U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 70-33/92-01

Docket No. 70-33

License No. SNM-23 Priority 1 Category UHFF

Licensee: Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02702

Facility Name: HFIR Project

Type of Meeting: Management Meeting

Meeting Date: April 14, 1992

Inspector: [signature] 4/30/92
J. Roth, Project Engineer date
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Section
Division of Radiation Safety and Safeguards

Approved by: [signature] 5-12-92
W. J. Pasciak, Chief date
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Section
Division of Radiation Safety and Safeguards

Meeting Summary: A management meeting was held at Region I, King of Prussia, Pennsylvania, on April 14, 1992 at the licensee's request to discuss the status of the licensee's actions with regard to cleaning up identified areas of contaminated soil at the Attleboro, Massachusetts site.

DETAILS

1.0 Meeting Attendees

1.1 Texas Instruments

R. L. Churchill, Program Manager
M. J. Elliott, Manager of Environmental Engineering
F. J. Veale, Jr., Esq., Environmental Attorney and Manager of Safety, Industrial Hygiene and Environmental Engineering

1.2 Nuclear Regulatory Commission

J. Kinneman, Chief, SDMP Task Force
M. Miller, Senior Health Physicist
J. Shepard, Project Manager, NMSS
J. Roth, Project Engineer

2.0 Summary of Discussion

Mr. Kinneman opened the meeting and thanked the licensee's representatives for attending the meeting. The purpose of the meeting was for the licensee to present the status of plans for remediating contaminated areas of the site. These contaminated areas were previously identified by the NRC as a result of a confirmatory survey conducted during 1984. Mr. Churchill provided a history of fuel fabrication activities at the site. Messrs. Elliott and Veale provided information on the status of actions taken to date to characterize and/or remediate radioactivity at the Attleboro site. Discussions were also held concerning decommissioning financial assurance requirements applicable to the site. In addition, Mr. Veale provided an update on actions taken by Texas Instruments and others with regard to the Shpack landfill located in Norton, Massachusetts and discussions held with the Department of Energy concerning inclusion of the Attleboro site in the Department's Formerly Utilized Sites Remediation Action Program (FUSRAP).

3.0 Conclusions

Mr. Kinneman concluded the meeting by thanking the licensee's representatives for the information provided. The licensee was informed that they were expected to complete the following actions.

-- the licensee will formally contact the Department of Energy by April 20, 1992

-- the licensee will provide the NRC with a remediation schedule at a meeting to be held by the end of July 1992. Interim written status reports on actions taken to establish a remediation schedule will be provided the NRC at the end of May and June respectively

-- the licensee will provide the NRC with a decommissioning financial assurance plan schedule by May 31, 1992.

No. 92-107

U. S. NUCLEAR REGULATORY COMMISSION
REGION I
NOTICE OF SIGNIFICANT LICENSEE MEETING

JUL 01 1992

Name of Licensee:	Texas Instruments, Incorporated
Name of Facility:	Attleboro Massachusetts Site
Docket No.:	70-33
License No.:	SNM-23
Time and Date of Meeting:	July 14, 1992, 10:00 a.m.
Location of Meeting:	Region I Office in King of Prussia, Pennsylvania DRS Conference Room
Purpose of Meeting:	Licensee requested meeting to discuss status of site characterization and remediation activities and plans for cleanup of radioactively contaminated soil at the Attleboro site.
NRC Attendees:	R. Cooper, Director, Division of Radiation Safety and Safeguards J. Joyner, Chief, Facilities Radiological Safety and Safeguards Branch W. Pasciak, Chief, Facilities Radiation Protection Section J. Kinneman, Chief, SDMP Task Force M. Miller, Senior Health Physicist J. Shepard, Project Manager, NMSS J. Roth, Project Engineer
Licensee Attendees:	F. J. Veale, Jr., Manager, Environmental and Industrial Hygiene Engineering M. Elliott, Manager, Environmental Engineering

JE46

Note: This meeting is open to the public. Attendance by NRC personnel at this meeting should be made known by COB July 13, 1992 via telephone call to J. Roth, Region I at FTS 346-5205. Handicapped persons requiring assistance to attend or participate in the meeting should make their requests known to J. Roth, U. S. Nuclear Regulatory Commission, Region I, 475 Allendale Road, King of Prussia, PA 19406 (215-337-5205).

Prepared by: J Roth 6/29/92
J. Roth, Project Engineer

Distribution:
J. Taylor, Executive Director for Operations (EDO)
H. Thompson, Jr., Deputy Executive Director for Nuclear Material Safety, Safeguards and Operations Support
J. Lieberman, Director, Office of Enforcement
R. Lobel, Regional Coordinator, OEDO
R. Bernero, Director, Office of Nuclear Materials Safety and Safeguards
R. Cunningham, Director, Division of Industrial and Medical Nuclear Safety, NMSS
J. Hickey, Chief, Fuel Cycle Safety Branch, NMSS
P. Lohaus, Chief, Low-Level Waste Management Branch, NMSS
D. Martin, LLDR/NMSS
J. Goldberg, Deputy Assistant General Counsel for Enforcement, OGC
Public Document Room (PDR)

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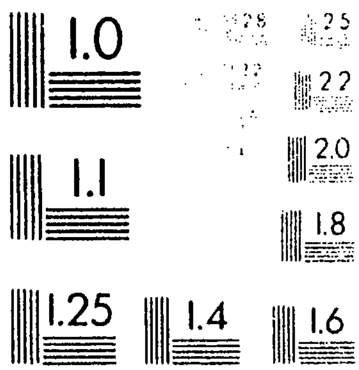
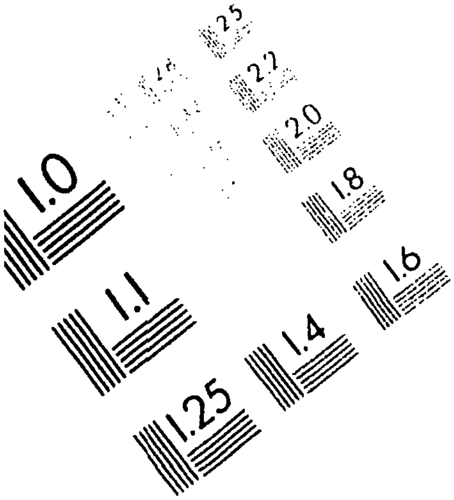
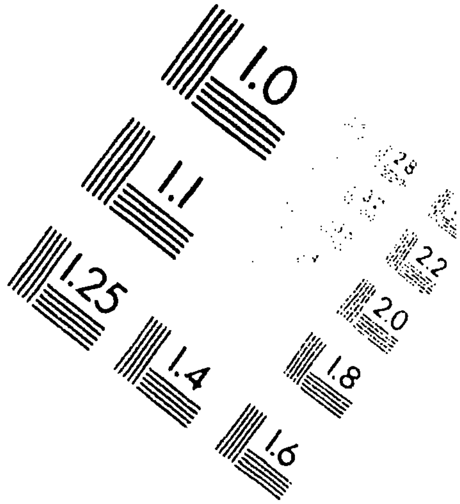
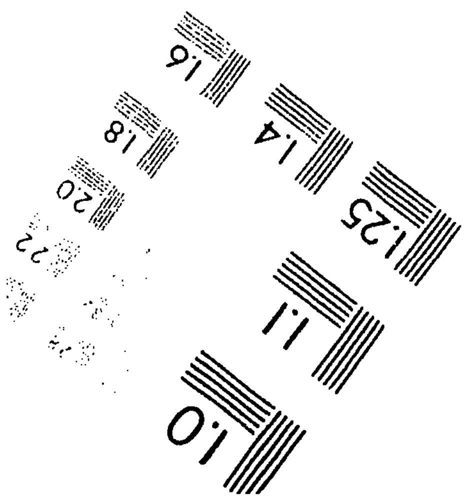
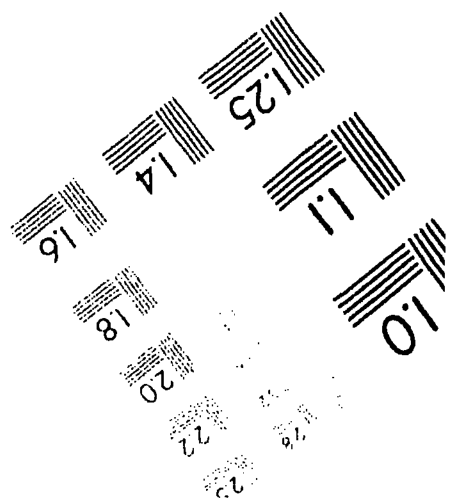
IMAGE EVALUATION TEST TARGET (MT-3)











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PHOTOGRAPHIC SCIENCES CORPORATION
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P.O. BOX 338
WEBSTER, NEW YORK 14580

Docket No. 70-33

Mr. Frank J. Veale, Jr.
Manager, Environmental Engineering
Industrial Hygiene
Metals and Controls Group
Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02703

Dear Mr. Veale:

Subject: July 14, 1992 Management Meeting Summary Report No. 70-33/92-02

This letter transmits a meeting report which summarizes our discussions with you and Mr. M. Elliott of your staff during a meeting held in the NRC Region I offices on July 14, 1992. At that meeting you provided information concerning the status of actions taken with regard to cleaning up identified areas of contaminated soil located on the south side of Building 12 at the Attleboro, Massachusetts site. We found this meeting useful in understanding the status of activities at the Attleboro site with regard to License No. SNM-23.

