1/10 (11.2 dpm); removable beta contamination was less than 20 dpm/100cm^2 except Building 10 floor grids 1/8 (20.6 dpm) and 8/7 (24.5 dpm). **Annex C criteria for direct alpha and beta-gamma radiation are 15,000 dpm/100 cm^2 maximum fixed, 5000 dpm/100 cm^2 average fixed and 1000 dpm/100 cm^2 removable.**

6. Conclusion

Fixed and removable contamination levels, inside the licensee's facilities, measured during this inspection are comparable to those in the licensee's close-out survey and are within the limits established in Annex C of the facility license (Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproduct, Source, or Special Nuclear Material, dated November 1976).

7. Environmental Program

During the course of this inspection, the inspector received a copy of the licensee's evaluation of the 10 CFR Part 20 burial site located between Buildings 11 and 12. This report will be reviewed for adequacy and content by NRC:NMSS and Region I subsequent to this inspection (83-01-01).

8. Exit Interview

The inspector met with the licensee representatives (denoted in paragraph 1) at the conclusion of the inspection on February 2, 1983. The inspector summarized the purpose, scope, and findings of the inspection. Since an area of elevated radiation level was identified outside Building 10 (paragraph 5), the inspector requested that the licensee determine the extent of area contamination. In addition, the licensee was requested to conduct an area radiation survey on all sides of Building 10 to assure that any additional elevated radiation areas are identified. The licensee notified the inspector by telephone on February 8, 1982, that the identified area of elevated radiation, located off the north edge of the rollup door concrete pad, was restricted to an area about one foot by two feet in size. Actions will be taken to remove the contaminated soil for burial as soon as weather conditions permit (83-01-02). The licensee stated that a radiation survey of areas outside Building 10 will be conducted (83-01-03).

Figure 1

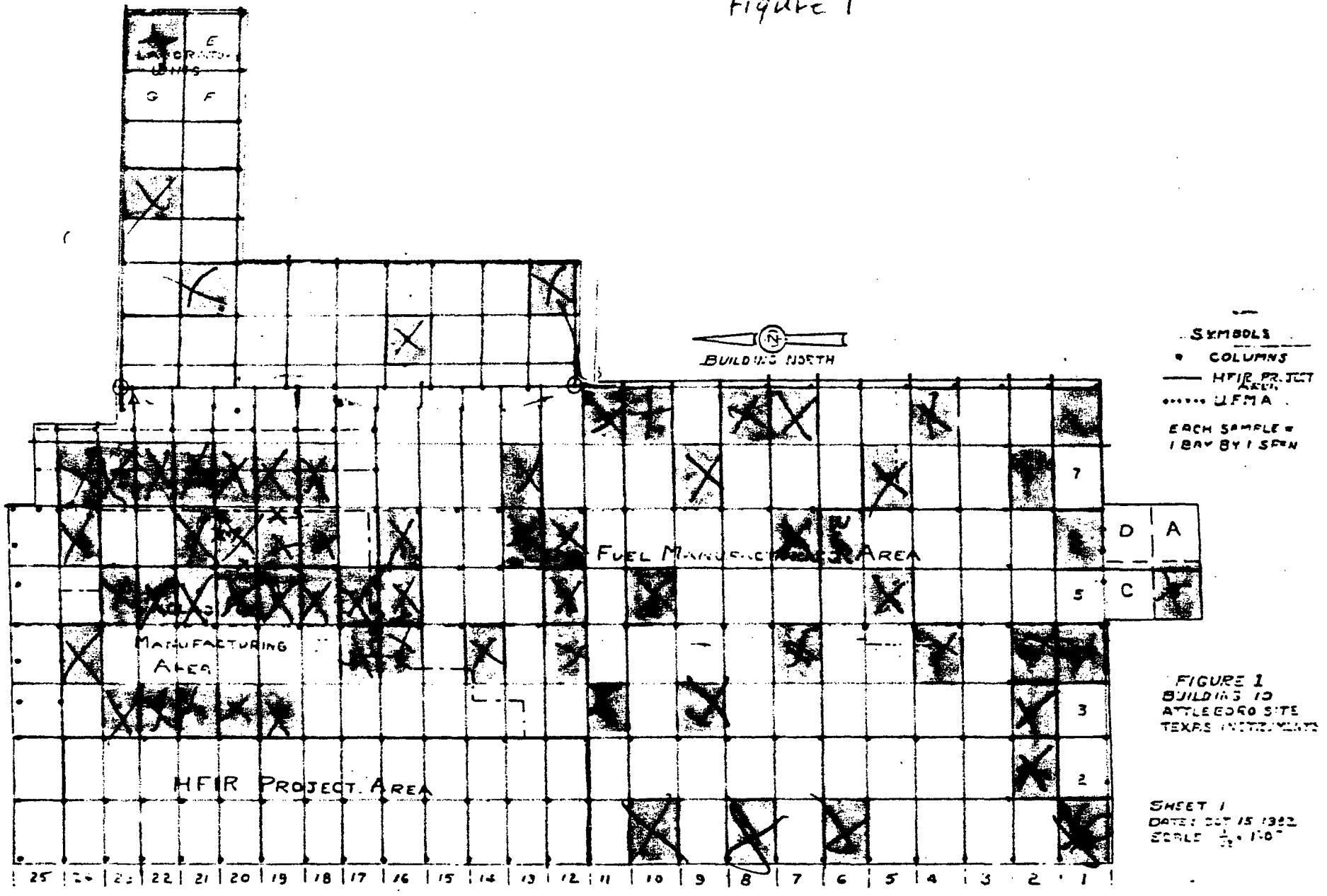


FIGURE 1
BUILDING ID
ATTLEBORO SITE
TEXAS INSTRUMENTS

SHEET 1
DATE: OCT 15 1982
SCALE 1/32" = 1'-0"

Figure 2

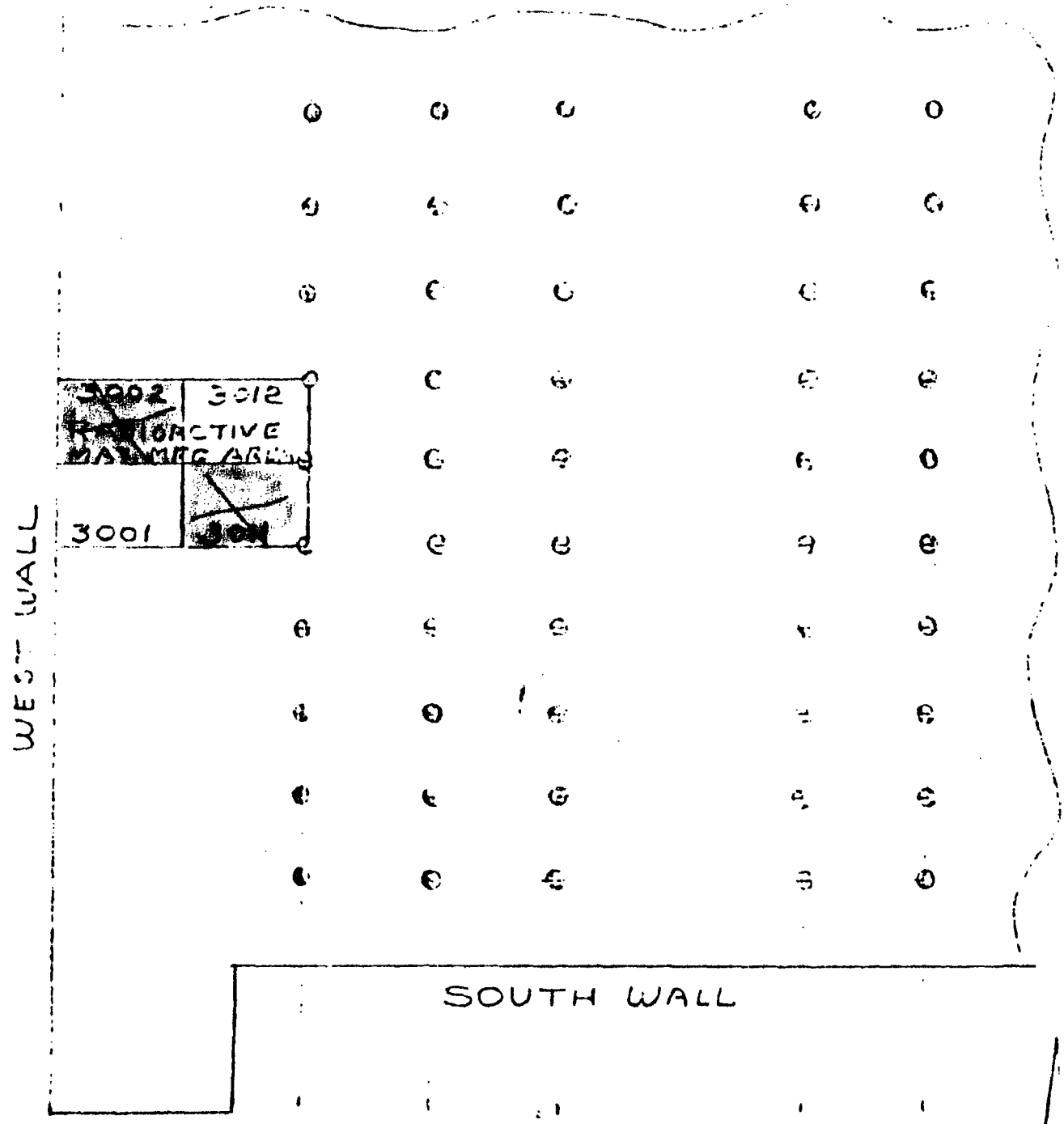
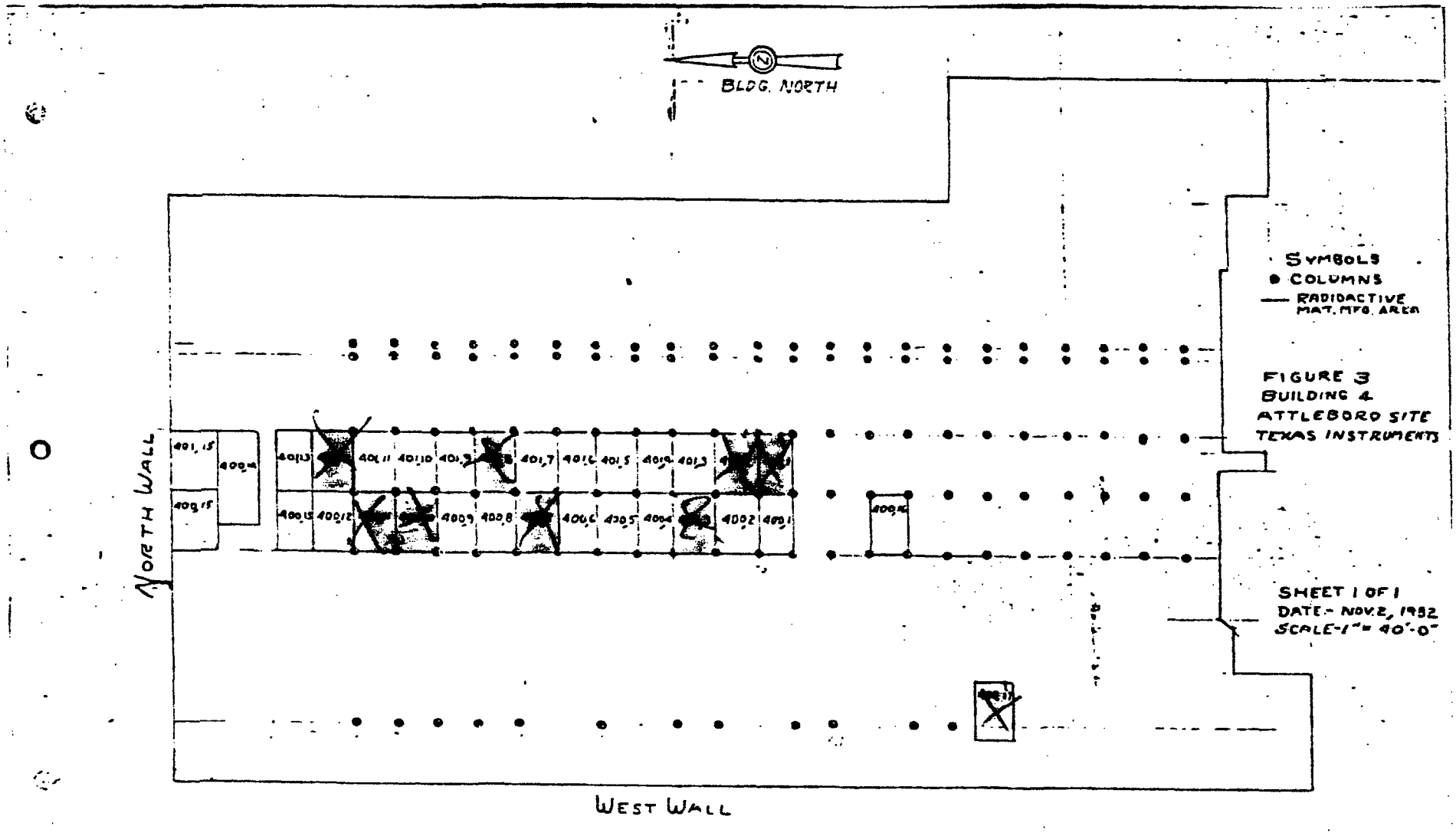


FIGURE 2
BUILDING 3
ATTLEBORO SITE
TEXAS INSTRUMENTS

SHEET 1 OF 1
DATE: NOV. 2, 1982
SCALE 1" = 40'-0"

FIGURE 3


BLDG. NORTH
SYMBOLS
COLUMNS
RADIOACTIVE MAT. MFG. AREA
FIGURE 3
BUILDING 4
ATTLEBORO SITE
TEXAS INSTRUMENTS
SHEET 1 OF 1
DATE- NOV. 2, 1982
SCALE-1"= 40'-0"
NORTH WALL
WEST WALL

U.S. NUCLEAR REGULATORY COMMISSION

REGION I

Report No. 70-33/82-01

Docket No. 70-33

License No. SNM-23 Priority 1 Category UR

Licensee: Texas Instruments Incorporated

34 Forest Street

Attleboro, Massachusetts 02702

Facility Name: HFIR Project

Inspection at: Attleboro, Massachusetts

Inspection conducted: April 13-14 1982

Inspector: J. Roth — 4/23/82
J. Roth, Project Inspector — date signed

J. Jang — 4/26/82
J. Jang, Radiation Specialist — date signed

date signed

date signed

Approved by: R. Keimig — 4-26-82
R. R. Keimig, Chief, Project Branch #2, DPRP — date signed

Inspection Summary:

Inspection on April 13-14 1982 (Report No. 70-33/82-01)

Areas Inspected: Routine, unannounced inspection by two region-based inspectors (21 hrs.) of: organization; Part 21; facility changes and modifications; internal review and audit; training; review of operations; environmental evaluations; transportation activities; and, licensee action on previously identified enforcement items.

Results: No violations were identified.

Region I Form 12
(Rev. April 77)

DETAILS

1. Persons Contacted

*R. L. Churchill, Program Manager, Metal Systems Department
*F. L. Sherman, Manager, HFIR Project
*F. J. Veale, Jr., Manager, Environmental Engineering
*R. J. Schwensfeir, Manager, Nuclear Safety and Nuclear Material Control

The inspector also interviewed 7 other licensee employees during this inspection.

* denotes those present at the exit interview.

2. Licensee Action on Previously Identified Enforcement Items

(Closed) Unresolved (33/78-10-04) Compensating for a design weakness in the alarm annunciator panel. The inspector verified that as a result of the decontamination and decommissioning activities at this facility, the annunciator panel referred to has been removed from the facility. No additional actions are required to resolve this item.

3. Organization

The inspector verified through discussions with licensee representatives that the staff had been reduced to a total of 8. Reporting to F. L. Sherman, Manager, HFIR Project are:

R. J. Schwensfeir, Manager, Nuclear Safety and Nuclear Material Control
H. Ortelt, Nuclear Material Control Representative
D. Collins, Engineering
W. Daft, Group Leader
G. Araugio, Operator
K. Rogers, Operator
J. Lecuelli, Operator

The staff indicated above will complete the decommissioning activities at this facility.

No violations were identified.

4. Facility Examination

The inspector examined the facility to observe operations in progress and to determine the extent to which facility decommissioning had progressed.

The inspector observed that all walls within the HFIR Project boundary had been removed and packaged for burial. All equipment with the exception of the waste water boildown unit and the waste barrel counter had been removed. The surface of the concrete floor had been removed to a depth of about 0.25 inches in those areas where contamination was suspected. All remaining walls and the ceilings have been high pressure steam cleaned. The licensee dug out portions of the facility floor where contamination in cracks occurred. All sealed floor drains in the area have been opened and the licensee was in the process of probing the drain lines to assure that they were not contaminated. The licensee was also in the process of surveying the facility floor, walls and ceiling for radioactive contamination. In addition, paint samples were taken from painted surfaces and analyzed to assure that the surfaces had not been repainted to cover previously contaminated areas.

The inspector discussed, with licensee representatives, the content and format of the facility decontamination and decommissioning survey report which must be submitted to NRC-NMSS along with the request to terminate the facility license.

No violations were identified.

5. Environmental Evaluations

Discussions were held with licensee representatives concerning the status of programs being conducted to characterize the extent, distribution and type of radioactivity found in a 10CFR20.304 burial site located in a lawn area approximately 100 yards north-northeast of Building 11. The licensee originally installed monitoring wells to a maximum depth of 10 feet at a distance of no closer than 50 feet to the perimeter of the burial site. Since the last inspection, the licensee installed additional wells around the burial site at a distance of about 100 feet from the original line of wells.

The inspector stated that the environmental evaluation of this site and any other suspect sites must also be incorporated into the final facility decontamination and decommissioning survey report. Subsequent to these discussions, the inspectors examined the burial site area and were shown the location of several of the new wells.

No violations were identified.

6. 10 CFR Part 21

The inspector verified that the licensee had posted the notices and information required by 10CFR21.6 and had prepared the procedures required by 10CFR21.21. All defects are to be reported to the Manager, HFIR Project for review.

No violations were identified.