Sincerely,

James H. Joyner, Chief
Facilities Radiological Safety
and Safeguards Branch
Division of Radiation Safety
and Safeguards

Enclosure:
NRC Region I Meeting Summary Report No. 70-33/92-02

170044

OFFICIAL RECORD COPY S: TI9202.MMR July 30, 1992

cc w/encl:
K. Abraham, PAO (2)
Public Document Room (PDR)
Local Public Document Room (LPDR)
Nuclear Safety Information Center (NSIC)
Commonwealth of Massachusetts (2)

F 07

Texas Instruments, Incorporated 3

bcc w/encl:
Region I Docket Room (with concurrences)
J. Roth, DRSS
J. Shepard, NRC-NMSS

RI:DRSS
Roth/rmn
07/27/92

RI:DRSS
Pasciak
07/30/92

RI:DRSS
Joyner
08/2/92

OFFICIAL RECORD COPY S: TI9202 MMR July 30, 1992

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U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 70-33/92-02

Docket No. 70-33

License No. SNM-23 Priority 1 Category UHFF

Licensee: Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02702

Facility Name: HFIR Project

Type of Meeting: Management Meeting

Meeting Date: July 14, 1992

Inspector: J Roth 7/27/92
J. Roth, Project Engineer
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Branch
Division of Radiation Safety and Safeguards
Date

Approved By: W. J. Pasciak 7-30-92
W. J. Pasciak, Chief
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Branch
Division of Radiation Safety and Safeguards
Date

Meeting Summary: A management meeting was held at Region I, King of Prussia, Pennsylvania on July 14, 1992 at the licensee's request to discuss the status of the licensee's actions with regard to cleaning up identified areas of contaminated soil at the Attleboro, Massachusetts site.

DETAILS

1.0 Meeting Attendees

1.1 Texas Instruments

M. J. Elliott, Manager of Environmental Engineering
F. J. Veale, Jr., Esq., Environmental Attorney and Manager of Safety, Industrial Hygiene and Environmental Engineering

1.2 Nuclear Regulatory Commission

R. Cooper, Director, Division of Radiation Safety and Safeguards
J. Joyner, Chief Facilities Radiological Safety and Safeguards Branch
J. Kinneman, Chief, SDMP Task Force
M. Miller, Senior Health Physicist
W. Pasciak, Chief, Facilities Radiation Protection Section
J. Roth, Project Engineer
J. Shephard, Project Manager, NMSS

2.0 Summary of Discussion

Mr. Cooper opened the meeting and thanked the licensee's representatives for attending the meeting. The purpose of the meeting was for the licensee to present the status of plans for remediating contaminated areas of the site as provided in the Interim Status Report dated June 30, 1992 (attached). These contaminated areas were previously identified by the NRC as a result of a confirmatory survey conducted during 1984. Messrs. Elliott and Veale provided, (1) results obtained of a pilot characterization study conducted to define the limits of contaminated areas on the site (copy attached); (2) information concerning a remediation plan that has been written (copy attached); (3) current information with regard to the status of a previously requested license modification dated July 25, 1991; and (4) information on the status of the revised financial assurance plan for the facility.

In addition, Mr. Veale provided an update on actions taken by Texas Instruments and others with regard to the Shpack landfill located in Norton, Massachusetts and discussions held with the Department of Energy concerning inclusion of the Attleboro site in the Department's Formerly Utilized Sites Remediation Action Program (FUSRAP).

3.0 Conclusions

Mr. Cooper concluded the meeting by thanking the licensee's represe atives for the information provided. The licensee representatives agreed to:

-- provide the NRC with a copy of a milestone chart for remediation activities.

-- provide the NRC with a copy of the site Health and Safety Program Plan to be used during remediation activities.

The NRC will prepare a license amendment reducing the authorized quantity of uranium-235 based on the original licensee request dated July 25, 1991.

Attachments:
1. June 30, 1992 Letter, M. J. Elliott to J. Roth
2. Radiological Characterization of Texas Instruments, Incorporated Attleboro Industrial Facility
3. Texas Instruments Incorporated Remediation Plan

TEXAS INSTRUMENTS

June 30, 1992

Certified Mail
Return Receipt Requested

Mr. Jerome Roth
U.S. Nuclear Regulatory Commission, Region I
475 Allendale Road
King of Prussia, PA 19406-1415

Re: Docket No. 70-33
SNM License No. 23
Texas Instruments Incorporated
Attleboro, MA 02703
1) June Interim Status Report toward Development of a Remediation Schedule
2) License Modification Request
3) Financial Assurance Plan

Dear Mr. Roth,

In the following correspondence, Texas Instruments Incorporated (TI) will report on recent activities on the topics listed above.

This is also a good opportunity to confirm our meeting at the NRC-Region I offices in King of Prussia, Pennsylvania on Tuesday, July 14, 1992. May I suggest 1:00 P.M. in the afternoon. Frank Veale and Mike Elliott will be attending from TI. TI will be presenting the results of its Pilot Study Investigation, as well as discussing the strategy toward remediation of the contaminated soils at its former burial site.

1.0 June Interim Status Report

1.1 Pilot Study Investigation:

During the weekend of June 6th and 7th, TI conducted a Pilot Study Investigation of its former burial site. The study consisted of excavation and sampling of soils to establish some specifications for the full-scale project. In particular, TI gathered information on the following matters; 1) volume estimates for soil requiring excavation, 2) contaminant characteristics to identify disposal options, 3) correlation between direct

field measurements and analytical data from samples collected in the field as well as the original 1984 ORAU Report, and 4) refinement of the Health & Safety Plan for the full-scale project.

Building on the Pilot Study Report, TI has developed a strategy for remediation of the contaminated soils. With such a strategy in place, TI will then be able to submit to NRC a schedule for development of a Remedial Action Plan by the deadline of July 31, 1992.

As indicated above, TI will present the results of this investigation and discuss the remediation strategy at the July 14th meeting in King of Prussia.

1.2 Government Interactions

TI has accomplished significant progress in the area of government interactions. The meetings alluded to in the last status report of May took place on June 3, 1992. Frank Veale and Dick Churchill met with staff members from Congressman Synar's office, Congressman Frank's office, and Senator Kerry's office.

As a result of these meetings, numerous correspondences to the DOE and the Schenectady Naval Reactor Office have ensued. Dave Berrick of Synar's staff committed to pressing DOE on the issue why TI does not qualify for government funding of the clean-up. He has also contacted the Naval Reactor Program about the same matter. Congressman Frank has written a letter to the DOE on TI's behalf. Senator Kerry's staff has prepared a letter to the DOE on TI's behalf for his approval. Kerry's letter may be authored jointly along with Senator Kennedy.

TI also wrote to the Schenectady Naval Reactor's Office requesting a letter to DOE regarding NR's position on government funding for TI. Meanwhile, NR has been searching their archives for examples of early AEC contracts with M&C Nuclear. Such contracts may demonstrate specific indemnification language favorable to TI's position.

1.3 Discussions with Other Fuel Cycle Facilities:

TI met with Mr. Thomas Gutman of UNC to review UNC's experience remediating contaminated soils in compliance with the Branch Technical Position. Mr. Gutman has offered to assist TI in development of its Remedial Action Plan.

Less formal, but regular correspondence continues with Jack Moulton of Combustion Engineering, and Don Barbour of Nuclear Metals Inc.

TI is hosting the next meeting of the Fuel Cycle Facilities Forum (FCFF) which is scheduled for July 15th and 16th. This Forum provides an opportunity for participants to exchange technical information on issues such as D&D and License Termination.

2.0 License Modification Request

In a letter originally submitted to NRC on July 25, 1991, TI requested modification of SNM No.23 to allow the possession of no more than 350 grams of contained U-235 in unsealed form.

At our April 14, 1992 meeting, the NRC indicated that this request could be granted, but TI was offered the opportunity to perform calculations to justify an even lower figure. TI's consultant, CPS could not arrive at a quantity of residual material from the information in the ORAU Report with any degree of certainty. Assuming various extrapolation methods, the quantity could have varied significantly. Consequently, TI will stand by its request of July 25, 1991.

3.0 Financial Assurance Plan

As a result of the exercise described in the Previous section, TI will need to secure financial assurances equal to the estimated cost of its remediation. TI's consultant, CPS, prepared a revised cost estimate based the pilot study investigation volume estimates and the preferred remediation strategy. This is summarized in a report entitled "Preliminary Cost Estimates of Various Remediation Options for Texas Instruments Incorporated, Attleboro, Massachusetts", dated June 14, 1992. Selected portions of this report are attached to this letter. The cost estimate

for Option 4, the preferred remediation strategy, is $380,980. The remediation strategy associated with this option involves minimizing the total volume of excavated material by surgically removing specific locations to an average depth of 0.6m where soils exceed the limits prescribed in the Branch Technical Position.

TI intends to secure a "Letter of Credit" for the amount of $380,980 as soon as the NRC approves such a course of action.

By the end of July, TI will submit a formal schedule detailing the activities required to develop the final remedial action plan. In the meantime, we look forward to a constructive meeting on the 14th. Please don't hesitate to contact us if any further details or clarification are required.

Sincerely yours
Materials & Controls Group

Michael J. Elliott
Environmental Engineering Mgr.

cc: Mr. John Kinneman-NRC
Mr. Richard Churchill-TI
Mr. Francis J. Veale, Jr., Esq.-TI

Preliminary Cost Estimates
of
Various Remmediation Options
for
Texas Instruments Incorporated
Attleboro, Massachusetts

Prepared by:
Creative Pollution Solutions, Inc
June 14, 1992

Options for Remediation of Identified Area of Contamination

The following are options by which the contaminated areas identified in the ORAU study can be remediated. In addition to the ORAU study the pilot excavation performed by Franklin Environmental Services and Creative Pollution Solutions, Inc. aided in estimating total cost for remediation of the identified area.

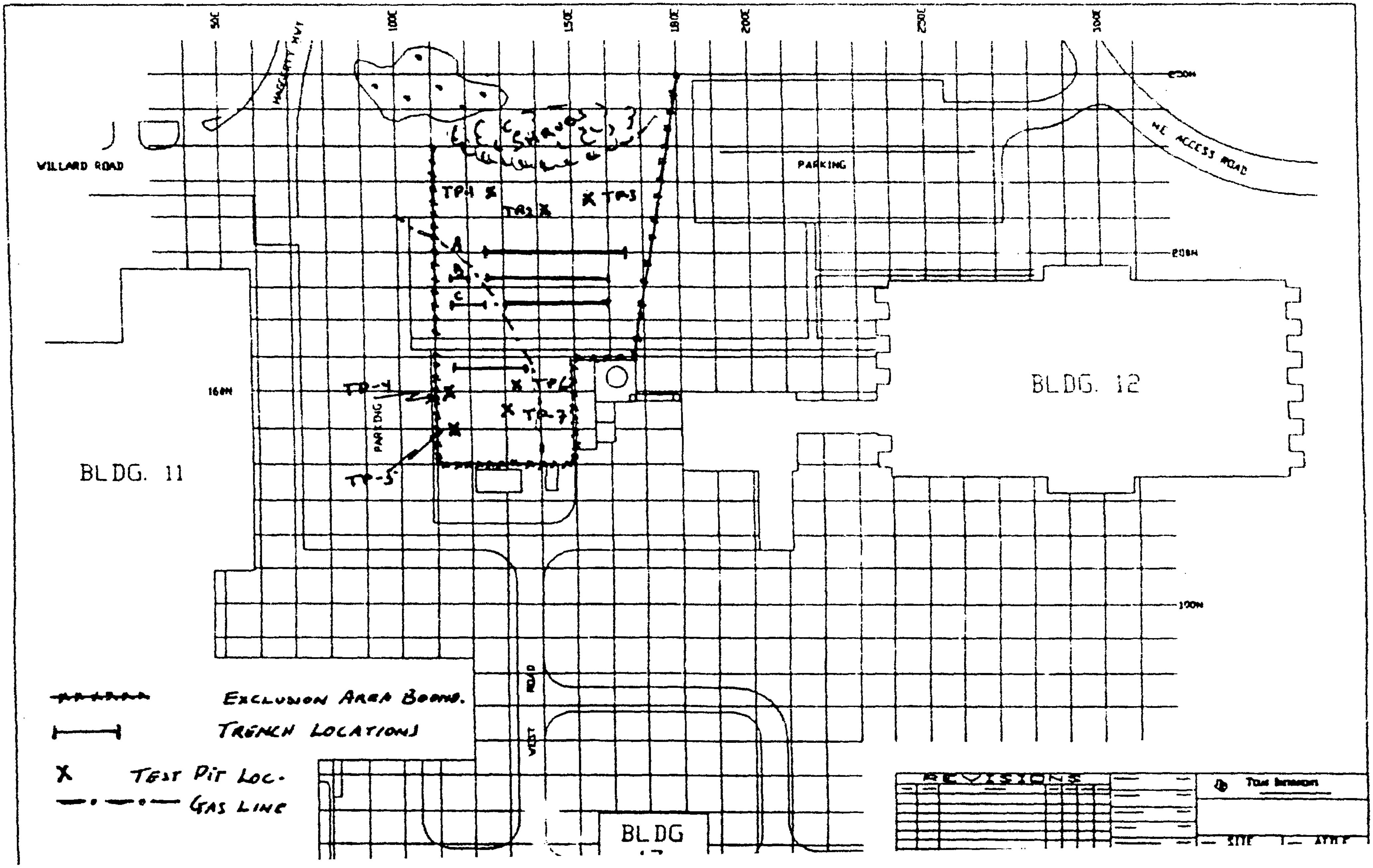
The data collected during the pilot excavation (Phase I) will be useful for cost estimation, development of the site remediation plan, and useful for cross reference with field measures to allow for field decision making. The data collected during phase I of this project included: trench relative exposure rate data, trench grab samples, and trench composite sample analysis performed at Lockhead Analytical Inc. This information will be presented in detail under separate cover.

The screening techniques employed were used as confirmatory measures, confirming the ORAU data, and may be used to modify the volume to be disposed. The gross alpha screening certainly confirm sample results in the ORAU report however, a correltation between gross alpha screening data and the Lockhead activity assays must be established to further estimate radionuclide concentrations in identified areas of each trench.

As identified in this report several options are available to Texas Instruments Incorporated. One of the options makes the assumption that the areas near trench A and trench B do not have to be remediated, except for isolated locations. This assumption may be supported by the analysis being performed by Lockhead.

The general approach of each option would be as follows:

- Excavation of the soil using conventional excavation equipment
- Screening of excavated soil primarily for volume reduction
- Monitoring of the debris for contamination
- Loading of the soil into roll-off containers
- Compaction of the soil
- Decontamination of the roll-off containers for transport
- Transport by truck to rail, then by rail to waste disposal site



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TP-7
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BLDG. 12
BLDG
WEST ROAD
EXCLUSION AREA BOUND.
TRENCH LOCATIONS
X TEST PIT LOC.
GAS LINE
REVISIONS

Option 4

Assumptions:

1) All U-235 > 30 pCi/gram; U-238 > 35 pCi/gram; Th-232 > 10 pCi/gram.