7. Internal Review and Audit

a. Internal Audits

The inspector examined licensee records of 61 weekly equipment audits conducted between January 5, 1981 and March 22, 1982 and 15 monthly nuclear safety audits conducted between January 20, 1981 and March 22, 1982. The audit reports indicated the status of processes and equipment and reviewed the nuclear safety aspects of the facility. No discrepancies were identified in these reports.

No violations were identified.

b. External Audits

The inspector examined the records of 6 quarterly nuclear safety audits conducted by a qualified individual from the Oak Ridge National Laboratory (ORNL) from April 21-23, 1980 through September 24, 1981. The inspector also examined the records of 9 quarterly health physics program audits conducted by a qualified individual from ORNL from March 20, 1980 through March 25, 1982. These records indicated that the nuclear safety and health physics programs were being conducted in a satisfactory manner. Program weaknesses identified during these audits were immediately corrected by the licensee.

No violations were identified.

8. Transporation Activities

a. Shipping

The inspector examined the records of one waste shipment made on April 20, 1981 and 10 special nuclear material (SNM) shipments made between August 21, 1981 and October 23, 1981. The records indicated that the containers were properly marked, labeled, surveyed, inspected, and sealed prior to shipment. In addition, the Manager, Nuclear Safety had also approved each container for shipment prior to release from the facility.

No violations were identified.

b. Procedures

The inspector examined the following route cards (procedures) to assure that each contained proper instructions to operators.

- "Packing DOT 6M General License Containers with Bottles of SNM" dated July 9, 1981.

- "Packing DOT 6M General License Containers with SNM and SNM Containing Components", dated February 11, 1980.

- "Process Waste or MD Drums with Assay", dated August 17, 1979.

No violations or inadequacies were identified.

9. Training

a. Annual Training

The inspector examined record of required annual training conducted on August 24, 1979, August 27, 1980 and August 28, 1981. Records indicated that all individuals required to be trained had received training either on the dates indicated or shortly thereafter. Topics covered in this training included: incident notification procedures, types of radioactive material used, types of radiation encountered, prenatal radiation exposure (female employees only), emergency actions and nuclear criticality safety. In addition, facility standard work rules, concerned with postings, following procedures, transport of SNM, handling procedures, and reporting requirements were also covered during the training sessions.

No violations were identified.

b. Special Training

On November 2-3, 1981 special training sessions were held to cover the facility decontamination and decommissioning work which was to be immediately initiated. Topics covered included, access requirements, types of radiation, biological effects of radiation, precautions to be taken during this phase of operations, ALARA, prenatal exposure (females only), applicable emergency response and procedures, and revised general work rules.

Manufacturing operations were completed in the facility on October 31, 1981 and decommissioning was started upon completion of training on November 3, 1981.

No violations were identified.

c. Ongoing Training

The licensee has conducted the following ongoing training since the start of decommissioning.

- November 17, 1981 - Procedures for equipment decommissioning and decontamination in the Fuel Manufacturing area.
- December 1, 1981 - Babcock and Wilcox personnel training.
- January 4, 1982 - Review of revised procedures.
- January 7, 1982 - General training for 5 additional project employees.
- January 29, 1982 - General training for 1 additional project employee.

No violations were identified.

10. Exit Interview

The inspector met with the licensee representatives (denoted in paragraph 1) at the end of the inspection at 11:00 a.m. on April 14, 1982. The inspector summarized the scope and findings of the inspection and stated that no violations were identified.

U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 70-33/82-02

Docket No. 70-33 License No. SNM-23 Safeguards Group V

Licensee: Texas Instruments, Inc.

34 Forest Street

Attleboro, MA 02703

Facility Name: Texas Instruments, Inc.

Inspection At: Attleboro, Massachusetts

Inspection Conducted: July 27, 1982

Date of Last Material Control and Accounting Inspection: October 29, 1981

Type of Inspection: Unannounced Material Control & Accounting

Inspectors: A. Della Ratta, Auditor — 9/9/82 date

E. Woltner, Auditor — 9/8/82 date

Approved by: A. Gody, Chief, Safeguards Section, Technical Programs Branch — 9/9/82 date

Inspection Summary:
Inspection on July 27, 1982 (Report No. 70-33/82-02)
Areas Inspected: Status of Decommissioning activities. The inspection involved 16 inspector hours on site by two NRC inspectors and was begun during the regular hours.
Results: The licensee was found to be in compliance with NRC requirements in the area inspected.

DETAILS

1. Persons Contacted

*F. Sherman, Manager, HFIR Project
*W. Daft, ICA Custodian

*denotes those present at exit interview.

2. 30703 - Exit Interview

The inspectors met with the licensee representatives (denoted in paragraph 1) on July 27, 1982. The inspectors summarized the scope and findings of the inspection.

3. 92713 - Status of Decommissioning Activities

No violations were identified. The inspectors toured the fuel processing area of the facility and held discussions with the licensee with regard to the status of decommissioning activities. The processing area was stripped of all equipment and final cleaning of the facility was completed. The licensee had removed all accessible SNM, with the exception of 7 grams U-235 awaiting shipment, from the facility in preparation for the final closeout of material control and accountability.

4. 85216 - Records and Reports

No violations were identified. The inspection results were attained through an audit of the licensee's records and reports from November 1, 1981, through the date of the inspection. One final shipment of SNM remains to be made during August 1982, consisting of 7 grams U-235 in enriched uranium. Nuclear Material Transaction Report Form (NRC 741) FBT-PZA-1 will be issued for the shipment. Upon completion of this shipment, the licensee will have zeroed out the inventory of SNM in its possession. A final Material Balance Report Form (NRC 742) will be issued stating a zero balance.

Records requiring retention for five years will be maintained by the Control & Finance Department, Planning & Forecasting Manager, Texas Instruments, Incorporated, in Attleboro, Massachusetts.

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

Region I

Report No. 70-33/81-11

Docket No. 70-33

License No. SNM-23 Priority 1 Category UR

Licensee: Texas Instruments Incorporated
34 Forest Street
Attleboro, Massachusetts 02703

Inspection at: Attleboro, Massachusetts

Inspection conducted: December 22-23, 1981

Inspector: P. Clemons, Radiation Specialist — date signed 2/5/82

Approved by: P. J. Knapp, Chief, Facility Radiological Protection Section, Technical Inspection Branch — date signed 2/5/82

Inspection Summary: Inspection on December 22-23, 1981 (Report No. 70-33/81-11)
Areas Inspected: Routine, unannounced inspection by a regional based inspector of the radiation protection program including: field inspection, dosimetry, terminations, audits, bioassay, surveys, training and drills. Shortly after arrival, areas where work was being done were examined to review radiation safety control procedures and practices. The inspection involved 12 inspector hours onsite by one regional based NRC inspector.

Results: No items of noncompliance were identified.

DETAILS

1. Persons Contacted

Dr. R. Schwensfeir, Manager, Nuclear Safety and Materials
Mr. F. Sherman, Manager, HFIR Project

2. Field Inspection

On December 22, 1981, the inspector toured the High Flux Isotopes Reactor Project Facility (HFIR) to determine the status of the decommissioning activities. The inspector noted that the external walls of the Fuel Manufacturing Area (FMA), the area where unencapsulated uranium was processed, were intact. The FMA is located within the HFIR Facility, and the walls isolate the potentially contaminated area from the clean areas. The inspector observed, within the FMA, that walls had been removed, equipment had been disconnected from the exhaust system, and the licensee was preparing to dismantle the press that was used in pellet production. According to a licensee representative, certain wall partitions had been boxed for ultimate disposal, and removed from the FMA into the HFIR Facility.

The inspector noted that outside of the FMA, but within the HFIR Facility, walls had been removed, equipment had been removed, and the licensee was in the process of removing additional equipment. This material had not been exposed to radioactive material. The inspector reviewed documents which indicated that all items were being surveyed prior to their release from the HFIR Facility.

No items of noncompliance were identified.

3. Dosimetry

The inspector reviewed dosimetry data for the period January through September 1981, for the purpose of determining whether the licensee was in compliance with the requirements of 10 CFR 20.101. Approximately 20 employees were monitored by the use of film badges, and the badges were analyzed quarterly.

No items of noncompliance were identified.

4. Audits

Condition No. 13 of Special Nuclear Material License No. SNM-23 states, "Audits of the radiological ... safety aspects conducted pursuant to this license shall be conducted at least quarterly..."

The inspector verified that the required audits had been performed by reviewing audit reports that had been submitted to the licensee dated June 11, 1981, September 15, 1981, and December 10, 1981. The audits had been performed by an individual who was not employed by the licensee.

No items of noncompliance were identified.

5. Termination Report

10 CFR 20.408 requires a licensee to submit a report of an individual's exposure to radiation and radioactive material incurred during the period of employment to the NRC Director of Management and Program Analysis when the individual terminates employment with the licensee. Such report shall be furnished within 30 days after the exposure of the individual has been determined by the licensee or 90 days after the date of termination of employment or work assignment, whichever is earlier.

10 CFR 20.409 requires the licensee to also notify the individual when the licensee is complying with 10 CFR 20.408.

The inspector reviewed termination reports for approximately twenty individuals who terminated employment with the licensee during 1981. The reports had been submitted as required.

No items of noncompliance were identified.

6. Bioassay

Section 5.5.1.1.1 of the Health and Safety Manual, incorporated by Condition No. 8 of Special Nuclear Materal License No. SNM-23, requires urinalysis for enriched uranium quarterly for people employed more than 50 percent of the time in the FMA, and scrap and salvage personnel. The inspector reviewed data for the period January through September 1981. The data did not indicate any problems with exposure control for the six to ten employees involved in the program.

No items of noncompliance were identified.

7. Surveys

10 CFR 20.201(b) requires surveys to be performed to enable compliance with the regulations in 10 CFR 20.

The inspector reviewed air sample data for the period June through December 1981 for six sampling points within the FMA. The data indicated that all results were within the regulatory requirements.

The inspector reviewed stack sample data for the period June through December 1981 to determine that sampling was being performed, and to determine if the sample results were within regulatory limits.

The inspector reviewed smear survey records for the period June through December 1981. The data revealed very low levels of removable contamination.

The inspector reviewed external radiation survey data for the period June through December 1981. The data indicated that beta-gamma surveys were performed monthly during the period.

No items of noncompliance were identified.

8. Training

Section 10.2 of the Health and Safety Manual requires that all employees involved in the handling of fissionable material be given a re-orientation lecture by the Health Physics Officer on an annual basis.

The inspector reviewed documentation which indicated that all HFIR employees received the required training, presented by the Manager, Nuclear Safety and Materials, during August 1981.

No items of noncompliance were identified.

9. Annual Drill

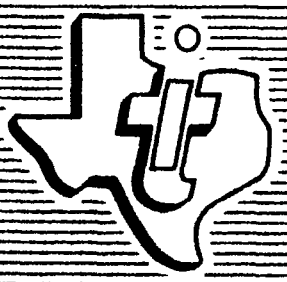
Section 10.2.4.1.2 of the Health and Safety Manual requires evacuation drills to be held annually. The inspector reviewed documents that indicated the required drills were conducted on April 21, 1981. At that time the licensee employed a three shift operation, and all shifts participated.

No items of noncompliance were identified.

10. Exit Interview

The inspector met with licensee representatives (denoted in Paragraph 1) at the conclusion of the inspector on December 23, 1981. The inspector summarized the purpose and the scope of the inspection, and the findings as presented in this report.

70-33



TEXAS INSTRUMENTS

INCORPORATED

ENVIRONMENTAL REPORT

RADIOLOGICAL SURVEY AND REVIEW OF THE TEXAS INSTRUMENTS COMPLEX ATTLEBORO, MASSACHUSETTS

PREPARED BY:

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17 January 1983

TABLE OF CONTENTS

List of Figures

LIST OF TABLES

INTRODUCTION

Texas Instruments, Incorporated (TI) has submitted an application for release of its Special Nuclear Material License No. 23, issued by the Nuclear Regulatory Commission. The license pertains to the continued operations of TI's Attleboro, Massachusetts facility. Prior submittals have dealt with interior building surveys.

Below we discuss the significant environmental aspects of the disposal of low level radionuclides on TI's grounds. This report contains information on a comprehensive study to assess the radiological conditions on the property from December of 1981 through October of 1982.

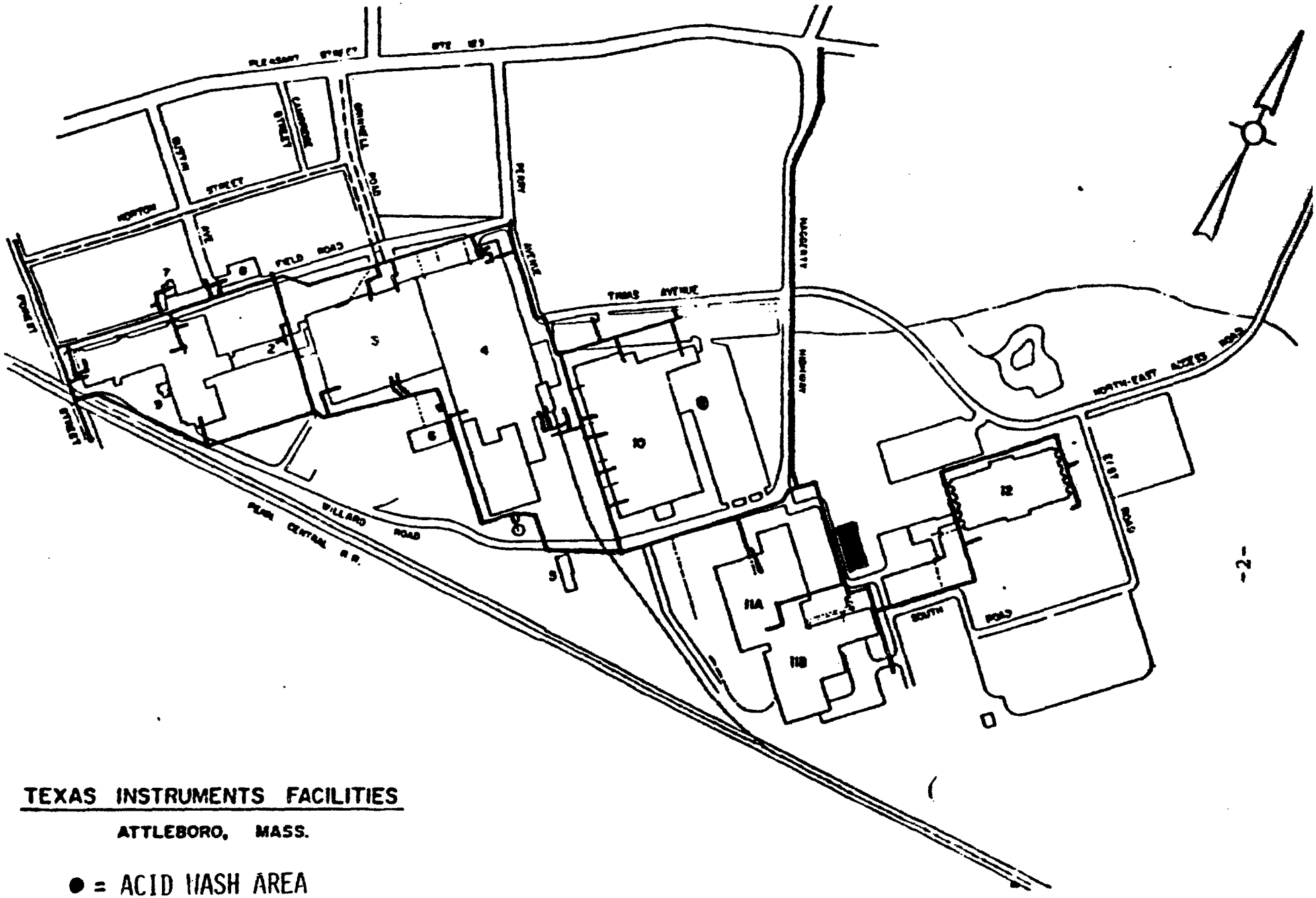
The study presents data obtained from a gamma radiological survey of the single dump site, along with background characteristics. This was compared to an earlier gamma radiological survey performed by the U.S. Department of Energy in June 1982. Also, the study reviews the history of the dump site, defines the magnitude of the dump area, and presents data on the core and sediment samples taken in and around the site.

In addition, a core boring was removed from an acid-wash treatment area northwest of the burial location studied. The acid-wash treatment area was not exposed to radioactive materials and the core removal was conducted to document this fact.

All soil and sediment results are discussed with reference to the five disposal options given by the NRC in the Federal Register, Vol. 46, No. 205, October 23, 1981. This states the maximum concentrations of radionuclides permitted for on-site disposal of thorium or uranium wastes from past nuclear operations.

A General Description of the Plant

Texas Instruments Inc. is located in Attleboro, Massachusetts, approximately 20 miles north of Providence and 30 miles south of Boston. The TI facility is in Bristol County, approximately 1.25 miles east of the Attleboro business center. The past dump site is located between the grounds of Buildings 21 and 12, as indicated in Figure 1.



TEXAS INSTRUMENTS FACILITIES

ATTLEBORO, MASS.

● = ACID WASH AREA

▬ = DISPOSAL SITE

FIGURE 1

MAGNITUDE AND PAST HISTORY OF THE SITE

A. History:

In 1952, the General Plate Division of Metals and Controls, Inc. (M&C) became involved in the nuclear materials field to fabricate enriched uranium into thin foils for use in reactor experiments. Information prior to this date does not reveal any significant involvement with nuclear materials.

M&C fabricated fuel components for the Navy's nuclear submarine "Seawolf" in 1953 and 1954. In 1955 M&C was issued Special Nuclear Materials License No: 23 for 110 Kg. of enriched uranium to be used in the manufacture of complete reactor fuel cores containing enriched uranium, cladding, and other structural components.

M&C received a contract in 1956 to manufacture the fuel core of the submarine "Triton". The contract was completed in August of 1958 with delivery of the core. Additional contracts for Triton refuelings were issued and completed by January of 1959.

Contaminated waste and scrap material containing significant levels of uranium were either recovered or sent to an aproved disposal site through Oak Ridge, Tenn. An October 1958 inspection performed by the AEC, reveals information regarding disposal techniques. According to the report, waste materials from any byproduct or operation were stored in 55-gallon drums, properly labeled and stored on-site for shipment to Oak Ridge or to the license customer upon receipt of shipping instructions. The AEC approved the burial of contaminated construction materials in the area this report studies. Liquid waste and source materials were not buried on Texas Instruments property.

In 1959, M&C merged with Texas Instruments Inc. and continued processing nuclear materials. At the time, TI was doing business with Sylvania, Bettis Atomic Power Labs, Knolls Atomic Power Labs, and various National Laboratories. TI also manufactured for research organizations such as the Atomic Energy of Canada and Massachusetts Institute of Technology.

A January 1964 Health and Safety Manual mentions TI's methods for radioactive waste management. According to the manual, enriched uranium and its alloys obtained from machine turnings, foil, etc., were placed in specially designed drums and stored in Bldg 10. Uranium and thorium contaminated combustibles were placed in 55-gallon drums and incinerated on-site. The ashes from this process were then moistened with water and analyzed for U-235 content. These waste ashes were shipped to Oak Ridge or an appropriate recovery site.

Uranium and thorium contaminated noncombustible scrap metal and machinery were collected and stored in ordinary 55-gallon steel drums. The drums were disposed of through authorized agencies, or buried on-site at the dumping area studied in the report. Burial on-site occurred after decontamination and in strict compliance with federal regulations, namely 10CFR 20.304.

TI Health Physics personnel employed at this time indicate that no waste powders containing source materials were buried on-site. No documentation or records indicate that any on-site disposal occurred.

Around 1966, TI began to reduce its fabrication of source materials operations. In 1973, the Source Material License was terminated. After this termination, all waste management was packed and shipped to Oak Ridge, Tenn. for strict accounting purposes.

It appears that the only contaminated material buried on-site was low level scrap waste (mostly metallic) which was disposed of in compliance with 10CFR 20.304. There is no evidence of any source material being disposed of on-site.

B. Photographic Review:

Figures 2, 3 and 4 reveal the dump site in early 1966. This area appears localized with material being disposed of only within the dump boundaries (note black arrows).

Figures 5 and 6 show the same area as it appears today. The site has been covered with topsoil with a grass surface. A cooling tower used in manufacturing is located at the south end of the dump (note black arrows).

The dump site was closed in 1967, during construction of building 12. Please refer to Figure 7. This aerial photograph taken during construction indicates the boundaries of the past dump and suggests that the covering soil in this area may have been spread over a portion of the construction site.

The photographs in this study and the job log from the construction were reviewed with Westcott Construction Co., Attleboro, the recipients of this construction contract. Westcott believes that any grading or site work would not have resulted in movement of soil from the dump site past the general area shown in Figure 7. Solid material would have been left within the boundaries of the dump site. There is no indication that metallic scrap, ductwork or "junk" were removed from the site, except for the single occurence which occurred in the summer of 1966. At this time material was uncovered during contstruction of underground air lines. This material was removed and shipped to an approved burial site in North Carolina. Full documentation and information was sent to the NRC at this time.

It appears that the boundaries of the dump site were broken down during grading operations and that the soil within may have been spread over a limited area of the construction site. There is no evidence from the photograph or from discussion with Westcott that contaminated material or soil were ever taken from the site or moved further than the area shown in figure 7, except as noted above.

For the above reasons our study of this dump site included the area around Bldg. 12 as well as the location of the dumpsite.

C. Employee Interviews:

Personnel involved with nuclear operations at W&C were questioned about the techniques used in disposing of contaminated material during this time.

All those questioned, including the Health Physicist and Industrial Hygenist, believed that no material other than contaminated ductwork and general waste were disposed of in this area.

Those involved with material disposal iterated strict compliance with 10CFR 20.304 and stated specifically that they never disposed of any source material on site.

D. Boundary Cores:

After reviewing the site photographs and discussing the grading procedures used by Westcott during the construction of Bldg. 12, three separate borings were performed on October 20, 1982. The borings were taken at the farthest boundaries where any contaminated material could have been moved during construction of Bldg. 12. Based on tests described below, all three borings are believed free from any deposit of contaminated material.

Boring 101 is located southeast of the dumps; boring 102, east; and boring, 103 north. Holes were drilled until bedrock was encountered, at a depth of between 9.5 and 10 feet. All data on these borings are found in Tables 1, 2, and 3. The location of these boundary borings is noted in Figure 8.

Cores were sectioned into 1-foot increments and divided lengthwise. Samples were sent for immediate analysis to Controls for Environmental Pollution Inc. in Santa Fe, New Mexico. A second set was sent to the USWAC in King of Prussia, Pennsylvania.

The results from each boring can be found in Table 4 reported in foot/depth increments. Activity is given in pci/gm of soil for both alpha α and beta β particles.

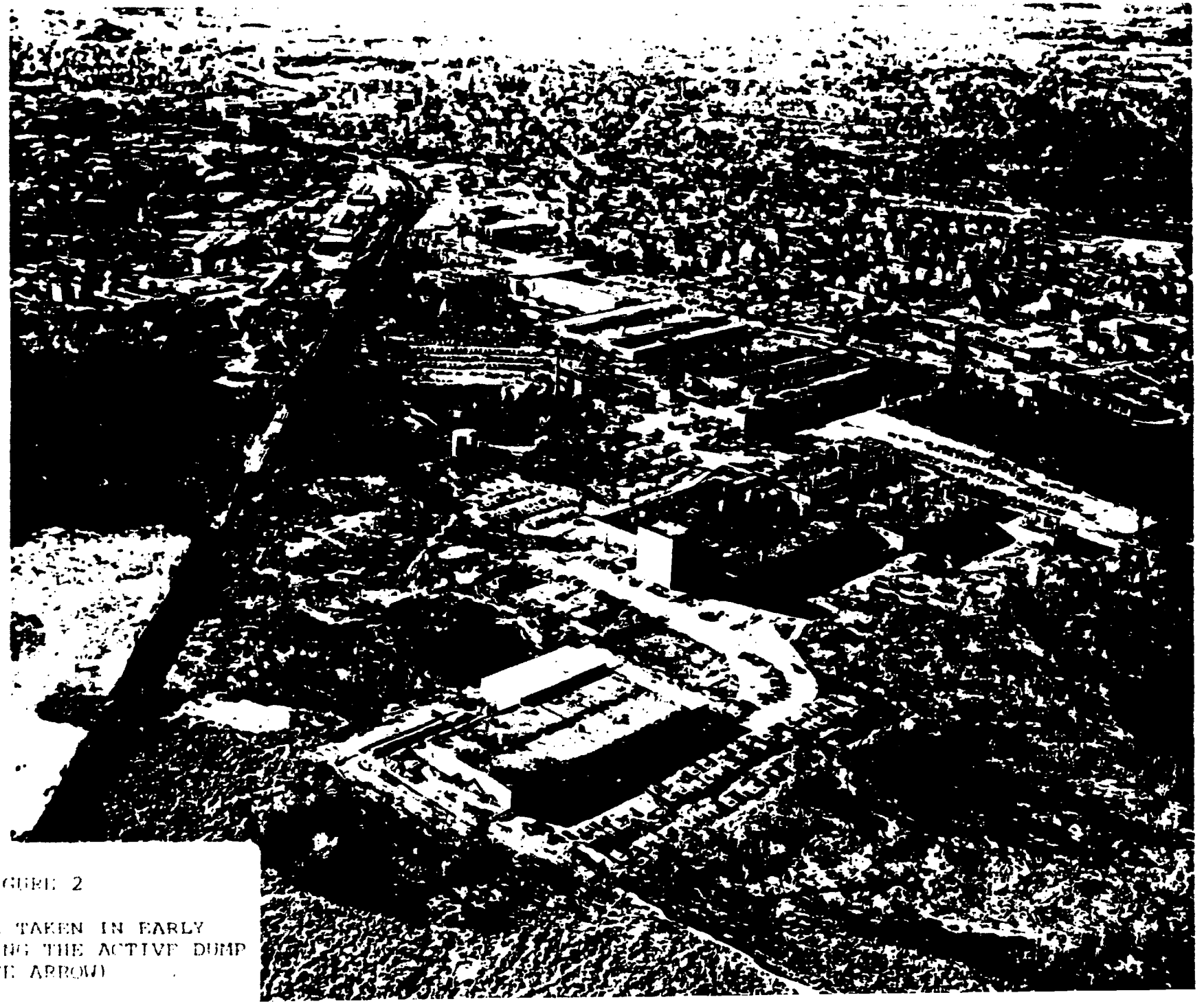


FIGURE 2

TOGRAPH TAKEN IN EARLY
S SHOWING THE ACTIVE DUMP
E. (NOTE ARROW)

FIGURE 4

PHOTOGRAPH TAKEN IN EARLY 1965 SHOWING THE ACTIVE DUMP SITE. (NOTE ARROW)

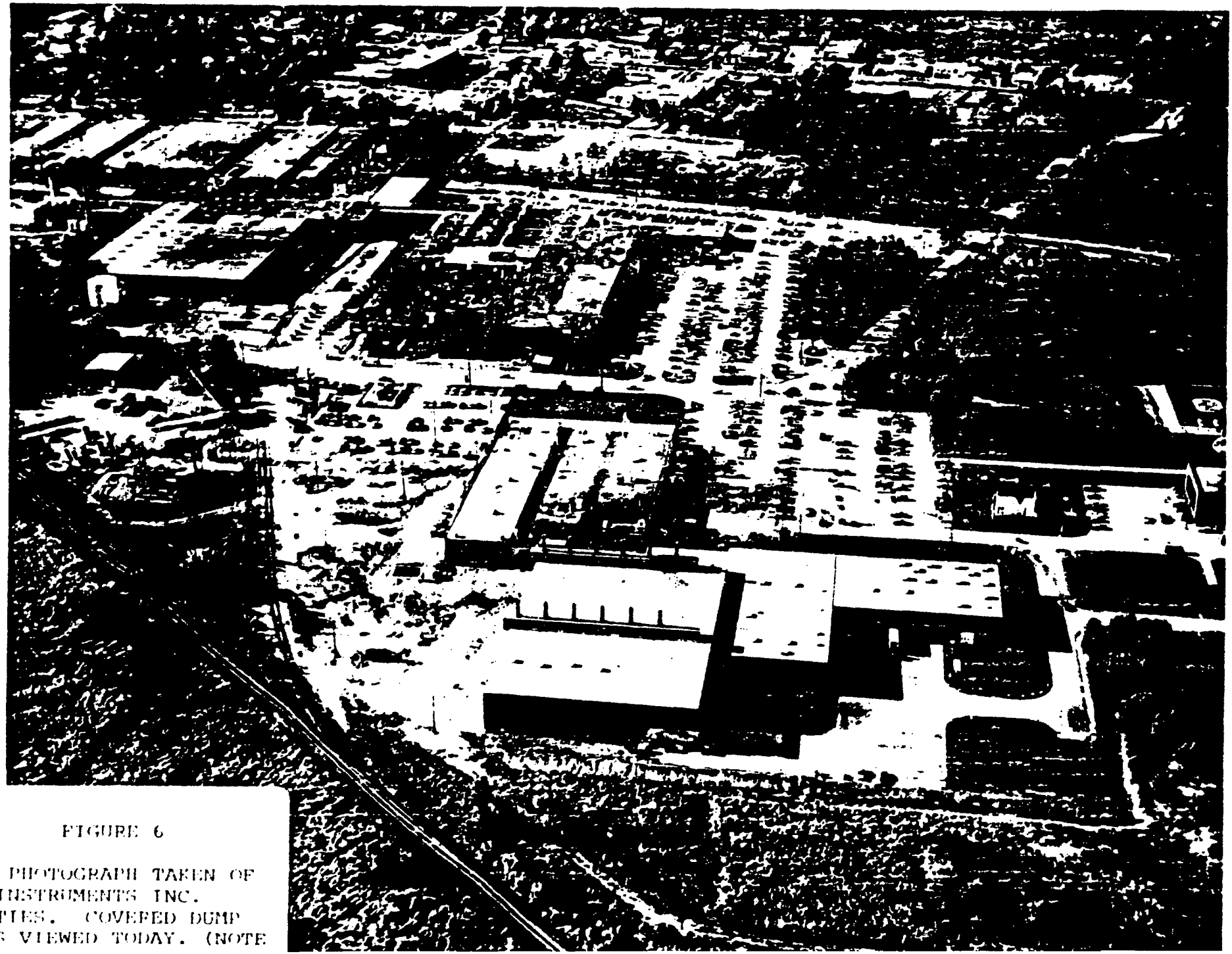


FIGURE 6

CENT PHOTOGRAPH TAKEN OF
XAS INSTRUMENTS INC.
CILITIES. COVERED DUMP
TE AS VIEWED TODAY. (NOTE

FIGURE 7
AERIAL PHOTOGRAPH TAKEN IN
[illegible] 1968 SHOWING BLDG 12
AS BEING CONSTRUCTED. NOTE
LOCATION OF BOMB SITE.

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF
DATE
HOLE NO. B-101
LINE & STA.
OFFSET
SURF. ELEV.

TO Texas Instruments | ADDRESS Attleboro, Mass.
PROJECT NAME Texas Instruments | LOCATION " "
REPORT SENT TO above | PROJ NO.
SAMPLES SENT TO Taken at Site | OUR JOB NO 83-146

GROUND WATER OBSERVATIONS
At 6' after Comp Hours
Wet
At ____ after ____ Hours

Rods "AW"	CASING	SAMPLER	CORE BAR
Type	BW	S/S	
Size I D	2½"	1 3/8"	
Hammer Wt	300#	140#	BIT
Hammer Fall	24"	30"	

	Date	Time
START	10/20/82	
COMPLETE	10/20/82	
TOTAL HRS.		
BORING FOREMAN	D Serowil	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPL No	Pen
		0'-1'	D	1	5		Damp		Brown Organic TOPSOIL	1	12"1
		1'-2'	D	7	3			2'		2	12"1
		2'-3'	D	4	3			3'	Black Organic PEAT	3	12"1
		3'-4'	D	5	10				Gray fine SAND, little silt	4	12"1
		4'-5'	D	12	9			5'6"		5	12"1
		5'-6'	D	9	10		Wet			6	12"1
		6'-7'	D	6	10			7'	Brown silty fine SAND, trace of gravel	7	12"1
		7'-8'	D	11	13				Gray fine SAND, trace silt	8	12"1
		8'-9'	D							9	12"1
		9'-10'	D					10'		10	12"1
									Bottom of Boring 10		

DRILLED FROM 0 TO 10 USED BW CASING THEN

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%

140 lb Wt x 30" Fall on 2 O D Sampler
Cohesionless Density: 0-10 Loose; 10-30 Med Dense; 30-50 Dense
Cohesive Consistency: 0-4 Soft; 4-8 M/Stiff; 8C + Hard

SUMMARY
Earth Boring 10'
Rock Coring
Samples 10

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF
DATE
HOLE NO. B-10
LINE & STA.
OFFSET
SURF. ELEV.

TO Texas Instruments | ADDRESS Attleboro, Mass " "
PROJECT NAME Texas Instruments | LOCATION
REPORT SENT TO above | PROJ NO
SAMPLES SENT TO Taken at Site | OUR JOB NO 83-146

GROUND WATER OBSERVATIONS
At 9'6" Wet after Comp. Hours
At ____ after ____ Hours

Rods "AW"	CASING	SAMPLER	CORE BAR
Type	BW	S/S	
Size I D	2½"	1 3/8"	
Hammer Wt	300#	140#	BIT
Hammer Fall	24"	30"	

	Date	Time
START	10/20/82	
COMPLETE	10/20/82	
TOTAL HRS.		
BORING FOREMAN	D. SerowIK	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc Rock - color, type, condition, hardness, Drilling time, seams and etc	SAMPL No	Pen
		0'-1'	D	1	2		Damp	2"	Brown Organic TOPSOIL	1	12"
		1'-2'	D	3	6			12"	Brown silty fine SAND	2	12'
		2'-3'	D	13	19				Gray silty fine to medium	3	12'
		3'-4'	D	18	26				SAND, boulders (Till)	4	12'
		4'-5'	D	15	36					5	12'
		5'-6'	D	50	40					6	12'
		6'-7'	D	46	30					7	12'
		7'-8'	D	32	24					8	12'
		8'-9'	D	16	30		Wet			9	12'
		9'-9'6"	D	30	Ref				Bottom of Boring - Refusal 9'6"	10	6'

... TO 9'6" USED BW CASING THEN

Proportions Used: trace 0 to 10%; little 10 to 20%; some 20 to 35%

140 lb Wt x 30" fall on 2" O.D. Sampler
Cohesionless Density: 0-10 Loose; 10-30 Med Dense; 30-50 Dense
Cohesive Consistency: 0-4 Soft; 4-8 M/Stiff; 8-15 Stiff; 30 + Hard

SUMMARY
Earth Boring 9'
Rock Coring
Samples 10

TABLE 3

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF
DATE
HOLE NO. B-103
LINE & STA.
OFFSET
SURF. ELEV.