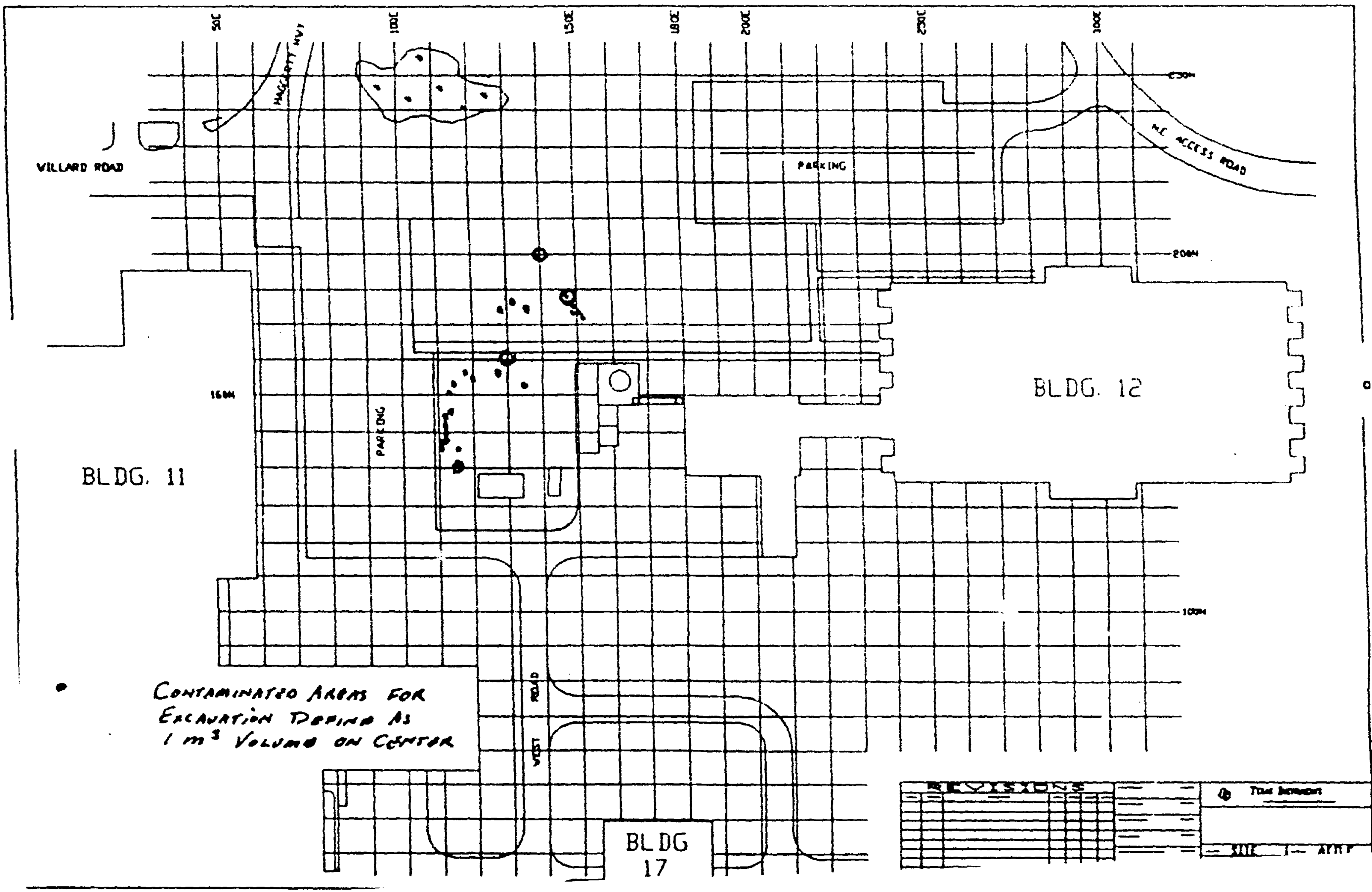
2) Surface contamination to a depth of 0.6 meters.

Volume Estimate: (see figure 3)

170 m^3 x 35.3 = 6000 ft^3

Cost Estimate: (see Appendix A)

Disposal:	$198,000
Packaging:	$4080
Transportation:	$89,250
Excavation:	$44,250
Health Physics:	$45,400
TOTAL :	$380,980



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WEST ROAD
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• CONTAMINATED AREAS FOR EXCAVATION DEFINED AS 1 m³ VOLUME ON CENTER
REVISIONS

Appendix A

General Cost Estimates

Appendix A -- General Cost Estimates

Transporation related costs:

Transportation costs are based on estimates from Franklin Environmental Services.

Transport using roll/off intermodal boxes with a capacity of 432 ft^3. Cost estimate includes delivery of the empty roll-off to the TI site, transport from the TI site to rail, the rail transport charges, and charges from the rail to the waste disposal site in Utah.

Delivery from rail	$325/roll-off
Transport to the rail	$325/roll-off
Rail transport	$4600/roll-off
Roll-off liner	$100 ea.
Box/roll-off rental	$70/week
Off-loading charge	unknown

Not including packaging (liner and box rental) transport will be approximately $5250/roll-off.

Waste Disposal:

$33.00/$ft^3$ of soil

ASSUMING NO SURCHARGES.

Excavation costs:

Excavation costs are based on estimates from Franklin Environmental Services.

Labor, material, equipment, heavy equipment and safety gear	$4425/day
Excavation using 3/4" screen (assume 5 hour operation per day)	440 ft^3/hr 2200ft^3/day

Health Physics

Baseline Costs (Independent of Option): $30,000

Layout dig areas, write remediation plan, modify Health and Safety plan, equip. and supplies, Post remediation survey (monitoring and sampling), and final report.

Field Costs: $1540/day

Includes one HP @ $75/hr, 3 technicians @ $35/hr, and one HP on call @ $100/day.

APPENDIX B

ASSUMPTIONS AND GENERAL CONSIDERATIONS FOR REMEDIATION

APPENDIX B: ASSUMPTIONS AND GENERAL CONSIDERATIONS FOR REMEDIATION

Volume Reduction:

Volume reduction is a common practice to minimize disposal costs. For soil, two methods can be employed. Screening the soil to remove aggregate followed by compaction of the soil. It is estimated that the aggregate content represents 20% of the unexcavated volume. The unexcavated density is assumed to be approximately 2 grams/cm^3 and the excavated density is approximately 1.2 gram/cm^3 based on weight and volume obtained in pilot excavation samples. Simple field compaction can achieve a 2:1 compaction ratio. Therefore an overall volume reduction of 20% is possible, however, not used in the option estimates.

Transportation:

Trucking

The radioactive material from the affected areas meet the definition of Low Specific Activity, LSA. Requirements for transport are specified within 49 CFR 173.425 and specifies shipment as exclusive use. Cost estimates per exclusive use vehicle were obtained. According to Tri-State Motor Co., an experienced company in exclusive use transport of radioactive material, the costs would be approximately $1.84/mile with a shipment cost to Clive, Utah coming to $4500; to Barnwell South Carolina at $2100; and to Hanford Washington at $5800; and to Beutte, Nevada at $5000.

A Gross vehicle weight limit of 80,000 lbs is imposed with an estimated cargo weight of 45,000 lbs. Regardless of soil density, the weight is the limiting factor in exclusive use, not the volume. Therefore, based upon volume excavated and assumed densities, the number of exclusive use vehicles can be determined.

Rail

Based on estimates received from Franklin Environmental Services, LSA shipments of 22 tons capacity per roll-off container, with three containers per rail car, would cost approximately $5250/roll-off. The number of roll-offs depends on the volume option selected. The $5250 does not inlcude the $70/week rental fee or the $100/liner for the roll-offs.

Disposal Options:

Site excavation and disposal prior to January 1, 1993 is the desired option regardless of the presented cost estimates. Since cost estimates after that date will be greatly enhanced due to surcharges and limited burial site access.

Disposal costs at the burial sites will vary and a bidding process would be prudent to ensure the lowest cost. Envirocare has suggested a cost per unit volume of approximately $\$33/ft^3$. Other burial sites suggest that value for planning purposes but encourage a bidding process. Exclusive of actual burial charges, a surcharge is imposed as mandated by the LLW Act and is presently $\$160/ft^3$.

EnviroCare, under its license, section 9, "Authorized Use", requires provisions be met for users outside the Northwest Compact. Massachusetts is outside this compact and therefore a surcharge may be imposed. The surcharge cost was not included in any cost estimates in this report.

RADIOLOGICAL CHARACTERIZATION
OF
TEXAS INSTRUMENTS, INCORPORATED
ATTLEBORO INDUSTRIAL FACILITY
ATTLEBORO, MASSACHUSETTS

by

Creative Pollution Solutions, Inc.

I. PILOT STUDY OVERVIEW

GENERAL

The area which was identified as the former burial area which is located between Buildings 11 and 12 was the focus of this radiological characterization. This area is presently used for several purposes. The area is primarily a well landscaped level parcel with large rock formations and flower beds. The area includes several paved parking lots to the north and south west and side walks interdispersed. The site is bordered in the northwesterly direction by shrubs, and a wooded low lying wetland.

The technical data used for this radiological characterization is derived from two major sources, the first is the 1984 Oak Ridge Associated Universities (ORAU) study and the second is the limited trench sampling conducted by Creative Pollution Solutions, Inc. (CPS) in June 1992. The isotopic analyses of the CPS trench sample composites were performed by Lockhead Analytical Inc.. Gross alphr counting was performed on all trench grab samples for the purpose of confirmation and correlation with isotopic data for future use as a field screening technique during the remediation process.

OAK RIDGE ASSOCIATED UNIVERSITIES (ORAU)

The ORAU study employed a grid sampling technique which established reference coordinates within the study area. The grid network established 480 sample grids. A walkover surface scan using portable NaI(Tl) gamma scintillation detectors was conducted at 1-2 meters over the entire gridded area. Exposure rates were taken at both contact and at 1 meter elevations on each grid coordinate as well as areas identified during the surface walkover scan. Surface soil samples were taken at grid coordinates and assayed for Uranium 238 and 235 as well as Thorium 232 and Radium 226. The surface exposure rate survey identified 21 isolated locations at which elevated (greater than background) exposure rates were identified. These 21 locations were further characterized by soil samples ranging in depth from 2 to 40 cm. In addition, 25 boreholes were used to further characterize areas which exhibited elevated surface exposure rates and/or were questionable areas found by ground penetrating radar. The boreholes ranged in depth from 1.0 meters to an average of 3.5 meters and a maximum on one borehole of 5.0 meters.

CREATIVE POLLUTION SOLUTIONS, INC. (CPS)

The CPS exercise employed a trenching technique and subsequent sample compositing from extracted materials. The trenches, a total four, were excavated with a conventional backhoe to a depth of 2 feet. They ran in parallel within the study area and in a southwest to northeasterly direction. The trenches were approximately 100 feet long and were segmented in areas which encroached on utilities. In addition to the trenches, 7 test pits were excavated in areas to the northeast and southwest of the trenches. (see diagram 1)

The CPS study was intended to provide the following information:

. Confirmation of the data in the Oak Ridge Associated Universities (ORAU) study (RSAP/SMBP-8, 1985);

. Comparison of composite sample data between ORAU and Lockhead Analytical Laboratories, Inc. (LAL) data;

. Determination of acceptability for disposal of the contaminated soil and debris;

. Identification of remediation options and the estimated costs for each option,

. Estimation of costs of the major elements required for remediation (with assistance from Franklin Environmental Services) defined in each option as follows:

- excavation costs
- on-site material handling (segregation/ compaction)
- packaging
- transportation
- disposal costs
- post verification survey costs

. Correlation of gross alpha screening data with ORAU and LAL data and as a demonstration of a rapid field screening technique to be employed during remediation; and

. Demonstration of the feasibility of remediation.

SAMPLING RESULTS AND CHARACTERIZATION

The ORAU, which is the more comprehensive of the two studies, provided the following information:

1. Most of the elevated (greater than background) data indicated U-238 as the major isotope.

2. Some samples indicated U-235 and Th-232 above background concentrations.

3. Ra-226 was not identified as a contaminant.

4. Contamination was experienced in isolated locations within the study area with no clear bounds.

5. Contamination was found to a depth of 1.8 meters in several locations.

6. The source of some of the elevated exposure rate locations were metal objects and/or debris which when removed reduced the exposure rate to background.

The analytical sampling results varied widely from many areas of background concentrations to isotopic maximums as follows:

Uranium-238	887 pCi/gram
Uranium-235	590 pCi/gram
Thorium-232	10,240 pCi/gram*
Radium-226	0.9 pCi/gram

* This was only found at one location. The majority of samples were at background concentrations.

The CPS trenching and composite sampling added the following information and/or confirmations:

1. Trenching with conventional equipment was a realistic method for ultimate remediation.

2. Trenching confirmed the presence of isolated spots of elevated contamination.

3. Trench composite sampling was a viable technique for the identification of contamination over large areas.

4. The trenching and pit excavation did not reveal any new areas of contamination.

5. The analytical results from LAL supported the results of the ORAU study.

6. The gross alpha screening technique correlated well with the analytical isotopic data in the ORAU and CPS studies.

7. Uranium-238 and Uranium-235 are the major contaminant.

8. Trenching confirmed the presence of metal scrap and/or debris.

The isotopic concentrations of Uranium found in the samples analyzed by both ORAU and LAL indicate varying abundances. The Uranium data reflects all conditions of isotopic abundance, natural, enriched as well as depleted Uranium. However, this information can be misleading due to the low concentrations found, nonhomoginaity of samples and/or study area and the various analytical techniques used for the determination of Uranium.

SUMMARY OF CONCLUSIONS

Some simple conclusions can be drawn from this study. It appears as if from the time of it's former use as an undeveloped parcel, as evidenced by historic photographs, to it's present landscaped configuration some contaminants may have been disturbed and distributed over an unspecified area. This process or processes have left some areas with isolated elevated concentrations of Uranium and a distribution of other areas with less, if any, contamination. This phenomenon also helps explain the presence of contaminants, at nonuniform distributed concentrations, at varying depths. It is also clear that much of the contamination is associated with scrap metals and/or debris in solid form and not soil contamination.

The identification of metal scrap and debris and the subsequent identification of this material, in many cases, as the source of contamination is significant. The use of mechanical screening in combination with radiological screening could reduce the volume of soil requiring remediation.

The use of existing Federal guidance on acceptable soil contamination is complicated due to the application of different acceptable levels for each isotopic form of uranium. For processed uranium (uranium without daughter products) one set of criteria indicate that for surface contamination or contamination of soil in areas without use restrictions the maximum concentrations are 35pCi/g for depleted uranium and 30 pCi/g for enriched uranium.

The determination of the quantity of uranium (U-235 as the licensed isotope) is difficult with the present data. Estimates of the quantity of U-235 present on the TI site is controlled by many necessary assumptions on the extent, concentration levels, depth and the acceptable reference or background level. The assumptions employed in estimating the U-235 mass can drastically change the resulting values. It would appear that

mitigation of the identified areas could result in minimal residual activity.

The use of mechanical screening along with gross alpha screening in the field should provide the most cost effective combination for the remediation of the site.

II. SUMMARY OF PILOT EXCAVATION

PRE-PLANNING

Initial Review of ORAU report:

Initially, the ORAU report was thoroughly reviewed to determine the types of hazards, radionuclides of concern, concentrations found, and the external exposure levels on the site.

Preliminary meeting with TI project manager:

After reviewing the report an initial meeting between Creative Pollution Solutions and TI to discuss the scope of work involved in pilot excavation. At this time it was determined by Texas Instruments that the pilot excavation was to be based on the contaminated areas identified in the ORAU report.

Initial Coordination with the Excavation Contractor

A meeting with Creative Pollution Solutions, Franklin Environmental, and Texas Instruments Incorporated was held to discuss logistics of the pilot operation. In this meeting the following items were discussed:

. Workplan

A discussion of the operations necessary adn the procedures to be used to obtain the necessary information to meet the objective s of the pilot study. Items discussed included: location of trenches, logistics of excavation, sampling operations, and equipment decontamination.

. Health and safety plan

It was determined that Franklin Environmental Services would provide the site health and safety plan and Creative Pollution Solutions would be responsible for the site specific radiation health and safety plan. Particular issues of concern which were discussed included: personnel monitoring for radiation exposure, decontamination, personal protective equipment required, and medical surveillance necessary.