TO Texas Instuments
PROJECT NAME Texas Instuments
REPORT SENT TO above
SAMPLES SENT TO Taken at Site

ADDRESS Attlelboro, Mass.
" "
LOCATION
PROJ. NO.
OUR JOB NO. 83-146

GROUND WATER OBSERVATIONS
At 3'6" after Comp Hours
At ____ after ____ Hours

Rods "AW"	CASING	SAMPLER	CORE BAR
Type	BW	S/s	
Size I D	2½"	1 3/8"	
Hammer Wt	300#	140#	
Hammer Fall	24"	30"	BIT

	Date	Time
START	10/20/82	
COMPLETE	10/20/82	
TOTAL HRS.		
BORING FOREMAN	D. Serow	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

Depth	Casing Blows per Foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPL No	SAMPL Pen
		0'-1'	D	1	3		Damp	1'	Black Organic PEAT	1	12"
		1'-2'	D	2	1			1'6"	Gray silty fine SAND	2	12"
		2'-3'	D	P	1				Brown silty fine SAND, little	3	12"
		3'-4'	D	3	4				medium sand	4	12"
		4'-5'	D	6	8		V/wet			5	12"
		5'-6'	D	2	4				Gray fine SAND, trace silt	6	12"
		6'-7'	D	5	7					7	12"
		7'-8'	D	7	11					8	12"
		8'-9'	D	8	8			9'		9	12"
		9'-10'	D	9	8			10'	Gray silty fine SAND	10	12"
									Bottom of Boring 10'		

... 10' ... USED BW CASING THEN ____

... Test

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%

140 lb Wt x 30" Fall on 2 O.D. Sampler

Cohesionless Density		Cohesive Consistency	
0 - 10	Loose	0 - 4	Soft
10 - 30	Med Dense	4 - 8	M/Stiff
		30 +	Hard

SUMMARY
Earth Boring 1
Rock Coring
Samples 1

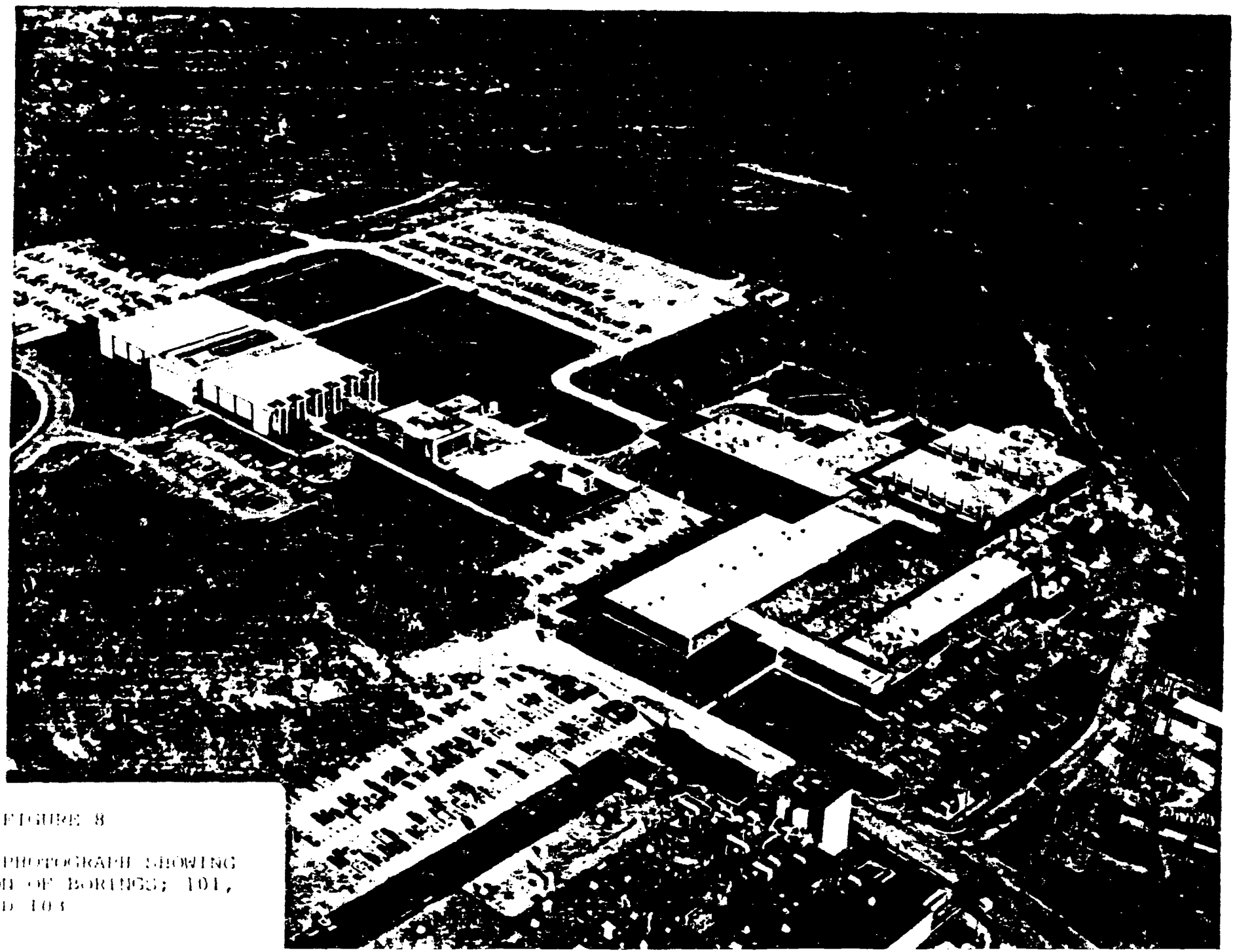


FIGURE 8

AERIAL PHOTOGRAPH SHOWING LOCATION OF BORINGS; 101, 102, AND 103

a=Alpha; b=Beta

	DEPTH	DATA PARTICLES	ACTIVITY IN PCI/GM
B-101	0'-1'	Gross a	4.37 ± 1.04
		Gross b	1.47 ± 0.10
	1'-2'	Gross a	6.38 ± 0.38
		Gross b	3.48 ± 0.15
	2'-3'	Gross a	3.30 ± 1.22
		Gross b	1.32 ± 0.11
	3'-4'	Gross a	6.38 ± 1.24
		Gross b	2.02 ± 0.12
	4'-5'	Gross a	3.30 ± 0.77
		Gross b	1.08 ± 0.09
	5'-6'	Gross a	3.38 ± 1.14
		Gross b	1.00 ± 0.08
	6'-7'	Gross a	3.38 ± 0.82
		Gross b	0.33 ± 0.08
	7'-8'	Gross a	7.70 ± 1.27
		Gross b	1.08 ± 0.08
	8'-9'	Gross a	4.26 ± 1.08
		Gross b	0.38 ± 0.08
	9'-10'	Gross a	2.19 ± 0.82
		Gross b	0.34 ± 0.08

	DEPTH	DATA PARTICLES	ACTIVITY IN PCI/GM
B-102	0'-1'	Gross 2	4.28 ± 1.74
		Gross β	0.33 ± 0.13
	1'-2'	Gross 2	5.86 ± 1.52
		Gross β	0.30 ± 0.12
	2'-3'	Gross 2	5.34 ± 2.01
		Gross β	0.35 ± 0.13
	3'-4'	Gross 2	4.95 ± 1.32
		Gross β	0.75 ± 0.12
	4'-5'	Gross 2	5.63 ± 1.30
		Gross β	0.32 ± 0.12
	5'-6'	Gross 2	4.34 ± 1.31
		Gross β	0.31 ± 0.12
	6'-7'	Gross 2	4.34 ± 1.31
		Gross β	0.34 ± 0.12
	7'-8'	Gross 2	3.72 ± 1.37
		Gross β	0.34 ± 0.12
	8'-9'	Gross 2	5.07 ± 1.33
		Gross β	0.32 ± 0.13
	9'-9.5'	Gross 2	4.36 ± 1.71
		Gross β	0.36 ± 0.11

	DEPTH	DATA PARTICLES	ACTIVITY IN PCI/GM
B-103	0'-1'	Gross 2	6.19 ± 1.38
		Gross β	1.75 ± 0.17
	1'-2'	Gross 2	8.83 ± 1.89
		Gross β	1.48 ± 0.15
	2'-3'	Gross 2	8.37 ± 1.84
		Gross β	1.20 ± 0.14
	3'-4'	Gross 2	8.28 ± 1.86
		Gross β	0.73 ± .12
	4'-5'	Gross 2	7.39 ± 2.58
		Gross β	0.87 ± 0.12
	5'-6'	Gross 2	2.47 ± 1.83
		Gross β	1.02 ± 0.15
	6'-7'	Gross 2	4.35 ± 1.82
		Gross β	0.86 ± 0.14
	7'-8'	Gross 2	5.18 ± 1.77
		Gross β	0.98 ± 0.15
	8'-9'	Gross 2	6.37 ± 1.98
		Gross β	0.91 ± 0.15
	9'-10'	Gross 2	5.88 ± 2.14
		Gross β	1.24 ± 0.16

a. Grid Area:

TI's Environmental Engineering Department conducted a ground radiological survey over the dump site and grounds surrounding Bldg. 12 from September through October of 1982. Gamma-ray data were collected from all areas which could have been contaminated with material or soil from the dumpsite during construction. This area was divided into grids of 25 square feet. Each grid was carefully marked off on the property prior to the survey. Five readings were taken from each grid, one at each corner and one in the center at 1 meter above the surface. The highest gamma radiation reading from each grid was recorded in micro rads/hr.

Figure 3 shows an aerial view of the surveyed area and its relation to the dump site (note black detailing around area surveyed).

b. Instrumentation and Calibration:

A Ludlum Model 12 portable Micro R meter containing a 1" x 1" NaI crystal coupled to a RCA-8199 photomultiplier tube measured the gamma radiation levels. Readings were taken directly from the meter after stabilization for at least a 45-second interval.

Ranges were calibrated with a Ludlum Model 500 Pulser and a CS 137 source traceable to 435, 182 MR/HR at 1 meter TFN 224008-Oct. 2, 1982.

C. Results

The results of the radiological survey are presented in Table C. External gamma ray measurements ranged from between 8 and 14 micro r*/hr. An average value of 9 micro r/hr was observed over the entire grid area. Exposure to this average level for 2K hrs/yr, a typical work year, would lead to an exposure of 13K micro-roentgens. For comparison a typical chest x-ray (according to the Department of Health, Education and Welfare data) might yield an exposure of 27K micro roentgens. This is more than double the exposure found within the grid area. Two localized areas measured at the maximum range of 14 micro r/hr can be found approximately 200 yds S.W. & 150 yds E. of the original dump site, at grid locations H-16 and W-12 respectively.

* A roentgen is a unit defined for radiation protection purposes for people exposed to penetrating gamma radiation. A micro-roentgen is one-millonth of a roentgen.

D. Background Radiological Characteristics:

Background radiological characteristics were developed from measurements taken off-site and within a one-mile radius of TI's property. Information was also gathered from selected data and published reports. The majority was obtained from the Environmental Radiation Ambient Monitoring System (ERAMS) surveillance program of the EPA's Office of Radiation Programs and from the Dept. of Energy's Radiological survey of the Shpack Landfill, Norton, MA, conducted by Oak Ridge National Laboratory dated 12/81, (DOE/EV-0005/31 ORNL-5799).

Levels obtained by direct measurement off-site showed a range of between 7 and 10 micro-roentgens/hr with an average of 8 micro-rotengens/hr. Information obtained for reports indicated the average background levels in the Attleboro/Norton area to be 7 micro-roentgens/hr.

The total body dose from natural background in the vicinity of Attleboro, MA is expected to be similar to that reported for the states of Massachusetts, Rhode Island, and Connecticut (USEPA 1977). Estimates of exposure from cosmic, terrestrial, and internal sources appear in Table 7.

E. Comparison to the Dept. of Energy Survey:

An aerial radiological survey was conducted over the TI industrial complex in Attleboro, Massachusetts from June 16 through 23, 1981. The survey was conducted at an altitude of 46m (150 ft) by a helicopter containing twenty sodium iodide detectors.

Gamma-ray data were collected over a 40 Km² (approximately 16 square miles) area centered on the complex by flying north-south lines spaced 76m (250 ft) apart. The processed data indicated that detected radioisotopes and their associated gamma-ray exposure rates were consistent with those expected from normal background emitters. External exposure rates were between 6 and 12 micro-roentgens per hour (ur/h) over the dump site. A small area to the southeast of the area showed levels in the 11-16 range.

The survey of the TI industrial complex was requested by the United States Nuclear Regulatory Commission (NRC), and was conducted by the United States Department of Energy's (DOE's) Remote Sensing Laboratory (RSL). The RSL is operated for DOE by EG&G, an independent contractor.

These results are consistent with the measurements obtained from the TI Radiological Survey.

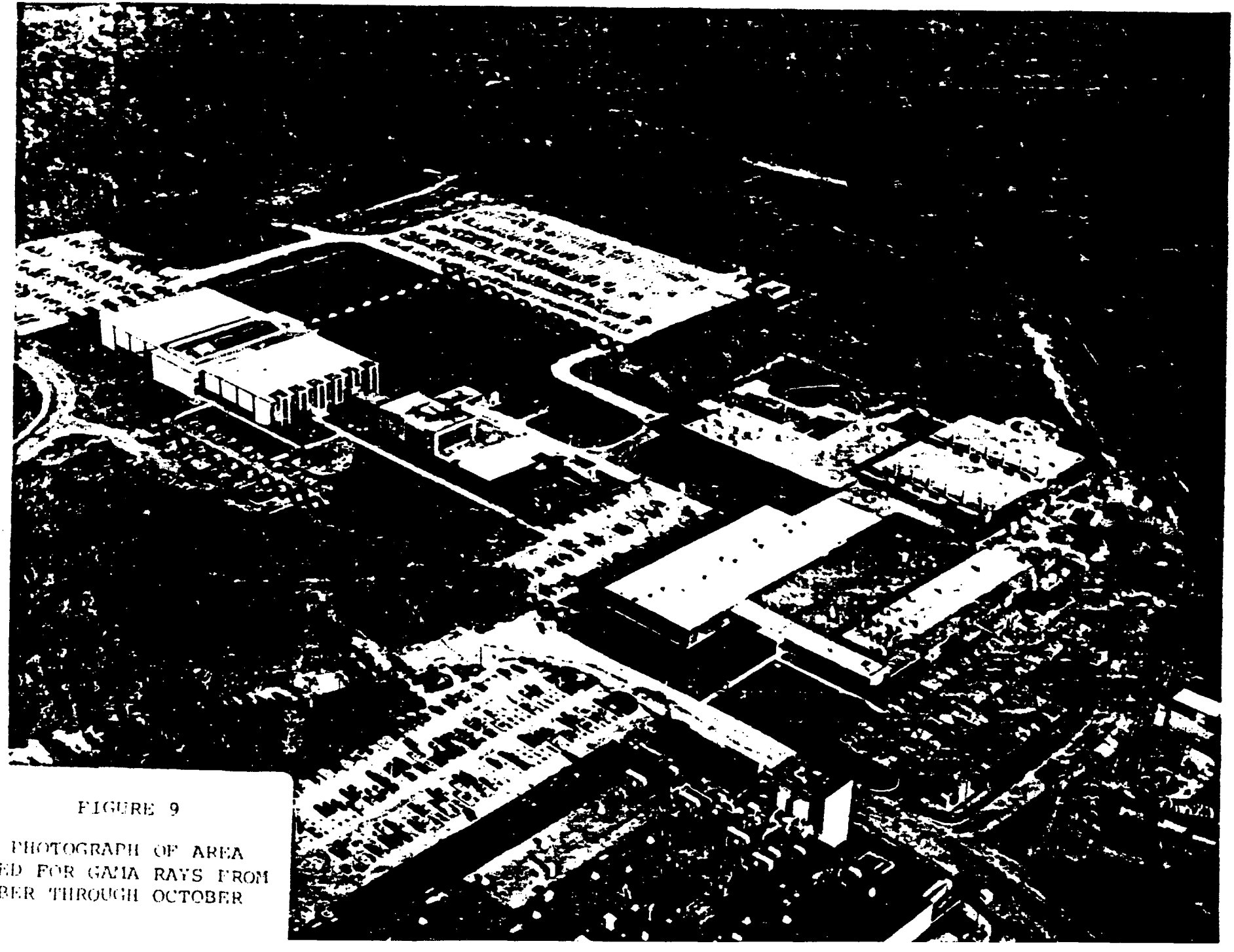


FIGURE 9

IAL PHOTOGRAPH OF AREA
VETED FOR GAMA RAYS FROM
TEMBER THROUGH OCTOBER
2.

DESIGNER AND MANUFACTURER
OF
Scientific and Industrial
INSTRUMENTS

LUDLUM MEASUREMENTS, INC.
915 · 235-5494
POST OFFICE BOX 248
501 OAK STREET
SWEETWATER, TEXAS, U.S.A. 79556

Diane Stevenson

CERTIFICATION OF CALIBRATION

CUSTOMER: CEP ORDER NO. 80-1650

Model No. 12 S/N 1460

Detector Model No. 44-2 S/N USN

Type of Source: Cs137

Size of Source: 150 mCi

Range	Calibration Point	Dial Reading
		0
X1000	(2000 uR) 2 mr/hr	2
X1000	(1000 uR) 1 mr/hr	1
X100, X10, X1	Range(s) calibrated with a Ludlum Model 500 Pulser	

Cs137 source traceable to NBS, 142 Mr/HR @ 1 meter TFN224008—Oct. 2, 1980.