. Site communications

It was determined that radio communication between personnel in the hot zone and support zone would be used.

. Site Authority

It was determined that field calls may be essential and with regards to sampling or exposure to radiation these judgements would be made by Creative Pollution Solutions but with regard to other health and safety considerations (including heavy equipment, heat, etc.) Franklin Environmental Services would make the decisions.

As a general rule it was decided that anyone could stop the job if they deemed it necessary.

Preliminary site layout and survey

Creative Pollution Solutions used reference site grid maps developed from the maps in the ORAU report to measure areas to perform the pilot excavation. The trench locations were determined based on the ORAU report. The plan was to excavate a total of four trenches (60' to 100' long x 3' wide x 2' deep) and 7 test pits (5' long x 3' wide x 2' deep). Diagram1 (p.11) shows the locations of the trenches and test pits. During the layout of the trenches and the test pits survey measurements were taken at the surface of the soil to confirm areas of elevated radiation levels.

Workplan Development

Creative Pollution Solutions, with assistance from Franklin Environmental, developed the Sampling Workplan to be used during the pilot excavation. The procedure used is included in Attachment 1 (p. 9-10).

Health and Safety Plan Development

Creative Pollution Solutions developed the site specific radiation health and safety plan to be used in conjunction with Franklin Environmental Services site specific health and safety plan.

Zones Demarcated

One day prior to the excavation Franklin Environmental Services, with guidance from Creative Pollution Solutions erected a boundary fence along the exclusion zone. In addition to this security guards were positioned at access points to assure no unauthorized personnel would enter the restricted area. (see Diagram 2 p. 12)

Final Coordination and Training

One day prior to the pilot excavation field crews from Franklin Environmental, Texas Instruments Incorporated, and Creative Pollution Solutions were briefed with regard to the workplan and the health and safety plan. In this meeting the site hazards and associated health risks were discussed.

OPERATIONAL PHASE OF THE PILOT EXCAVATION

A chronological depiction of the activities on site during the one day pilot excavation follows:

6:00	Field teams arrive on site
6:30	Set up lab stations and command post
7:00	Set up decontamination zone
7:15	Area air samplers were positioned
7:30	Issue all field personnel appropriate dosimetry (Everyone in the exclusion area was issued TLD badges and pocket dosimeters, specified personnel entering the hot zone were issued Breathing zone air samplers)
8:30	Field personnel test communications and don proper protective gear to begin operations
9:00	Begin digging Test pits 1,2,3 (see summary workplan for details of excavation operation)
10:15	Continue with Trenches A and B
	Break
13:00	Continue with Trench C and Test pits 4 ,5,6, and 7
	Finish with Trench D and special D (in this area a decision was made, due to elevated survey readings, to dig further down then the previously specified depth of 2 feet)
16:00	Sampling aspect of the pilot excavation complete
17:00	Landscaping of trench areas by Franklin Environmental Services - including separating aggregate rock and temporarily storing in drums.
18:00	Refencing of hot area (leaving the access walk way free for site employees)
19:00	Begin to survey /decon heavy equipment
19:30	Survey of access walkway
20:00	Final packaging of samples and drums for temporary storage
21:00	Field personnel leave site

ATTACHMENT 1

SOIL SAMPLING WORKPLAN

As identified in diagram 1, the work to be performed during the pilot study involved the following:

1) Excavating identified test pits and trenches;

2) Monitoring the area and trench during excavation;

3) Taking grab soil samples approximately every 15-20 feet along each trench (and one grab sample per test pit);

4) Putting the excavated soil back into the trenches; and

5) Performing a final area radiation survey.

A decision was made to start the excavation from the areas identified test pit 1, 2 and 3 and work toward trench C. All trenches and test pits were approximately 2 feet deep (unless field measurements indicated a need to go deeper) x 3 feet wide (1 bucket width). The length of the trenches varied based on location from between 60 feet to 100 feet.

The excavation of the trenches was performed in a systematic fashion in order to control contamination. The excavation team finished trench A and began to excavate trench B while the sampling team did the appropriate work on trench A (see Soil Sampling and Monitoring below).

After the sampling team completed trench A the excavation team backfilled the trench.

A similar approach was used on the other side of the site. First the test pits (4,5,6 and 7) were excavated and then the last trench was excavated.

After all the test pits and trenches were backfilled the excavation team collected aggregate stone from all excavation areas and put them in 55 gallon drums for temporary storage. At this point all personnel and equipment were decontaminated before leaving the site.

SOIL SAMPLING AND MONITORING

1) Removed soil was monitored with NaI survey meter to identify elevated levels,

2) The trench and/or test pits were monitored with NaI survey meter at depths of 12" and 24" at 15-20 foot intervals along the trench.

3) A 5 gallon grab sample of soil and debris was taken every 15-20 feet along the trench.

4) 5 gallon pails were transfered to the soil sample transfer area; 5 gallon pails were labelled as follows:

Three test pits -- TP-1, TP-2, and TP-3

1st trench -- A-1, A-2, ...

2nd trench -- B-1, B-2, ...

3rd trench -- C-1, C-2, ...

5) Five gallon field grab samples were used to prepare composite samples and small grab samples for gross alpha analysis.

PERIMETER AIR SAMPLING

1) Air samples were collected from the perimeter of the site as well as one air sample in the excavation area.

2) Coordination with field personnel was necessary to obtain the 1 air sample in the exclusion zone.

BZA SAMPLES

1) Five breathing zone air samplers were issued to identified field personnel.

Health and Safety Survey and Data

In accordance with the health and safety plan and the work plan, various surveys were conducted to assess exposure conditions. These included the use of personnel dosimetry, breathing zone air sampling, general area air sampling, perimeter air sampling, and bioassay.

Personnel dosimetry consisting of Thermoluminescent dosimeters and self reading pocket dosimeters were issued to all personnel involved in the pilot study. Record keeping of personnel dosimetry is the responsibility of Texas Instruments as required by their license (SNM-23). As expected the results of the personnel dosimetry indicated no measurable exposures since the dose rates as measured in field were very small. (Appendix A-1)

Air sampling was performed to assess boundary, general area, and personnel exposures. The general area air samples (Appendix A-2) were evaluated in the field initially (approximately 1 hour post work initiation). The time (1 hr), flow rate (22 lpm), background count, were such that the minimum detectable concentration was at the non-occupational Maximum Permissible Concentration (MPC). Discrimination for radon progeny was achieved via a conservative two count technique. All air samples showed concentrations which were less than the Minimum Detectable Activity (MDA). As a result, the boundary and general area air sampling were allowed to run for the remaining time of work conduct. The two perimeter air samples was found not to be running (during time of collection) due to a ground fault interrupter trip. However, since the general area air sampler which was located in close proximity of the actual intrusion showed no indication of airborne radioactivity, it would be reasonable to assume that the perimeter would likewise indicate the same. All air samples were later analyzed for alpha and beta activity using a gas flow proportional counter at a time post sampling that was long in order to allow the radon progeny to decay. These sample results indicated less than MDA concentrations. Personnel air sampling was performed with the use of 2 lpm Breathing Zone Air (BZA) sampling devices. These samplers were allowed to run during the entire work phase to assess potential individual intakes. In all cases but one, the activity on the BZA filters were less than MDA which corresponds to an intake of less than 2.5 E-2 MPC-h and the single positive result corresponded to an intake estimate of 4.1 E-2 MPC-h (Appendix A-3). It should be noted that any MPC-h value less than 2 MPC-h is not recordable. (Code of Federal Regulations Chapter 10 Part 20)

Bioassay samples were required for all principals in accordance with the Health and Safety Plan. These bioassay samples included baseline and post work samples. The samples were urine samples which were analyzed for uranium via flourometric techniques. The results were not available for this report. However, based on air sampling data it is anticipated that the urinalysis results will be within baseline levels.

Field Survey and Soil Analyses

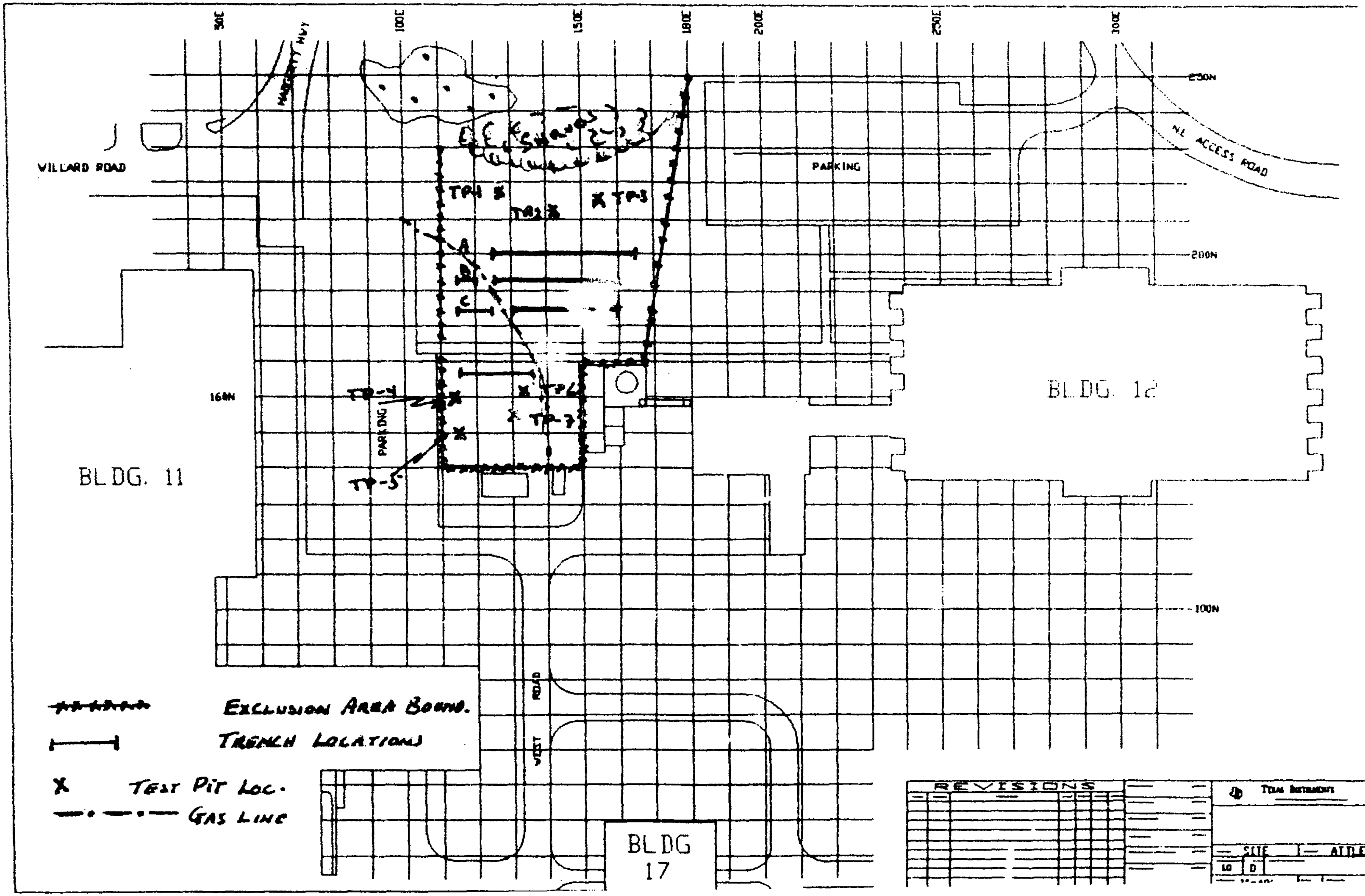
Sampling was performed from each test pit and along each trench as depicted within Diagram 1. General area surveys of the pits and trenches were performed at 0, -1', and -2' elevations in an attempt to correlate anomaly data of ORAU to actual excavation. This data (Appendix B-1) does demonstrate elevated levels in the suspected areas and confirms the choice of locations for pilot excavation.

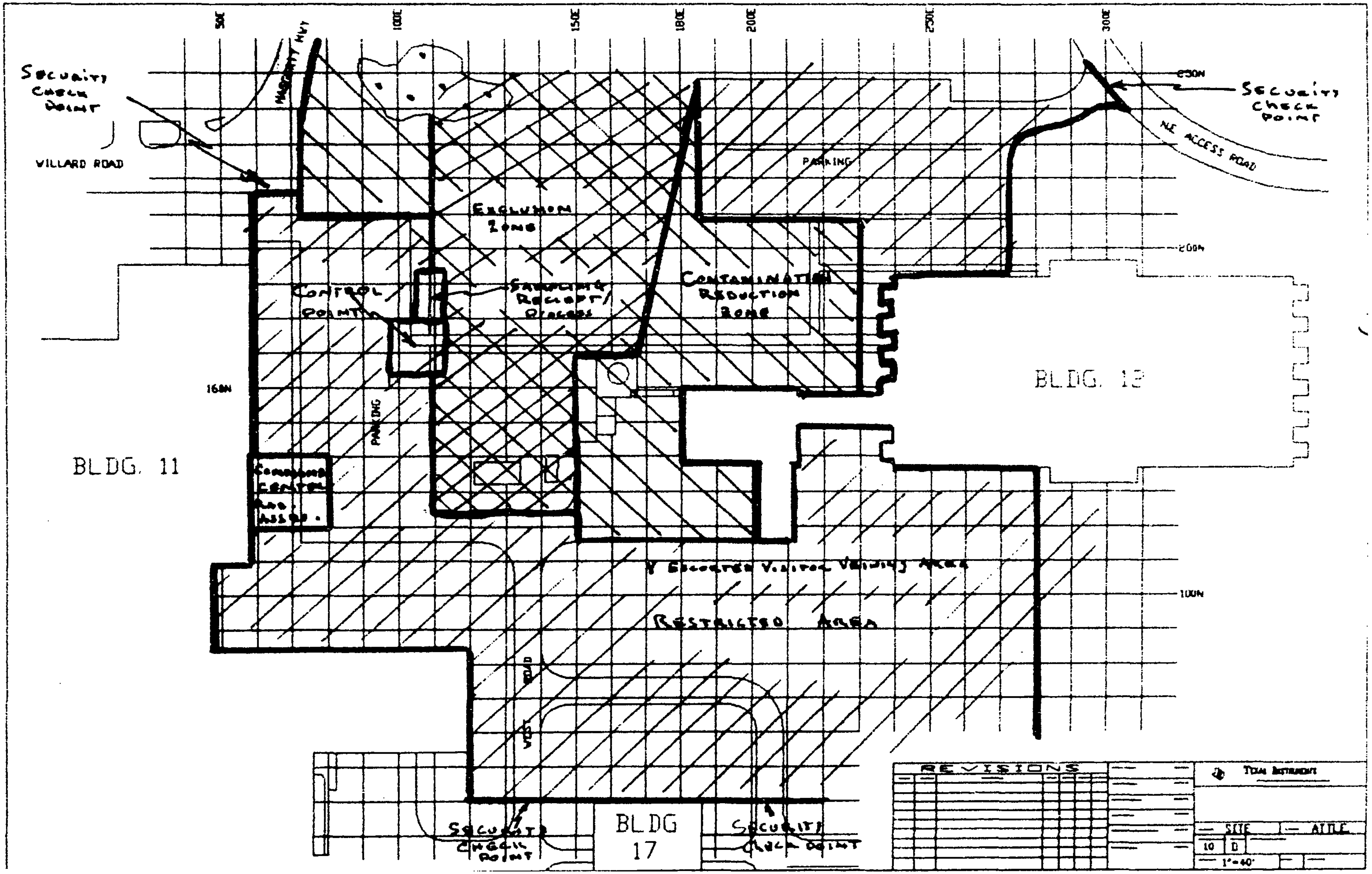
Soil samples were obtained from each test pit and at 15-20' intervals along each trench. The sample volumes were approximately 4 gallons, collected in 5 gallon containers. From each of these containers 1 liter samples were extracted and composites generated. The composite samples were as follows: 1) Composite 1 - Test pits 1, 2, 3 and trench A; 2) Composite 2 - Trench B and C; 3) Composite 3 - Trench D and Test pits 4, 5, 6, and 7; and 4) Composite 4 - A sample from trench d which demonstrated a much higher direct reading than any other area and presumably would represent worst case. Each of these samples were sent to Lockheed Analytical Laboratories (LAL) (appendix B-2) for contract analyses of isotopic uranium and thorium. In addition, each sample from the 1 liter containers along with the composites and special composites of trench b and c were analyzed using a gross alpha screening technique (Appendix B-3) to ascertain spatial variations within the trench. A comparison of the LAL data and the gross alpha screening technique was made and demonstrated good correlation amongst the data.