Date 4-8-82 Signature Louise R. Ludlum

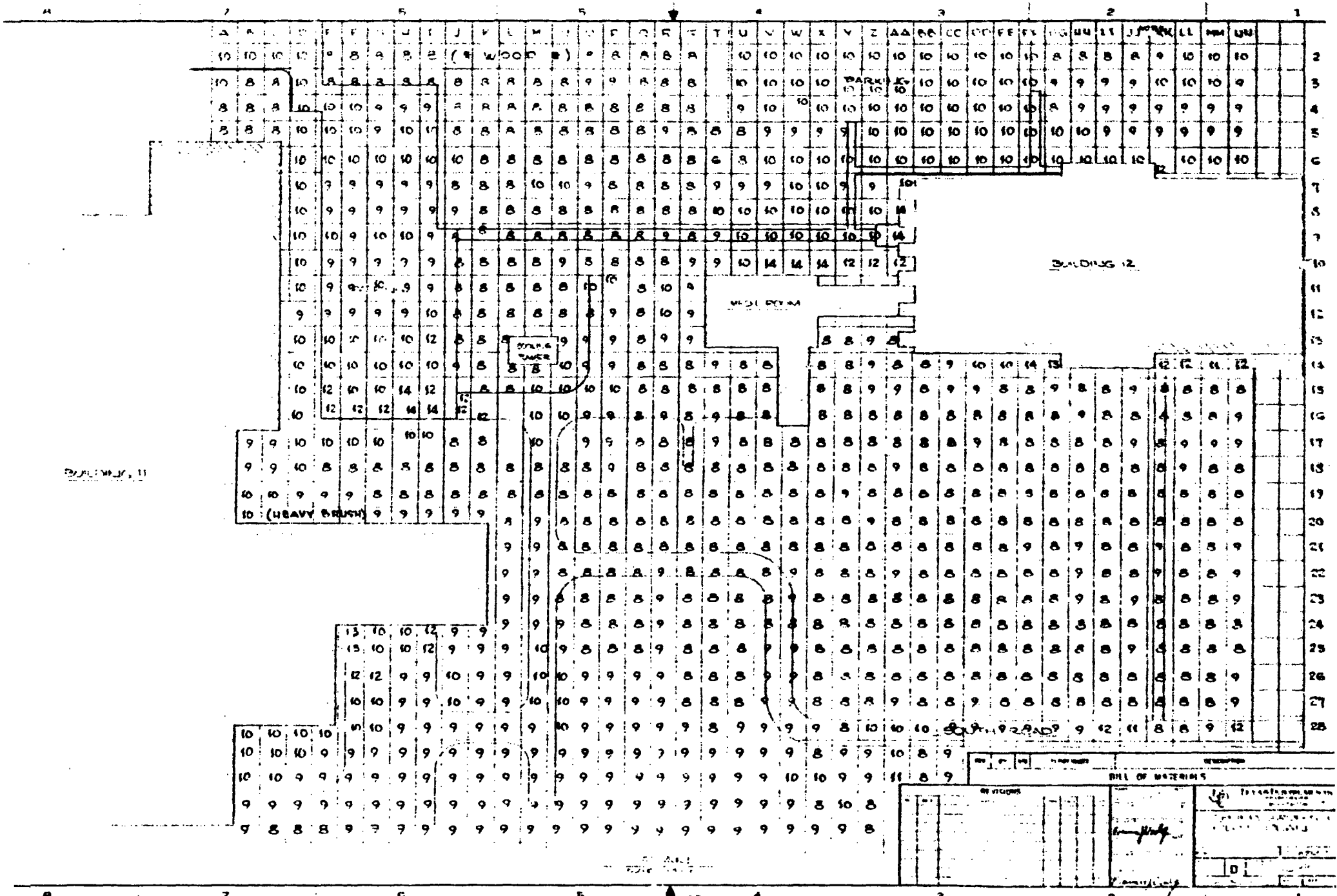

BUILDING 12
BUILDING 11
(HEAVY BRUSH)
BILL OF MATERIALS

Table 7

Estimated annual Total Body Dose of Radioactivity from Natural Background in Vicinity of Attleboro, Massachusetts (mrem per person)

State	Cosmic	Terrestrial	Internal	Total
Massachusetts	40	75	18	133
Rhode Island	40	65	18	123
Connecticut	40	60	18	118

A. Techniques and Methodology:

For this study a series of 8 wells were driven to bedrock, all located approximatley 150 feet from the initial dump-site boundary. Note Table 3. Sampling occurred between May and October of 1982.

All water samples were drawn by means of a groundwater monitoring pump manufactured by I.E.A., Essex Junction, Vermont. Integrity was assured by purging each well prior to sampling, and by effective cleaning of all equipment after each well sample. To be assured of no cross contamination in the wells sampled, the following technique was performed: after a well was sampled the groundwater pump used to obtain the sample was flushed for 30 minutes with fresh water. Then a sample of the cleaning water was taken and filtered through a 0.45 micron filter and analized for gross alpha and beta contamination by CEP (New Mexico). No appreciable levels of radiochemical activity were observed.

Samples were divided into duplicates and sent to CEP (New Mexico) and the USNRC King of Prussia, Pennsylvania for analysis. For a complete discussion on analytical methodologies, preparation methods, instruments used, calculation method and quality assurance plan please refer to Appendix A.

CEP analiyzed all samples for activity in water (pci/liter) for both dissolved and suspended solids as determined in water and pci/gm on suspended solids, note Table 9. In addition an isotopic scan was performed on the water from well-27, these results are given in Table 10.

based upon the results obtained from Table 9 and 10, it was decided that the overall activity appeared to be the greatest near well 27. It also appeared from the photographic review of this area, that the material previously deposited in the dump site may have been graded or pushed in this location.

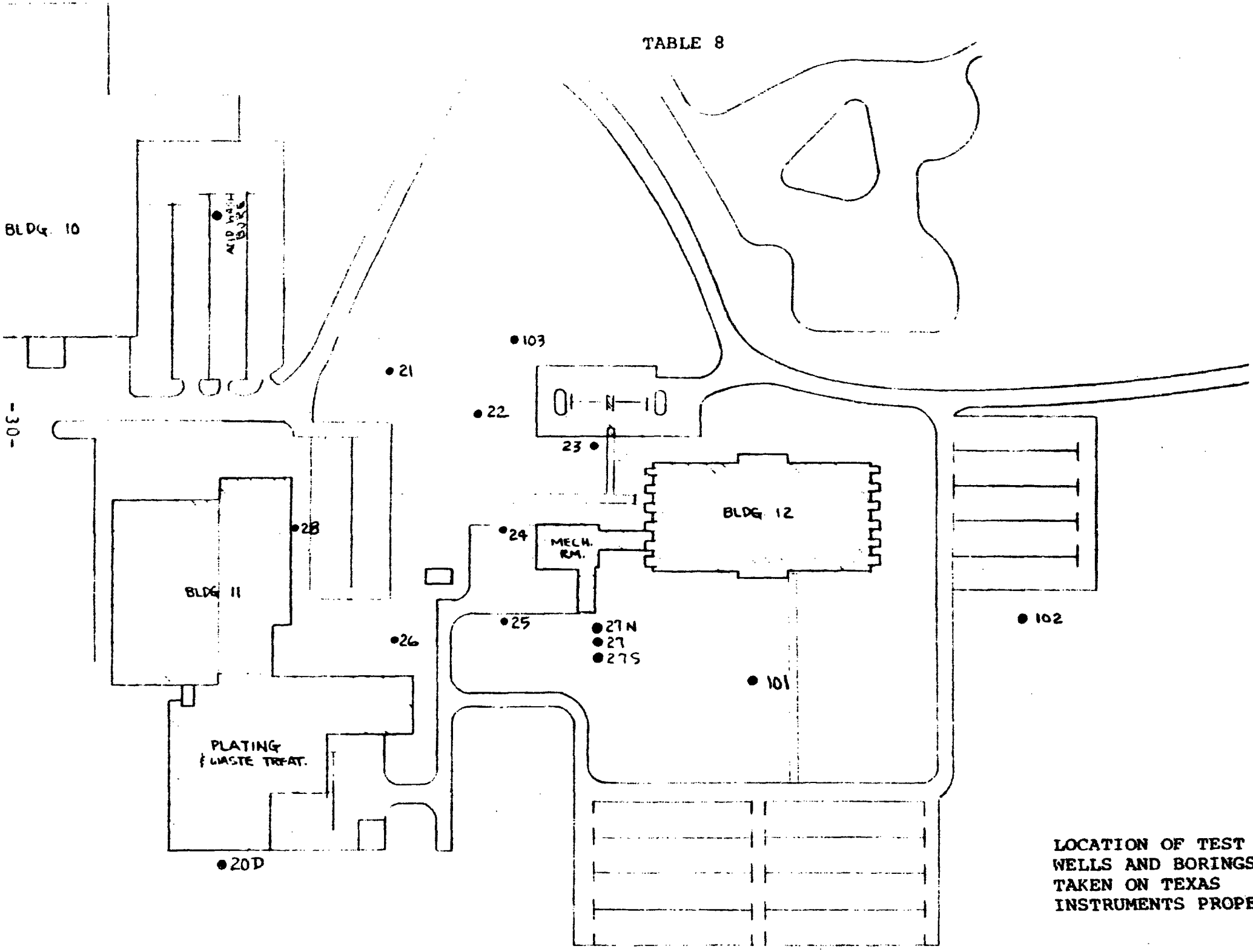
Two cores 27N and 27S were drilled approximately 2 feet from each other by Guild Drilling Company. Each core was driven to bedrock and sectioned into 2 foot intervals. Analysis was performed for gross alpha; and beta and the following isotopes; radium-226; uranium-234, -235, and -238; thorium-228, -230 and -232. Results of these analysis are given in Table 13. Boring records are given in Tables 11 and 12.

The core taken from the acid area was analyzed by I.E.A., Essex Junction, Vt., no levels above background were detected. Gross alpha in pci/liter was reported at 7 $\pm$ 6; gross beta- K-40 at 9 $\pm$ 5 and total uranuim in mg/l at 0.002. These levels are reported in pci/liters as an EPA 24 hour extraction procedure was performed. The procedure for this test is outlined in the May 19, 1980 Federal Register, Volume 45, Number 98, pages 33127 through 33133.

C. Background Measurements:

The DOE measured recent soil background in the Norton-Attleboro area in 1981 of 0.84 p ci for 226 Ra and 0.66 p ci for 238 U per gram of soil. Ranges for 226 Ra varied between 0.48 and 0.80 pci/gram of soil and between 0.50 and 0.88 pci/gram of soil for 238 U.

TABLE 8



LOCATION OF TEST WELLS AND BORINGS TAKEN ON TEXAS INSTRUMENTS PROPE

TABLE 5

Sample Identification	Type of Analysis	Suspended pCi/liter	Dissolved pCi/liter	Suspended Solids pCi/gram
#21	Gross Alpha	15 ± 3	2	34 ± 15
	Gross Beta	13 ± 3	3	23 ± 5
#22	Gross Alpha	97 ± 36	15 ± 4	13 ± 10
	Gross Beta	66 ± 6	10 ± 2	17 ± 1
#23	Gross Alpha	6 ± 4		34 ± 27
	Gross Beta	3		None Detected
#24	Gross Alpha	2	3 ± 6	None Detected
	Gross Beta	3		None Detected
#25	Gross Alpha	112 ± 33	2 ± 6	53 ± 15
	Gross Beta	59 ± 5	3 ± 2	23 ± 2.
#26	Gross Alpha	23 ± 10	2	34 ± 33
	Gross Beta	57 ± 3	3 ± 2	202 ± 31
27	Gross Alpha	62 ± 35	23 ± 6	61 ± 10
	Gross Beta	6 ± 2	125 ± 11	3 ± 1
#28	Gross Alpha	157 ± 42	2	20 ± 5
	Gross Beta	128 ± 6	7 ± 2	15 ± 1

Table 10

ISOTOPIC SOIL FROM WELL 27
(PCI/LITER)

	URANIUM 234	URANIUM 235	URANIUM 238
Well 27	25.3 ± 3.6	3.3 ± 0.9	52.0 ± 3.3
	THORIUM 228	THORIUM 230	THORIUM 232
Well 27	13.6 ± 1.7	5.0 ± 1.4	9.5 ± 1.4

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF
DATE
HOLE NO. R-27-N
LINE & STA.
OFFSET
SURF. ELEV.

TO Texas Instruments
PROJECT NAME Texas Instruments
REPORT SENT TO above
SAMPLES SENT TO taken at site

ADDRESS Attleboro, Mass.
LOCATION ATTLEBORO, MASS.
PROJ NO
OUR JOB NO 83-35

GROUND WATER OBSERVATIONS
At Comp after Hours
At after Hours

	Rods-AW	CASING	SAMPLER	CORE BAR
Type		BW	S/S	
Size I.D		2½"	1-3/8"	
Hammer Wt		300#	140#	BIT
Hammer Fall		24"	30"	

	Date	Time
START	8/25/82	
COMPLETE	8/25/82	
TOTAL HRS.		
BORING FOREMAN	D. Serowik	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per foot	Sample Depths From - To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	SAMPLE Pen
		0'- 2'	D	4	10	15	12	0'4"	Brown organic TOPSOIL	1	24"
				(140# wt.)							
		2'- 4'	D	12	15	11	16		Gray silty fine SAND & gravel, TILL	2	24"
				(300# wt.)							
		4'- 6'	D	8	4	4	6			3	24"
				(300# wt.)				6'-0"			
		8'- 8'	D	5	5	4	4			4	24"
				(140# wt.)					Gray-brown silty fine SAND, Little cobbles		
		9'- 10'	D	4	3	5	7			5	24"
				(140# wt.)							
		11'-12'	D	5	7	7	15			6	24"
								12'-6"	Refusal 12'-6"		
									Bottom of Boring 12'-6"		

[illegible] REAMED TO 10' USED 2½ CASING. THEN S/S to 12'6"

[illegible] Test
[illegible] Test
[illegible] Cone Test
[illegible] Undisturbed Sample

Proportions Used

trace	0 to 10%
little	10 to 20%
some	20 to 35%
and	35 to 50%

140 lb Wt x 30" fall on 2" O.D. Sampler

Cohesionless Density		Cohesive Consistency		
0-10	Loose	0-4	Soft	30 + Hard
10-30	Med Dense	4-8	M/Stiff	
30-50	Dense	8-15	Stiff	

SUMMARY:
Earth Boring 12
Rock Coring
Samples 6

TABLE 12

GUILD DRILLING CO., INC.

100 WATER STREET EAST PROVIDENCE, R I

SHEET 1 OF
DATE
HOLE NO. B-27-S
LINE & STA.
OFFSET
SURF. ELEV.

TO Texas Instruments
PROJECT NAME Texas Instruments
REPORT SENT TO above
SAMPLES SENT TO taken at site

ADDRESS Attlebero, Mass.
LOCATION ATTLEBORO, MASS.
PROJ NO
OUR JOB NO 83-25

GROUND WATER OBSERVATIONS
At [illegible] after ____ Hours
At ____ after ____ Hours

	Rods-AW	CASING	SAMPLER	CORE BAR
Type		BW	S/S	
Size I D		2 1/2"	1-3/8"	
Hammer Wt		300#	140#	BIT
Hammer Fal		24"	30"	

	Date	Time
START	8/25/82	
COMPLETE	8/25/82	
TOTAL HRS.		
BORING FOREMAN	D. Serowik	
INSPECTOR		
SOILS ENGR.		

LOCATION OF BORING

DEPTH	Casing Blows per Foot	Sample Depths Ft. To	Type of Sample	Blows per 6" on Sampler From 0-6	To 6-12	To 12-18	Moisture Density or Consist	Strata Change Elev	SOIL IDENTIFICATION Remarks include color, gradation, Type of soil etc Rock-color, type, condition, hardness, Drilling time, seams and etc	SAMPLE No	Pen	Rec
		0'- 2'	D	2	3	3	10	0'4"	Brown organic TOPSOIL	1	24	1
				(140#wt)								
		2'- 4'	D	5	12	29	20		Brown-gray silty fine SAND & gravel, some cobbles, FILL	2	24	1
				(300# wt.)								
		4'- 6'	D	12	10	9	14			3	24	1
				(140#wt.)				6'-0"				
		6'- 8'	D	4	3	4	8		Gray-brown fine silty SAND & gravel, little coarse gravel	4	24	1
				(140# wt.)								
		8'- 10'	D	4	5	6	12			5	24	3
				(140#wt.)								
		10'- 10'11"	D	12	84for5"			10'-11"	Refusal	6	11	
				(300#wt.)					Bottom of Boring 10'-11"			

USED BW CASING THEN S/S to 10'-11" -refusal

Proportions Used
trace 0 to 10%
little 10 to 20%
some 20 to 35%

140 lb Wt x 30" fall on 2 O D Sampler
Cohesionless Density: 0-10 Loose; 10-30 Med Dense
Cohesive Consistency: 0-4 Soft; 4-8 M/Stiff; 30 + Hard

SUMMARY
Earth Boring 10'-11"
Rock Coring
Samples

SAMPLE IDENTIFICATION	TYPE OF ANALYSIS	PCI/GRAM
27[illegible] 0-2'	Gross Alpha	5.09 + 1.23
	Gross Beta	5.79 + 0.82
	Radium-226	1.00 + 0.09
	Uranium-234	0.40 + 0.07
	Uranium-235	0.05 + 0.03
	Uranium-238	0.35 + 0.07
	Thorium-228	0.05 + 0.02
	Thorium-230	0.05
	Thorium-232	0.10 + 0.03
27[illegible] 2'-4'	Gross Alpha	13.0 + 1.7
	Gross Beta	11.1 + 1.0
	Radium-226	3.38 + 0.[illegible]
	Uranium-234	0.42 + 0.0[illegible]
	Uranium-235	0.11 + 0.0[illegible]
	Uranium-238	1.70 + 0.13
	Thorium-228	0.08
	Thorium-230	0.05
	Thorium-232	0.10 + 0.03
27[illegible] 4'-6'	Gross Alpha	17.0 + 1.9
	Gross Beta	15.2 + 1.2
	Radium-226	3.12 + 0.33
	Uranium-234	0.93 + 0.11
	Uranium-235	0.06 + 0.02
	Uranium-238	1.36 + 0.1[illegible]
	Thorium-228	0.11 + 0.02
	Thorium-230	0.09 + 0.02
	Thorium-232	0.12 + 0.03

27.4 6'-8'	Gross Alpha	11.0 + 1.8
	Gross Beta	10.7 + 1.0
	Radium-226	2.34 + 0.13
	Uranium-234	0.20 + 0.12
	Uranium-235	0.17 + 0.06
	Uranium-238	1.35 + 0.17
	Thorium-228	0.07 + 0.02
	Thorium-230	0.05
	Thorium-232	0.05
27.4 8'-10'	Gross Alpha	7.46 + 1.35
	Gross Beta	6.59 + 0.85
	Radium-226	2.57 + 0.11
	Uranium-234	0.15 + 0.05
	Uranium-235	0.05 + 0.03
	Uranium-238	0.37 + 0.09
	Thorium-228	0.06 + 0.02
	Thorium-230	0.05
	Thorium-232	0.12 + 0.03
27.4 10'-12'	Gross Alpha	12.7 + 1.3
	Gross Beta	16.9 + 1.2
	Radium-226	2.10 + 0.11
	Uranium-234	0.05
	Uranium-235	0.05
	Uranium-238	0.05
	Thorium-228	0.05 + 0.02
	Thorium-230	0.05
	Thorium-232	0.03 + 0.03

275 0'-2'	Gross Alpha	7.38 + 1.55
	Gross Beta	3.34 + 0.71
	Radium-226	2.55 + 0.12
	Uranium-234	1.43 + 0.08
	Uranium-235	0.11 + 0.02
	Uranium-238	2.76 + 0.11
	Thorium-228	0.05
	Thorium-230	0.05
	Thorium-232	0.05
275 2'-4'	Gross Alpha	6.63 + 1.41
	Gross Beta	4.49 + 0.77
	Radium-226	2.09 + 0.14
	Uranium-234	0.22 + 0.04
	Uranium-235	0.05 + 0.03
	Uranium-238	0.14 + 0.03
	Thorium-228	0.11 + 0.03
	Thorium-230	0.09 + 0.03
	Thorium-232	0.11 + 0.03
275 4'-6'	Gross Alpha	21.3 + 2.1
	Gross Beta	25.7 + 1.4
	Radium-226	2.22 + 0.13
	Uranium-234	0.49 + 0.06
	Uranium-235	0.09 + 0.02
	Uranium-238	0.44 + 0.17
	Thorium-228	0.12 + 0.02
	Thorium-230	0.43 + 0.04
	Thorium-232	0.30 + 0.05

275 5'-8'	Gross Alpha	22.7 + 2.2
	Gross Beta	25.0 + 1.4
	Radium-226	2.50 + 0.13
	Uranium-234	1.04 + 0.14
	Uranium-235	0.13 + 0.07
	Uranium-238	3.40 + 0.25
	Thorium-228	0.05
	Thorium-230	0.11 + 0.03
	Thorium-232	0.19 + 0.04
275 8'-10'	Gross Alpha	1.75 + 0.27
	Gross Beta	3.74 + 0.7[illegible]
	Radium-226	2.25 + 0.12
	Uranium-234	0.75 + 0.10
	Uranium-235	0.05 + 0.03
	Uranium-238	0.15 + 0.05
	Thorium-228	0.11 + 0.03
	Thorium-230	0.05
	Thorium-232	0.15 + 0.04
275 10'-10' 11"	Gross Alpha	10.0 + 1.3
	Gross Beta	5.98 + 0.74
	Radium-226	1.30 + 0.10
	Uranium-234	0.73 + 0.05
	Uranium-235	0.05 + 0.03
	Uranium-238	0.39 + 0.04
	Thorium-228	0.09 + 0.03
	Thorium-230	0.05 + 0.02
	Thorium-232	0.11 + 0.03

A. PHYSIOGRAPHY

The Attleboro facility is located in the Seaboard Lowland section of the New England physiographic province. This section is a strip of land along the coast; it rises little more than 500 feet above sea level and extends eastward from Connecticut through Rhode Island, Massachusetts, and New Hampshire into Maine. Immediately north of the Attleboro area there is probably a transition zone between the lowland and the New England upland section.

Present topographic features are probably the result of glacial and recent erosion. The study area is underlain predominantly by a weak rock belt of carboniferous sedimentary rocks. Glacial erosion was undoubtedly greater on the weak than on the strong rock belts, thus accentuating the lineation of the topographic features, small hills and valleys that generally trend northwest and southeast. The Ten Mile River basin, the primary watershed within the study area, was formed by these erosional processes.

Elevations range from 50 feet (plains and valleys) in the southern part to 400 feet above sea level (uplands) near Plainville in the northern part of the TI facility.

3. STRUCTURE AND STRATIGRAPHY

The Attleboro area lies entirely within the Narragansett basin, a structural basin and topographic lowland that is partly submerged to the south by the waters of Narragansett Bay. The axis of a northeastward-striking syncline is present in the southern portion of the mapped area. The axis continues eastward to the city of Taunton (USGS 1967a). In addition, an anticline may be present in the northern half of the mapped area; the probable axis extends east-northeast from west of Watson Pond (USGS 1967a).

The rocks in the Narragansett basin are sedimentary, of Pennsylvanian age, and approximately 12,000 feet thick (USGS 1976a). The Pondville conglomerate of Pennsylvanian age, the oldest rock exposed in the basin, lies unconformably on older crystalline rocks. The Rhode Island formation, the most extensive bedrock of the basin, overlies the Pondville conglomerate and the Wamsutta formation and, in places, rests directly upon the pre-Pennsylvanian crystalline rocks. The Pennsylvanian rocks probably were deposited in the broad crustal downwarp of the Narragansett basin. No marine fossils are found in the rocks of this age, so the basin probably was separated from the sea during all of Pennsylvanian time. A general uplift near the end of the Pennsylvanian period may have been related to a late phase of the Appalachian revolution (USGS 1967a); however, uplifts in the Tertiary period and subsequent erosion resulted in a deep dissection of central and eastern Massachusetts and removal of the sediments from the Attleboro area.

Valleys that were formed in the Narragansett Bay area and then filled with glacial deposits are now well below sea level, indicating that the preglacial land surface was much higher relative to sea level than the present land surface. The Taunton River to the southeast of Attleboro, for example, flows above a preglacial valley, the floor of which is covered with glacial drift and is generally about 30 to 60 feet below sea level (USGS 1967a).

Unconsolidated deposits of Quaternary age mantle almost all of the Attleboro region. The glacial deposits were laid down by at least two continental ice sheets that extended as far south as Long Island and New Jersey. The glaciers removed most of the preglacial soil mantle and abraded the rock below but left some scattered weathered bedrock. Material eroded by the glaciers was transported and deposited as till by the ice, as sand and gravel by melt-water streams, and as silt and clay in lakes. Some till lies directly on bedrock; in other cases, it is overlain by many small, thin swamps containing muck and peat and by stream courses with postglacial alluvium. Silt and clay accumulated in temporary lakes and ponds and thus are present locally at the base of, within, or on top of deposits of sand and gravel. Some of these deposits have since become buried by alluvium and swamp deposits. Nonglacial surficial deposits within the glaciated area are relatively minor in extent and thickness. Streams have deposited alluvium along their courses since the last glacier receded. These deposits commonly overlie till, which is also locally exposed at the surface.

C. ENGINEERING GEOLOGY

Foundation conditions in the Attleboro area can be directly correlated with the surficial geology. The bearing capacity of the till is generally good (3 to 32 tons per square foot) because of high density and poor sorting. Expansion is negligible. The bearing capacity of the stratified glacial deposits and alluvium can be differentiated by sand/gravel and silt/clay, the former being rated fair (4 to 8 tons per square foot) to poor (1 to 4 tons per square foot) and for silt and clay is very poor (less than 1 ton per square foot) to poor. Structures founded over small lenses of compressible clay or silt settle unevenly. Compressibility and expansion is negligible except in thick organic deposits (USGS 1970).

Conclusions

It appears from the information gathered in this study that the radioactivity level of waste material is sufficiently low so that no member of the public is expected to receive a radiation dose in excess of 1 millirad per year to the lung or 3 millirads per year to the bone from inhalation and ingestion. These radiation dose guidelines were recommended by the Environmental Protection Agency (EPA) for protection against transuranium elements present in the environment as a result of unplanned contamination (42 FR 60590-60593). The concentrations on Texas Instruments Inc. property is sufficiently low so that no individual will receive an external dose greater than 10 microroentgens per hour above background. This was shown from the radiological survey conducted over the disposal area and discussed previously in this study.

All contaminated material is buried under soil which is covered by peat and a grass covering. Accessibility to any material would only be accomplished by digging into the soil. As Texas Instruments Inc. is patrolled by guards it is very unlikely this would occur.

Concentrations as noted in the test borings performed, fall below the concentrations given in the 40FR(52061-62063) option 1, which is based upon EPA cleanup standards. A summary of these maximum concentrations permitted under disposal options 1-4 is summarized in Table 14.

It is our contention that the activity of radioactive materials are sufficiently low on Texas Instruments Inc. property to justify their storage on-site. Because of the tremendous volume of soil in the area, which quantitatively would exceed 100,000 cubic yards to be disposed of, transportation to a licensed disposal site would not be practical nor justifiable from the standpoint to the public health. Accordingly we propose to leave the site intact and request full termination of SNM License no. 25 under NRC Option No. 1.

TABLE 14

SUMMARY OF RADIUM CONCENTRATIONS
PERMITTED UNDER DISPOSAL OPTIONS

Kind of Material	Levels in (pci/gm) Disposal Options 1	2	3	4
Natural Thorium (Th-232+Th-228) with daughters present and in equilibrium	10	50	-	200
Natural Uranium (U-238+U-234) with daughter present and in equilibrium	10	-	40	200
Depleted Uranium				
Soluble	25	100	-	1,000
Insoluble	35	500	-	3,000
Enriched Uranium				
Soluble	30	100	-	1,000
Insoluble	30	200	-	2,000

1. Based on EPA clean up standards.
2. Concentrations based on limiting individual doses to 170 mrem/yr.
3. Concentration based on limiting equivalent exposure to 0.02 working level or less.
4. Concentrations based on limiting individual doses to 500 mrem/yr and in case of natural uranium, limiting exposure to 0.02 working level or less.

INFORMATION FOR

TEXAS INSTRUMENTS

ATTLEBORO, MASSACHUSETTS

REGARDING

RADIOCHEMICAL ANALYSES ON

SOIL CORE SAMPLES

PREPARED BY

JAMES J. MUELLER

CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

1925 ROSINA STREET - POST OFFICE BOX 5351

SANTA FE, NEW MEXICO 87502

November 3, 1982

CONTENTS

Introduction

This document has been prepared by **Controls for Environmental Pollution, Inc., (CEP)** as requested by Frank Veale of Texas Instruments, Attleboro, Massachusetts.

The following discussion will include; analytical methodologies used to analyze Texas Instruments' soil samples, preparation methods, instrumentation used, calculation method and CEP's Quality Assurance Plan.

1.0 Analytical Methods

The procedures used for this contract are routinely utilized by CEP in the analyses of environmental samples. The analytical methods used have been studied collaboratively and found acceptable. CEP's analytical procedures are the same as, equal to, or better than those currently used by the Environmental Protection Agency. All data reported by CEP and the limit of sensitivity to each analytical measurement technique is reported at the 95% confidence level. These methods are derived from, "EML Procedure Manual", HASL-300, U.S. Department of Energy, New York, N.Y., U.S. Environmental Protection Agency "Radiochemical Method Manual", Los Alamos Scientific Laboratory "Radiochemical Procedures", LA-1721 and J.J. Mueller, "Radio and Water Chemistry Manual", June 1966, ACNP-66538.

1.1 Soil Samples

1.1.1 Sample Preparation Method

The following soil sample preparation method is used routinely by CEP and was used for the Texas Instruments Project:

1.1.1.1 The plastic containers were opened when they arrived at the CEP laboratory and their contents transferred into new clean drying pans.

1.1.1.2 The drying pans filled with soil were placed into an oven at 110°C and allowed to dry thoroughly.

1.1.1.3 After the soil was thoroughly dried, the soil was pulverized to approximately one-hundred mesh.

1.1.1.4 After the entire soil sample was ground to one-hundred mesh, the soil was mixed and separated utilizing a splitter box technique.

1.1.1.5 The thoroughly mixed soil sample was spread out on new clear plastic, marked off into quarters, and aliquots taken from each quarter until a uniform sample was collected for analysis.

1.1.2 Gross Alpha and Beta

A 10-gram aliquot of the pulverized sample was ashed in a muffle furnace, dissolved in hydrofluoric-nitric acid mixture. The residue was dissolved in dilute hydrochloric acid and evaporated several times with 8N nitric acid and transferred to a tared planchet. The Gross Alpha and Gross Beta radioactivities were determined using a low background gas proportional counter (Beckman Wide Beta II). The Gross Alpha and Gross Beta activities were corrected for self-absorption.

1.1.3 Radium-226

Two-hundred grams of dried and pulverized sample was placed in a Marinelli beaker and counted for eight hours, on a Ge(Li) detector, which is coupled to a 2048 computer based, multi-channel analyzer (Northern Scientific). The resulting spectrum was fed into a computer and specific nuclides, if present, were identified and quantized in terms of energy and net count rate with the aid of the computer. This method was approved by EPA to determine Radium-226.

1.1.4 Isotopic Uranium (U-234, U-235, U-238)

CEP used the following analytical method for analyzing Uranium-234, 235, 238 in soil: A ten-gram aliquot was spiked with Uranium-232 tracer. Total dissolution of the soil was performed using hydrofluoric-nitric acid mixture, nitrated and evaporated to dryness. The residue was dissolved in concentrated nitric acid and again taken to dryness and redissolved in dilute acid. The sample was purified with an ion exchange

resin column. The Uranium was electroplated and the discs counted on a solid state alpha spectrometer and the chemical recovery was determined from the Uranium-232 tracer peak.

1.1.5 Isotopic Thorium (Th-228, Th-230, Th-232)

CEP used the following analytical method for analyzing Thorium-228, 230, 232 in soil: Two ten-gram aliquots of the specimen were taken and Thorium-232 external tracer added to one of the aliquots. Total dissolution of the soil was performed using hydrofluoric-nitric acid mixture. The residue was dissolved in dilute hydrochloric acid. The samples were purified with an ion exchange resin column. The Thorium was electroplated and the stainless steel disc was counted on a solid state alpha spectrometer and the chemical recovery was determined from the Throium-232 tracer peak in the second aliquot.

1.1.6 Limits of Detection for Soil

Parameter	pCi/gm
Gross Alpha	0.3
Gross Beta	0.1
Radium-226	0.05
Uranium-234	0.05
Uranium-235	0.05
Uranium-238	0.05
Thorium-228	0.05
Thorium-230	0.05
Thorium-232	0.05

2.0 Activity Determinations

Analytical detection limits are governed by a number of factors including:

2.1 Sample Size

The sample size is taken based on the numerical data one wishes to obtain which can describe a particular situation and which can be interpreted as a basis for

possible action. The sample size has to be representative and provide for accurate analysis or the entire process is invalid.

2.2 Counting Efficiency

The fundamental quality in the measurement of radioactive substance is the number of disintegrations per unit time. As with most physical measurements in analytical chemistry, it is seldom possible to make an absolute measurement of the disintegration rate but rather it is necessary to compare the sample with one or more standards. The standards determine the counter efficiency which may then be used to convert sample counts per minute (cpm) to disintegrations per minute (dpm).

2.3 Background Count Rate

Any counter will show a certain counting rate without a sample in position. This background counting rate comes from several sources: 1) natural environmental radiation from the surroundings, 2) cosmic radiation, and 3) the natural radioactivity in the counter material itself.

The background counting rate will depend on the amount of these types of radiation and the sensitivity of the counter to the radiation.

2.4 Background and Sample Counting Time

The amount of time devoted to counting background depends on the level of activity being measured. In general, with low level samples, this time should be about equal to that devoted to counting a sample.

2.5 Time Interval Between Sample Collection and Counting

Decay measurements are useful in identifying certain short-lived isotopes. The disintegration constant, or its related quantity, the half-life, is one of the basic characteristics of a specific radionuclide and is readily determined if the half-life is sufficiently short.

2.6 Chemical Recovery of the Analytical Procedures

Most radiochemical analyses are carried out in such a way that losses occur during the separations. These losses occur due to a large number of contaminants that may be present and interfere during chemical separations. Thus it is necessary to include a technique for estimating these losses in the development of the analytical procedure.

2.7 Equation

The activities per unit sample mass or volume are determined using the following formula:

$$A = \frac{C-B}{(2.22)(V)(R)(E)(e^{-\lambda t})} \pm \frac{1.96\left[\frac{C+B}{T}\right]^{\frac{1}{2}}}{(2.22)(V)(R)(E)(e^{-\lambda t})}$$

WHERE:

- A = Activity as pCi units sample mass or volume.
- C = Sample count rate in counts per minute.
- B = Background counts per minute.
- V = Sample volume or mass analyzed.
- E = Counter efficiency and cpm/dpm.
- 2.22 = Numerical constants to convert disintegrations per minute to picocuries.
- $(e^{-\lambda t})$ = Decay factor to correct the activity to time of collection.
- T = Counting time in minutes.
- 1.96 = Statistical constant for the 95% confidence level.
- R = Chemical recovery or photon yield.

2.8 Lower Limit of Detection (LLD) Determination

CEP uses the following method to determine lower limit of detection (LLD) as per Regulatory Guide 4.13. The LLD is defined, for purposes of this guide, as the smallest concentration of radioactive material in a sample that will yield a net

count (above system background) that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66\, s_b}{E \cdot V \cdot 2.22 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

WHERE:

LLD is the "a priori" lower limit of detection as defined above (as pCi per unit mass or volume). (Current literature defines the LLD as the detection capability for the intrumentation only, and the MDC, minimum detectable concentration, as the detection capability for a given instrument, procedure, and type of sample.)

s_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute).

E is the counting efficiency (as counts per disintegration).

V is the sample size (in units of mass or volume).

2.22 is the number of disintegrations per minute per picocurie.

Y is the fractional radiochemical yield (when applicable).

λ is the radioactive decay constant for the particular radionuclide.

Δt is the elapsed time between sample collection (or end of the sample collection period) and time of counting.

The value of s_b used in the calculation of the LLD for a particular measurement system is based on the actual observed variance of the background counting rate or of the counting rate of the blank sample (as appropriate) rather than on an unverified theoretically predicated variance.

In calculating the LLD for a radionuclide determined by gamma-ray spectrometry, the background included the typical contributions of other radionuclides normally present in the samples.

3.0 Major Nuclear Instrumentation

The following nuclear instrumentation was used to analyze samples.

3.1 Tracor Northern Computer Based Gamma Spectrometer

The Gamma Spectrometer consists of a Tracor Northern TN-4500 Multichannel Analyzer equipped with: a) a DEC LSI-11/23 microprocessor; b) a DEC RT-11 version IV operating system; c) a free standing console consisting of a full ASCII keyboard; and d) a comprehensive MCA Control Section and e) two solid state Ge(Li) detectors and three intrinsic detectors having 2.8 KeV, 3.0 KeV, 2.07 KeV, 1.85 KeV and 1.85 KeV resolutions and respective efficiencies of 16.1%, 8.9%, 22.6%, 30.6% and 25.1%.

The Computer Based Tracor Northern Gamma Spectrometry System is used for all gamma counting. The system uses the latest software to search and identify, as well as quantize the peaks of interest.

3.2 Beckman Wide Beta II Low Background Gas Proportional System

The Beckman Wide Beta II two-inch detector counting system has an average of 2.5 cpm Beta background and 0.1 cpm Alpha background. The system can also be set up for one-inch detector. The system capacity is one hundred samples. The detector has an efficiency of 49% for Cesium-137 and 40% for Plutonium-239.

3.3 Beckman Wide Beta II Low Background Gas Proportional System (Simultaneous)

The Beckman Wide Beta II two-inch planchet counting system has an average of 2.5 cpm Beta background and 0.1 cpm Alpha background. The detector has a 49% efficiency for Cesium-137 and 40% for Plutonium-239. This system has been designed for simultaneous alpha and beta counting. The system sample capacity is one hundred samples.

3.4 Beckman Low Beta II Low Background Beta System

The Beckman Low Beta II Gas proportional one-inch detector counting system has an average of 1.5 cpm Beta background and 0.1 cpm Alpha background and

detector efficiency of 49% for Cesium-137 and 40% for Plutonium-239. The system capacity is one hundred samples. The system can also be set up for two-inch detector having 2.5 cpm Beta background and 0.1 cpm Alpha background.

3.5 Beckman Low Beta II Low Background Beta System

The Beckman Low Beta II Gas Proportional two-inch detector counting system has an average of 3.0 cpm Beta background and 0.2 cpm Alpha background and detector efficiency of 49% for Cesium-137 and 40% for Plutonium-239. The system capacity is one hundred samples. This system can also be set up for one-inch detector having 1.5 cpm Beta background and 0.1 cpm Alpha background.

3.6 Alpha Spectrometry Systems

One Alpha Spectrometer consists of four silicon surface barrier detectors contained in a vacuum chamber and connected to a Northern Scientific multichannel pulse height analyzer. Two spectrometer systems consist of eight silicon surface barrier detectors each contained in separate vacuum chambers and connected to a Nuclear Data Computer Based Spectrometer and a second Northern Scientific Pulse Height Analyzer.

4.0 CEP's Receiving Procedure

Upon arrival at the laboratory, each sample is assigned a color-coded number. The laboratory receiving report is filled out to include:

(a) customer's name and address,
(b) attention indiviudal,
(c) laboratory code number,
(d) sample type,
(e) date and time collected,
(f) customer identification, and
(g) analysis required.

The laboratory receiving report consists of five pages and is distributed as follows:

(a) Original Copy - department head
(b) Laboratory Copy - laboratory supervisor
(c) Acknowledgement Copy - client, if required
(d) Accounting Copy - Quality Assurance/Accounting
(e) Project Director Copy

This form of receipt allows for few errors to occur:

(1) The laboratory receiving reports are reviewed by the Quality Assurance Department prior to disseminating the forms to the individuals.
(2) The accounting sheet is kept on file in the Quality Assurance Department until a report is submitted for review. If Accounting should receive a report without an accounting sheet, the report is re-routed back to Quality Assurance.
(3) Each department head and supervisor review the laboratory receiving report during scheduling. If any questions are raised, they are brought to the attention of quality assurance personnel.

5.0 Personnel Training

Although the degree of skill and training necessary for personnel naturally corresponds to individual job responsibilities, all laboratory personnel are acquainted with basic laboratory operations. The laboratory analyst learns:

(1) how the sample processing system of the laboratory works so that he is familiar with the sequence of work;
(2) how the samples are to be treated when they arrive at the laboratory;
(3) how to use routine laboratory equipment;
(4) how to clean glassware properly; and
(5) how to maintain routine laboratory equipment.

Before a new analyst is assigned to independent work, a gradual on-the-job training program is conducted. The trainee first observes experienced personnel at work and studies the laboratory manual thoroughly. The trainee then performs the analysis of spiked samples under the close supervision of an experienced analyst. Finally, the analyst is allowed to work independently, but his work is checked frequently at first.

Provisions are made to retrain each analyst regularly, especially in areas in which he does not perform often.

The work in the laboratory ranges from sample preparation to simple analyses such as gross beta or solids analysis, to complex analyses, such as strontium or plutonium separations or atomic absorption analysis. The time necessary to train an analyst properly increases with the difficulty of the analyses expected of him. Several months of training may be necessary before a new analyst can perform independently all the types of work required of him.

The most difficult task in the laboratory is to operate the analytical or counting equipment properly. This job is complicated because the operator must be able to detect invalid data early, in order to avoid wasting time and analytical effort. CEP's lab staff has five or more years experience and 95% of the lab staff has a degree.

6.0 Quality Control Program

In order to insure the utmost in precision and accuracy of all analyses, a three phase quality control program is in effect at all times.

6.1 Reagents, Carriers And Tracer Radionuclides

All reagents, including carriers and tracer radionuclides, which are critical to the procedures in question are standardized and checked periodically by the Quality Assurance Officer. When possible, the reagents are standardized using two different chemical procedures, e.g., strontium carrier-gravimetrically and atomic absorption.

6.2 Spike Samples

All personnel within the laboratory are required to run spiked samples to prove their proficiency in determining accurately the content of the spiked sample in question. Furthermore, to eliminate the possibility of preferential treatment of a spiked sample by an analyst, spiked samples are slipped into routinely analyzed

samples without the knowledge of the analyst. Also, every set of samples has a spike and a blank run with it.

6.3 Instrumentation

All instrumentation is maintained on a preventive maintenance program by the manufacturer. Each instrument is checked with a standardized source weekly. If the source check detects any anomaly from the routine performance of the instrument, no analysis is allowed to be performed by that instrument until it is functioning properly.

All radioactive sources and solutions used for calibration are calibrated against National Bureau of Standards' standards where possible. Interlaboratory comparisons with the United States Public Health Services, U.S. Environmental Protection Agency, Environmental Radioactivity Laboratory Intercomparison Studies Program, and with many public health departments are performed periodically. The above three phase quality control program is administered by the management of CEP.

6.4 Sample Analysis

Blank and standard spike samples are analyzed routinely along with the samples as part of CEP's internal quality control program. This program includes both intra and inter-laboratory samples. Also included in this program are internal laboratory spike (ILS) samples which are known performance samples introduced by the analyst. All samples with the exception of the ILS's, are assigned code numbers to prevent samples being given preferential treatment.

All reagents, carriers, radioactive tracers and instrumentation used in analysis are calibrated on a scheduled basis as described in the Quality Assurance Plan.

The methods employed for analysis are those which measure the desired constituent with precision and accuracy and meet the data needs in the presence of the interferences normally encountered. The routine analysis of spiked

samples is the measurement of quality while the use of analytical grade reagents is a control of measure. The quality control program has two primary functions. First, the program monitors the reliability of the results reported. The second function is the control of quality in order to meet the program requirements.

6.5 Data Handling and Reporting

A system for controlling the passage of data through the laboratory has been established. A general outline of the data handling process is described below:

1.) As results are completed, more information such as the name of the analyst who performed the work, his calculations for the sample, and all pertinent data that would allow recalculation of results at a later time, if necessary, is noted on the result sheets.

2.) As various analyses are performed and results are reviewed by the analyst, the request sheet is checked off and the result sheets are attached to the analytical request sheet.

3.) After all analyses are completed, the results are sent to the laboratory supervisor and department head for reporting results. After the results are reviewed, they are transferred to a final report form.

4.) The report form is submitted to the Quality Assurance Department for review prior to typing of final report.

5.) The analysis request form and result sheets are appropriately filed for future reference. Several years of results are kept for ready reference.

This procedure allows data to be tested for adequacy at any point during the analysis and to be re-examined at a future date. The data are reviewed thoroughly several times by designated personnel, beginning with the senior analyst, before being reported in final form.

In any analytical program, the department head and Quality Assurance Department are responsible for recognizing anamolous results and discussing these with the appropriate persons so that a sample can be renanalyzed before it is discarded after a significant amount of time has passed.

7.0 Quality Assurance Practices

7.1 Introduction

CEP's analytical laboratories role is to provide our clientele with precise and accurate data from which decisions can be made. CEP's quality assurance program has been designed to: (1) ensure the accuracy and precision of data produced by the laboratory and, (2) maintain the quality of the laboratory data continuously.

7.2 Functions of Quality Assurance Department

CEP's quality assurance department is a separate entity from the operating (laboratories) division reporting directly to the president. The quality assurance program implemented by CEP includes quality control as stated in regulatory guide 4.15 "quality assurance comprises all those planned and systematic actions that are necessary to provide adequate confidence in the results of a monitoring program, and quality control comprises those quality assurance actions that provide a means to control and measure the characteristics of measurement equipment and processes to established requirements; therefore, quality assurance includes quality control".

The quality assurance plan (CEP-QA-1, See Appendix A) provides the policy for quality assurance program for CEP's analytical laboratories. Specific procedures have been written to be followed for certain activities. A copy of QA policies and procedures list is attached for your reference.

The department supervisors, quality assurance director and quality control officer work together in order to insure the reliability of the analytical results reported. In both design and implementation of the quality assurance program, these individuals maintain lines of communication in order to fully evaluate the accuracy and precision of the results.

As results are completed, information such as the name of the analyst who performed the work, his calculation for the samples, and all pertinent data that would allow supervisor and manager to review the data are noted on the result sheets. After all analyses are completed, the results are sent to the department manager for review and transferred to the final report form.

The responsibilities and authority of the quality assurance department are discussed in CEP-QA-1, Appendix A. In addition, the department is also responsible for the following:

1. Develops and carries out quality control programs, including statistical procedures and techniques, which will help laboratories to meet authorized quality standards at minimum cost; and advises and assists management in the installation, staffing and supervision of such programs.
2. Monitors quality control activities of the laboratory to determine conformance with authorized policy and procedures and with sound practice; and makes appropriate recommendations for correction and improvement as may be necessary.
3. Seeks out and evaluates new ideas and current developments in the field of quality control and recommends means for their application whereever advisable.
4. Advises management in reviewing technology, methods and equipment, with respect to quality aspects.
5. Advises the Purchasing Section regarding quality of purchased materials, reagents and chemicals.
6. Recommends packaging materials and procedures.
7. Performs related duties as assigned.

7.3 Personnel Qualifications

The degree of skills and training necessary for laboratory personnel is dependent upon their job responsibilities. All laboratory personnel, however, are required to be thoroughly acquainted with basic laboratory operations. He/she must learn:

1. how the simple processing system of the laboratory works;

2. how each type of sample is to be treated when it arrives in the laboratory;
3. how to use routine equipment; and
4. how to clean glassware properly.

The analyst, regardless of degree or experience, undergoes a thorough, gradual on-the-job training program. This is by observing an experienced analyst at work and by studying the analytical procedure thoroughly. In addition, this includes a discussion of CEP's Q.A. program. Job descriptions for each position are maintained by the personnel department.

7.4 Operating Procedures and Instruction

The policy in developing or implementing procedures for a monitoring program are discussed in the quality assurance plan. The procedures for specific activities are listed in the "Q.A. Manual Checklist", Appendix A.

The methods employed for analyses are those which measure the desired constituent with precision and accuracy and meet the data needs in the presence of the interferences normally encountered. The routine analysis of spiked samples is the measurement of quality while the use of analytical grade reagents is a control of measure. The quality control program has two primary functions. First, the program monitors the reliability of the results reported. The second function is the control of quality in order to meet the monitoring program requirements.

7.5 Records

Upon arrival at the laboratory, each sample is assigned a prefixed color-coded number. This code number is placed on all apparatus used for that sample during chemical and radiometric determinations. This code number is recorded in the laboratory receiving report which is filled out at the time that the samples are received. The laboratory receiving report consists of five pages which are distributed to various departments within the company. This number is used for

retrieving the raw data on any sample after analysis has been completed.

All records of analyses are kept in storage as required. This includes all raw data, calculations, quality control data and reports.

7.6 Reference Standards And Instrument Performance Checks

All radioactive sources and solutions used for calibration are calibrated against National Bureau of Standards' standards where possible.

All reagents, including carriers and tracer radionuclides, which are critical to the procedures in question, are standardized and checked periodically by the Quality Assurance Officer. When possible, the reagents are standardized using two different chemical procedures, e.g., Strontium carrier-gravimetrically and atomic absorption.

All personnel within the laboratory are required to run spiked samples to prove their proficiency in determining accurately the content of the spiked sample in question. Furthermore, to eliminate the possibility of preferential treatment of a spiked sample by an analyst, spiked samples are slipped into routinely analyzed samples without the knowledge of the analyst. Also, every set of samples has a spike and a blank run concurrently with it.

All instrumentation is maintained on a preventative maintenance program by the manufacturer. Each instrument is checked with a standardized source weekly. If the source check detects any anomaly from the routine performance of the instrument, no analysis is allowed to be performed by that instrument until it is functioning properly.

Calibration procedures for measuring and testing equipment have been prepared. In addition, procedures for the preparation and use of quality control charts have been written. (See "Q.A. Manual Checklist" list).

7.7 Inter- And Intra-Laboratory Analyses

The quality assurance plan (CEP-QA-1) defines the policy in these aspects of the

quality assurance program. In addition, the procedures to carry out these activities have been prepared and implemented. The specific procedures are CEP-QA-17, CEP-QA-27, CEP-QA-28, and CEP-QA-29, which include the analysis of reagents blanks, duplicates, internal lab spikes and blind spikes, as well as cross-check samples from U.S. EPA.

APPENDIX A

CEP'S QUALITY ASSURANCE PLAN

CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

QUALITY CONTROL PROGRAM

Copy No. _____

QUALITY ASSURANCE PLAN

ENVIRONMENTAL CHEMISTRY, NUCLEAR MEASUREMENTS

RADIOBIOASSAY, AND WATER CHEMISTRY

Date	Rev#	Reviewed by	Approved by mgr. of Q.A.	Comments
1/2/74	0			
12/13/79	1			
12/21/81	2			

CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

QUALITY CONTROL PROGRAM

QUALITY ASSURANCE PLAN

ENVIRONMENTAL CHEMISTRY, NUCLEAR MEASUREMENTS, RADIOBIOASSAY, AND WATER CHEMISTRY

1.0 PLAN DESCRIPTION

1.1 Purpose

The purposes of this Quality Assurance Plan are: (a) to define the nature and extent of Quality Assurance for Environmental Chemistry, Nuclear Measurements, Radiobioassay and Water Chemistry; (b) to set forth the requirements for preparation of Q.A. and Q.C. procedures; and (c) to provide a general description of the methods to be used in carrying out the Quality Assurance Surveillance and audit functions.

1.2 Scope

This Quality Assurance Plan is intended primarily to cover radiochemistry and other chemistry activities associated with providing Controls for Environmental Pollution's clients a quality service.

1.3 Objectives

The overall objective of this Q.A. Plan is to (a) verify that work procedures and practices are adequate to assure that all clients are kept within the limits regulated by the State and federal agencies; (b) to coordinate an in-house Quality Control program independent of external programs to assure that Controls for Environmental Pollution, Inc. is operating at maximum efficiency; including specific objectives as follows:

a. To verify that chemistry activities are documented and coordinated with the client's program so as to preclude surprises or apparent anomalies;

b. To verify that all chemistry procedures and practices are correct and adequate for the intended usage and required accuracy and reliability of results;

c. To verify that the procedures and practices conform to the Client's Specifications with respect to methods and frequency of sampling and analysis;

d. To verify that procedures and practices are appropriate for and consistent with the Client's Specifications and other regulatory criteria;

e. To verify that qualified personnel are provided with continued training, as necessary, for proper performance of the analytical work;

f. To verify that records are completed and maintained for each sample and analysis conducted;

g. To verify that procedures contain adequate Quality Control features and that such Quality Controls are practices as part of normal routine;

h. To verify that equipment is maintained and calibrated to the extent and at the frequency necessary for accurate results.

2.0 RESPONSIBILITIES

Responsible to prepare, review or otherwise assist in developments of Quality Inspection and Quality Assurance procedures, instructions and plans. Responsible to review procedures, specifications and other control or source documents as may be required in the development of surveillance procedures or other quality assurance procedures or requirements. Responsible to perform inspections, write reports and provide follow-up action and to direct and review the analytical efforts in the accomplishment types of quality assurance activities. Responsible to evaluate tests, non-conformances, standard requirements, regulatory requirements and to make recommendations for resolution and/or further evaluations by management, other departments or outside consultants. Responsible to issue or recommend stop work orders for work which is not in compliance with requirements.

3.0 LOCATION OF WORK

Quality Assurance activities associated with Environmental Chemistry, Nuclear Measurements, Radi bioassay, and Water Chemistry work may be performed at any of the following locations as necessary to accomplish the objectives of this Q.A. Plan:

a. Administrative offices of Controls for Environmental Pollution, Inc.

b. Central laboratory facilities of Controls for Environmental Pollution, Inc. located in the Operational Division.

c. Other locations of CEP laboratories.

4.0 SCHEDULING

Quality Control, Quality Assurance Surveillance, and certain activities necessary to prepare for Q.A. Audits, as further defined in Sections 5.0 and 6.0 of this Q.A. Plan, shall be performed regularly. For those types of analysis performed regularly and requiring a high degree of sensitivity and accuracy, as jointly designated by the manager or supervisor or department involved, the director of Quality Control, and Quality Control Officer.

Quality Assurance Audits shall be scheduled and performed as follows:

4.1 Chemistry (Water Quality)

REV.2- a. Internally spiked samples issued monthly by Quality Control officer will be as follows:

Wet Chemistry

Nitrate, Boron, Fluoride, Total Phosphate

Atomic Absorption Spectroscopy

Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Mercury, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Vanadium, Zinc

Spiked samples that will not be introduced into the monthly Quality Control program are as follows:

Total Dissolved Solids, Sulfate

These parameters (Sulfate and Total Dissolved Solids) will be represented by semi-annual Environmental Protection Agency cross-check samples and Environmental Resources Associates certified samples.

Spikes not introduced into the lab should be documented on an Explanation Form.

b. Spiked samples provided by the Environmental Protection Agency as cross-check samples will be submitted semi-annually.

c. Standardization of reagents which are critical to proper results Monthly or prior to use, as appropriate.

d. Results of spiked sample analysis reviewed and evaluated as are received by Quality Control Officer.

e. Prompt review and evaluation of any unusual or unexpected results will be subject to rerun.

4.2 Radiobioassay

a. Blanks and standards run Daily on each instrument in regular use or prior to use, as appropriate.

b. Spiked or split samples issued weekly, biweekly and monthly by Quality Control Officer.

c. Results of analysis of blanks, standards and spiked or split samples reviewed and evaluated by Quality Control Officer.

d. Prompt review and evaluation of any unusual or unexpected analytical results, any such results will be subject to rerun.

e. Reagents, carriers and tracer radionuclides which are in regular use and are critical to proper results standardized Monthly or prior to use, as appropriate.

4.3 Environmental Chemistry

a. Chemistry and radiochemistry methods same as paragraphs 4.1 and 4.2 where applicable.

b. Intercalibration by Controls for Environmental Pollution, Inc.'s laboratory with other laboratory agencies.

c. Quarterly review of results and evaluation of any indicated probable trends.

d. Prompt review and evaluation of any unusual or unexpected analytical results, any such results are subject to rerun.

The requirements stated above shall apply only to those analyses required by the Client's Specifications.

4.4 Gas Chemistry

a. Checks of the gas chromatograph against certified reference standards for all primary system impurities which must be controlled within specified limits, at least Weekly or prior to use, as appropriate.

4.5 Instrument Calibration (Nuclear Measurements)

All laboratory instrumentation and equipment shall be maintained on preventive maintenance programs as appropriate for the nature and frequency of usage.

Except as indicated in paragraph 4.2 (a) of this Q.A. Plan, laboratory instruments in regular use shall be checked Weekly against standards traceable to standards issued by the National Bureau of Standards. Less frequently used instruments shall be similarly calibrated prior to use.

5.0 METHODS

The nature of Environmental Chemistry, Radiobioassay, and Water Chemistry work is such that most Quality Control and Quality Assurance measures must be built into the analytical procedures in order to be effective. Because the sample is almost always consumed or altered during the analytical processes, laboratory personnel must make certain that every step is done correctly to yield valid results.

The work procedures must include the use of standardized practices and equipment which have been demonstrated to adequate for compliance with client's requirements as regards accuracy, sensitivity and reliability of results. Laboratory personnel must be trained on the particular methods and equipment to be used. Equipment, chemicals, samples and instrumentation must be controlled at every step to assure accuracy and reliability.

5.1 General Quality Assurance Methods

To accomplish the objectives of this Q.A. Plan, Quality Control and Quality Assurance requirements shall be implemented, through the analytical procedures and the laboratory administative procedures and controls, utilizing the following general methods.

5.1.1 Quality Control

a. Standardization and qualification of procedures including:

   1. Uniform step-by-step procedures (Cook book form);

   2. Training of personnel in use of procedures and equipment;

b. Uniform instructions for reagent preparation, control, storage, use and shelf life (including appropriate labeling and dating);

c. Proper selection of glassware, plastic containers and other analytical equipment and supplies;

d. Regular calibration of equipment (with standards traceability to National Bureau of Standards where necessary and available);

e. Uniform and consistent procedure for taking, controlling, preserving and using samples (including identification labels with dates and time, type and amount of preservative, and control number for all record purposes);

f. Provisions for control of procurement, storage and use of all chemicals used in analytical procedures;

g. Provisions for analysis of duplicate samples, including standards and blanks where such procedures are required.

h. Independent selective review and checking of calculations, curves or other analysis of results.

i. Standardized logs and analysis record sheets for recording sample identification, procedure used, results, and independent checks where required.

REV-2 5.1.2 Quality Assurance Surveillance

The spiked sampling program and the Q.A. Audit program provides an adequate assurance that the CEP Q.C. Program/Q.A. Plan is being adequately implemented. Therefore, deletion of the Q.A. surveillance requirements has been made from the CEP Q.C. Program/Q.A. Plan.

5.1.3 Quality Assurance Audit

Certain audit-related requirements will be implemented directly in the work procedures; other audit functions will be developed as part of the preparations for conducting Quality Assurance Audits as provided in Section 6.0 of this Q.A. Plan. The following basic methods will be used for auditing:

a. Introduction of spiked samples (contents unknown to Controls for Environmental Pollution, Inc.'s staff);

b. Laboratory intercalibration by use of split samples with client's laboratory;

c. Independent review of results of selected analyses (including spiked samples);

d. Direct inspection of laboratory and audit of work and records.

5.2 Particular Work Methods

The following basic methods shall be followed to accomplish the objectives of this Q.A. Plan.

5.2.1 Chemistry (Water Quality)

All Water Chemistry personnel shall follow the Water Chemistry Procedure Manual approved by management. All analytical results shall be recorded on approved forms after each test and signed by the Laboratory Supervisor.

On a monthly basis, spiked samples of ions commonly tested during the week shall be introduced into the laboratory operations by the Quality Control Officer. On a quarterly basis, water samples with various ion concentrations shall be presented for analyses, from a source independent of Controls for Environmental Pollution, Inc. laboratory. All such monthly and quarterly results shall be reviewed independently and, where necessary, corrective action shall be recommended to the laboratory management, with a copy to the President.

5.2.2 Radiobioassay

All Radiobioassay personnel shall follow the Radiochemistry Procedure Manual approved by management. All analytical results shall be recorded on approved forms after each isotope analysis and signed by the laboratory supervisor.

On a daily basis, all counting equipment in regular use shall be checked using blanks and standards on each instrument. Less frequently used equipment shall be similarly calibrated prior to use. On a monthly basis, unknown spiked samples shall be sent to the Controls for Environmental Pollution, Inc. laboratory for analysis. All such results shall be reviewed independently and, where necessary, corrective action shall be recommended to the laboratory management, with a copy to the Operations Manager and Director of Quality Control.

In addition to preventive maintenance, each instrument in regular use shall be checked weekly. Less frequently used instruments shall be calibrated prior to use. If any irregularity is detected in the calibrations or counting performance of any instrument, no analysis shall be performed on that instrument until it is functioning properly.

5.2.3 Environmental Chemistry

Environmental samples are analyzed in a low background laboratory which deals primarily with trace level radiochemistry.

Environmental samples shall be collected and analyzed in the manner and on a schedule as necessary to comply with the Client's Specifications.

Results shall be formally reported to the management monthly, within ten (10) days following the end of the reporting period. Unusual, unexpected or anomalous results shall be reported immediately to the Quality Control Officer, who shall initiate appropriate action to review and evaluate the results and take corrective action if indicated.

5.2.4 Gas Chemistry

Gas Chemistry analyses shall be conducted in accordance with the Analytical Instruments Procedures Manual approved by the management.

The checks given in paragraph 4.5 of this Q.A. Plan shall be performed at the frequency indicated. Complete records shall be maintained of these checks, including the gas supplier's certification of references standards and the basis for that certification.

5.3 New Procedures

When a procedure is not available, the requirements will be evaluated and a suitable analytical method established. After satisfactory verification that the procedure provides the necessary sensitivity, accuracy and selectivity, a formal procedure will be approved by the supervisor and Director of Quality Control and included in the appropriate Procedure Manual.

6.0 PROCEDURE REQUIREMENTS

As indicated in Section 5.0 of this Q.A. Plan, the Quality Control and Quality Assurance Surveillance procedures are incorporated into the analytical work procedures and laboratory administrative procedures and instructions.

Quality Assurance Audits (QAA's) shall be performed as follows, with the numbering shown to be used for record purposes. Scheduling of these audits will be as deemed necessary by the director of QA.

CEP-QA-3 Quality Assurance Audit, Water and Organic Chemistry

CEP-QA-4 Quality Assurance Audit, Radiobioassay

CEP-QA-2 Quality Assurance Audit, Environmental Chemistry

CEp-QA-5 Quality Assurance Audit, Nuclear Measurements

Reports of these QAA's shall describe the particular activities audited; the basis and procedures for examination and evaluation of records; procedures for verifying validity and consistency of results; procedures for evaluating adequacy of Q.C. and Q.A. Surveillance Activities; and deficiencies and implementing corrective action.

7.0 REPORTS AND RECORD REQUIREMENTS

7.1 Chemistry (Water Quality)

Records and reports of analytical results of the various samples, including quantities and chemical constituency, shall be retained as permanent records.

7.2 Nuclear Measurements

All records and logs relative to data and radioactive materials prepared shall be kept as permanent records.

7.3 Radiobioassay

Records and reports shall be retained as permanent records.

7.4 Environmental Chemistry

Detailed analytical records and quarterly reports shall be retained as permanent records. Records and reports shall be prepared as directed by CEP clients.

7.5 Gas Chemistry

Records and reports shall be retained as permanent records. In addition, records of all certified reference standards, and their correlation with analytical results, shall be retained for the time period established by the client.

7.6 Quality Assurance

Quality Assurance records shall consist of all logs, reports, results, deficiency reports and the like which are generated in the course of carrying out the requirements of the Q.A. Plan. Such Records shall be retained as permanent records in accordance with CEP's administrative requirements.

8.0 ATTACHMENTS

None

9.0 REVIEW, APPROVAL AND DISTRIBUTION

9.1 Quality Assurance Plan and Procedures

The first drafts of the completed Quality Assurance Plan and Procedures for Environmental Chemistry, Nuclear Measurements, Radiobioassay, Water Chemistry, and all subsequent drafts or changes to these Plans and Procedures shall be distributed for review, comment and approval as follows:

Manager of Nuclear Measurements	1 Copy	(For review and comment)
Manager of Radiobioassay	1 Copy	(For review and comment)
Manager of Environmental Monitoring	1 Copy	(For review and comment)
Operations Manager	1 Copy	(For review and comment)
Manager of Water Chemistry	1 Copy	(For review and comment)
Director of Quality Assurance	1 Copy	(For approval)

A marked-up copy of the Plan and Procedures, or a comment letter incorporating all comments from the reviewers, shall be returned to the issuer (Quality Control Officer) within ten to fifteen days.

After resolution of all comments, and completion of signatures required on the signature sheet, the Director of Quality Assurance will approve the Plan and Procedures and distribute copies to the controlled distribution.

9.2 Quality Control Inspection Procedures

Any Quality Control Inspection Procedures found to be necessary shall be reviewed by the Director of Quality Assurance, or his assignee.

Applicable, up-to-date QCIP's shall always be available at the Quality Control Office for use by personnel assigned specific QC duties.

A complete set of current QCIP's shall always be readily available at the Quality Control Office.

QA MANUAL CHECKLIST

CEP-QA-1 Quality Assurance Program

CEP-QA-2 Environmental Chemistry QC Audit

CEP-QA-3 Water Chemistry QC Audit

CEP-QA-4 Radiobioassay QC Audit

CEP-QA-4A Radiation Control Manual for Laboratory Personnel

CEP-QA-5 Nuclear Measurements QC Audit

CEP-QA-6 Standard Operating Procedure Quality Assurance Instrument and History Records

CEP-QA-7 Quality Assurance Audit Checklist - Laboratory Area

CEP-QA-8 Standard Operating Procedure Quality Assurance Instrument and History Records

CEP-QA-9 Radionuclide Issuance Procedure

CEP-QA-10 Definition of Terms

CEP-QA-10A Quality Control

CEP-QA-11 Counting Techniques and Data Handling

CEP-QA-12 Training Program for New Employees

CEP-QA-13 Procedure for Filling Sample Ledger Sheets for Reactor Account

CEP-QA-14 Nuclear Measurements Instrument Loading and Unloading Procedure

CEP-QA-15 TLD Ledger Sheets Procedure

CEP-QA-16 Sample Storage Procedure

CEP-QA-17 Quality Assurance Spike Program for Environmental Department

CEP-QA-18 Quality Assurance Plan for Waste Water

CEP-QA-19 Waste Water Chemistry Audit Procedure

CEP-QA-20 Quality Control in Waste Water

CEP-QA-21 Quality Control of Laboratory Services

CEP-QA-22 Quality Control of Glassware in Waste Water Chemistry (see QA-37)

CEP-QA-23 Instrument Calibration and Maintenance Procedure for Water Quality

CEP-QA-24 Water Quality Data Handling and Reporting

CEP-QA-25 Importance of Quality Assurance in Water Quality Department

CEP-QA-26 Glossary of Terms used in Water Quality

CEP-QA-27 Spike Program for Radiobioassay Department

CEP-QA-28 Spike Program for Water Quality Department

CEP-QA-29 Spike Program for Waste Water Department

CEP-QA-30 Training Program for New Employees in Water Quality and Waste Water

CEP-QA-31 Personnel Bioassay Monitoring

CEP-QA-32 Soil Sampling Procedure

CEP-QA-33 Air Sampling Procedure

CEP-QA-34 Grab Water Sampling for Radioactivity

CEP-QA-35 Grab Water Sampling Procedure for Water Quality Analysis

CEP-QA-36 Vegetation Sampling Procedure

CEP-QA-37 Quality Control of Glassware in Water Chemistry

CEP-QA-38 Sampling and Preservation of water for compliance with National Interim Primary Drinking Water Regulation 40 CFR 141

CEP-QA-39 Quality Control Program for Water Chemistry

CEP-QA-40 Quality Control Program for Organic Chemistry (Pesticides)

CEP-QA-41 Quality Assurance Operating Procedure for Recording Temp. of Freezer, Refrigerator, Ovens and Incubators

CEP-QA-42 QA Operating Procedure for Verification of Accuracy of Thermometers

CEP-QA-43 QA Standard Operating Procedure for Verification of Accuracy of Mettler Analytical Balances

CEP-QA-44 Same as 43 but for Top Reader

CEP-QA-45 QA Standard Operating Procedure for the Calibration of Wide Beta Systems

CEP-QA-46 QA Standard Operating Procedure for Determining Efficience of Detectors for Wide Beta II and Low Beta II Systems

CEP-QA-47 QA Standard Operating Procedure for Calibration of Low Beta II Systems

CEP-QA-48 QA Standard Operating Procedure for frequency of Calibration maintenance & efficiency determination of Beckman Low Beta II and Wide Beta II Systems

CEP-QA-49 Quality Control Program for Organic Chemistry

CEP-QA-50 Protective Clothing for Non-Radiological Work

CEP-QA-51 Responsibilities to insure Proper Contamination Control of all Personnel Involved in Toxic Work

CEP-QA-52 Safety Records, Logs, and Reports

CEP-QA-53 Training Program for Field Personnel

CEP-QA-54 Medical Assistance Programs at CEP's Facilities

CEP-QA-55 Bottom Sediment Sampling for Rivers

CEP-QA-56 Procedure for Analytical Performance of Radioanalytical Lab.

CEP-QA-57 Quality Control of Counting Equipment (Radiochemistry)

CEP-QA-58 Importance of Quality Control in Radioanalytical Laboratory

CEP-QA-59 Preparation of Precision Control Charts

CEP-QA-60 Preparation of Accuracy Control Charts

CEP-QA-61 Phytoplankton and Zooplankton Sampling Procedure

CEP-QA-62 Sampling Procedure for Water at Epilimnion, Thermocline and Hypolimnion in a lake

CEP-QA-63 Standard Operating Procedure for Loading and Unloading Wide Beta II, Instrument #11

CEP-QA-64 Standard Operating Procedure for Loading and Unloading Wide Beta II, Instrument #1 or #11

CEP-QA-65 Standard Operating Procedure for Loading and Unloading Low Beta II, Instrument #2, #15 or #18

CEP-QA-66 Standard Operating Procedure for Loading and Unloading Low Beta II, Instrument, New Low Beta

CEP-QA-67 Bottom Sediment Sampling in Lakes

CEP-QA-68 Standard Operating Procedure for Loading and Unloading NMC PC-3T and PC-4

CEP-QA-69 Standard Operating Procedure for returning NMC PC-3T and PC-4 to operation after a power failure

CEP-QA-70 Control of Incoming Reagents and Chemicals

CEP-QA-71 Quality Assurance Plan - Organic Chemistry

CEP-QA-72 Standard Operating Procedure for returning Beckman Wide Beta and Low Beta to operation after a power failure

CEP-QA-73 Standard Operating Procedure for returning Northern #8 to operation after a power failure

CEP-QA-74 Standard Operating Procedure for returning ND Alpha Spec to operation after a power failure

CEP-QA-75 Standard Operating Procedure for returning Northern Econ II to operation after a power failure

CEP-QA-76 Standard Operating Procedure for returning LS-100 and LS 110C to operation after a power failure

CEP-QA-77 Procedure for Receiving Reagents and Chemicals

CEP-QA-78 Standard Operating Procedure for returning Gamma System to operation after a power failure

CEP-QA-79 Verification of Analytical Data in the Event of Nuclear Instrument Malfunction

CEP-QA-80 Procedure for receipt of samples

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FEB 1982

MEMORANDUM FOR: T. T. Martin, Director
Division of Engineering and
Technical Programs
Region I

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

SUBJECT: REQUEST FOR CONFIRMATORY SURVEY OF TEXAS INSTRUMENTS, INC., PROPERTY, SNM-23

By letter dated November 2, 1982, Texas Instruments, Inc. (TI), submitted the results of their radiological surveys of Buildings 3, 4, and the remainder of Building 10 (outside the former HFIR area) that had been used a number of years ago for radioactive material processing at the TI Attleboro site in support of an application to terminate Special Nuclear Material License No. SNM-23. We have reviewed the results of their survey and request your assistance in making a confirmatory survey to verify that the facility and equipment have been decontaminated to acceptable levels.

A copy of the TI November 2, 1982, submittal is enclosed.

The results of the confirmatory survey and your recommendations on this matter should be submitted to the Uranium Fuel Licensing Branch, Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety and Safeguards so that we may take appropriate action.

The results of the confirmatory survey of the former HFIR area in Building 10 were reported in your Inspection No. 70-00033/82-03.

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

Enclosure: TI letter dated 11/2/82

OFFICE ►	FCUP	FCUP	FCUP	
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MEMORANDUM FOR: R. W. Starostecki, Director
No. 2, Division of Resident and
Project Inspection
Region I

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

SUBJECT: REQUEST FOR CONFIRMATORY SURVEY OF TEXAS INSTRUMENTS, INC., PROPERTY, SNM-23

By letter dated May 17, 1982, and supplements dated June 24, and July 9, 1982, Texas Instruments, Inc. (TI), submitted the results of their radiological survey of Building 10 in support of an application to terminate Special Nuclear Material License No. SNM-23. We have reviewed the results of their survey and request your assistance in making a confirmatory survey to verify that the facility and equipment have been decontaminated to acceptable levels.

Copies of the TI May 17, June 24, and July 9, 1982, submittals are enclosed.

The results of the confirmatory survey and your recommendations on this matter should be submitted to the Uranium Fuel Licensing Branch, Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety and Safeguards so that we may take appropriate action.

Original Signed by
Ralph G. Page

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

Enclosures: TI letters dated
5/17/82, 6/24/82, and
7/9/82

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