The LAL data represents a range of values in isotopic abundances. Of particular interest is the data which represents the special sample out of trench D. This sample was composed of a finer texture, and a color (grayish) composition that differed from the surrounding soil and contained debris in the appearance of small machining fines. In addition, the location of this area was identified by elevated direct radiation levels identified by ORAU and CPS at the surface and at depth by CPS. This particular location indicated a depth in excess of 3 feet although a maximum depth was not determined at this time.

Correlation between the LAL data and the gross alpha screening method was made. In addition to the composites, averages of the gross alpha data for each corresponding composite sample was made. This data (Appendix B-4) is in good agreement and demonstrates this method as a viable technique to quickly determine the extent of soil contamination. This method can be readily demonstrated to be a practical field analyses technique. We have also undergone preliminary correlation of the soil data to "pancake" G-M response and can demonstrate the ability to detect samples containing > 100 pCi/g of uranium in soil as a first pass method in actual remediation. This correlation will be developed further.

a


50E
100E
150E
180E
200E
250E
300E
250N
200N
160N
100N
WILLARD ROAD
PARKING
NL ACCESS ROAD
TP-1
TP-2
TP-3
A
B
C
TP-4
TP-5
TP-6
TP-7
PARKING
BLDG. 11
BLDG. 12
BLDG 17
WEST ROAD
EXCLUSION AREA BOUND.
TRENCH LOCATIONS
TEST PIT LOC.
GAS LINE
REVISIONS
Texas Instruments
SITE
ATTLE



Security Check Point
Villard Road
Margarita Hwy
50E
100E
150E
180E
200E
250E
300E
250N
200N
160N
100N
Parking
NE Access Road
Security Check Point
Exclusion Zone
Control Point
Contamination Reduction Zone
BLDG. 13
BLDG. 11
Parking
Command Center
Escorted Visitor Viewing Area
Restricted Area
Visit Road
BLDG 17
Security Check Point
Security Check Point
REVISIONS
Texas Instruments
SITE
TITLE
1"=40'

Appendix A-1

Peronnel Dosimetry Issuance and Data

TLD ISSUANCE

Date: 6/7/92

NAME	BADGE #	TOTAL DOSE
L. Branco	99004	Minimal
Mike England	99012	Minimal
Lee Mulligan	99013	Minimal
Bob Smith	99001	Minimal
Steve Ayotte	99002	Minimal
Steve Duquette	99009	Minimal
Don Goddard	99005	Minimal
Alan Cornell	99014	Minimal
Rich Moniz	99008 (blue)	Minimal
Al Brown	99016	Minimal
Marcia Austin	99008 (black)	Minimal
Jay Malcolm	99005	Minimal
Fred McWilliams	99006	Minimal
Mark Chartier	99005 June	Minimal
Werner Schuele	99016 June	Minimal
Mark Griffon	99007 June	Minimal
Mike Elliott	99009 June	Minimal
Mark Henault	99010 June	Minimal
Frank Veale	99015 June	Minimal
Rich Derby	99011 June	Minimal
Ray Lizotte	99013 June	Minimal

Note: Minimal is defined as an exposure less than 10 mrem.

POCKET DOSIMETER RECORDS

NAME	BADGE #	READING IN (mrem)	READING OUT (mrem)
L. Bianco	9010179	0	-5
M. England	9010180	2	0
Allen Brown	9010182	0	-2
Lee Mulligan	9010183	0	-5
Bob Smith	9010184	0	-5
Steve Ayotte	9010198	0	-5
Steve Duquette	9010199	2	0
Don Goddard	9010201	0	0
Alan Cornell	9010203	1	-5
Rich Moniz	0122533	1	2
Jay Malcolm	0122534	-5	0
Mark Chartier	0122535	0	2
Marcia Austin	0122538	2	5
Werner Schuele	0122539	3	8
Mike Elliott	0122540	0	0
Mark Henault	0122544	2	2
Frnak Veale	0122545	3	5
Fred McWilliams	0122549	2	2
Mark Griffon	0122548	0	2
Rich Derby	0122574	0	-5
Ray Lizotte	0122569	2	8

Appendix A-2

General Area Air Sampling

GENERAL AREA AIR SAMPLING LOCATION AND DESCRIPTION

Rotary vane type air sampling pumps were used to provide continuous boundary and general area air sampling. These air samples provide an estimate of boundary conditions and general area hazards created during intrusion of the affected areas. Each air sampler was calibrated to a flow of 22 lpm and a restrictive orifice on the pump system maintained continuous flow. The air sampling heads were 2 inch open face type. The filter media used was a standard glass fiber media with retention of 99.97%. At each location designated for air sampling, the air sampling pump was positioned so that the air sampling pump was at an elevation of approximately 5 feet representing the breathing zone. Each air sampler was protected with a ground fault interrupter due to wet conditions encountered within the field.

The location of air sampling systems were as follows (refer to attached diagram):

Location	Description		
Perimeter 1	At side walk intersection near building 12		
Perimeter 2	Between Flag pole and building 12 parking lot on line with side walk described in perimeter 1 location.		
Control Point	Located at control point (see health and safety plan) on right side of side walk at the edge of parking lot.		
Field - General Area	Various locations:	1.	Between test pits 1, 2, & 3 and Trench A.
		2.	Between Trench B and C
		3.	Between Trench C and the sidewalk.

AIR SAMPLING ANALYSIS

Analysis of air samples was performed initially in field to ascertain any immediate hazards and then later in laboratory to quantify total activity concentrations.

Field analysis was performed using a Ludlum 2200 scaler coupled to a Ludlum 43-10 sample probe capable of detecting both alpha and beta radiations. Field calibrations were performed.

Table 1

Field Calibration Data

Alpha Background:	0	c/m
Beta Background:	126	c/m
Alpha Efficiency:	0.17	c/d
Beta Efficiency:	0.228	c/d

Since environmental radon particulate progeny produces interferences in counting, it is necessary to develop a method to discriminate against these and still ascertain airborne activity quickly. In this case, a two count method was used where the initial count is followed by a second count 35 minutes later. Here it is presumed that the effective half life of radon progeny is 35 minutes. Therefore, the long lived alpha activity is given by;

$$A_L = 2\,(A_{35}) - A_0$$

Where: A_L is the long lived alpha activity,
A_{35} is the activity based on the count 35 minutes post initial count, and
A_0 is the activity based on the initial count.

Field assessment was based on airborne activity using the initial count and the alpha to beta count ratio to obtain qualitative information on the extent of radon progeny. Subsequent counts 35 minutes later was used to better quantify the airborne alpha activity. Later all samples were taken to a laboratory for more accurate analysis once the radon progeny had decayed. The two count method in field and counting within the laboratory indicated all activity to be less than the minimal detectable activity (MDA).

The minimum detectable activity is can be developed as follows:

$$LLD = \frac{k^2}{2} + 2\sqrt{2}\,k\sigma_b$$

Where: LLD is the lower limit of detection
K is the defined for a 95% confidence interval of a one tail test and is equal to 1.65, and
σ_b is the standard deviation in the background count.

$$MDA = \frac{1}{eT}\,(LLD)$$

Where: MDA is the minimum detectable activity and
ϵ is the efficiency, and
T is the counting time.

$$MDC = \frac{MDA}{V}$$

Where: MDC is the minimum detectable concentration and
V is the volume of air sampled.

For field analysis the minimum detectable concentration was determined to be < 5.5E-13 μCi cc^{-1} for a one hour sample period as was performed initially and < 6.8E-14 μCi cc^{-1} for an 8 hour sample as performed subsequently. Sample analysis in the laboratory used increased count times and had a better efficiency given rise to a MDC of < 5.3 E-14 μCi cc^{-1} and < 6.6 E-15 μCi cc^{-1} for 1 and 8 hour sampling times respectfully.

Appendix A-3

Breathing Zone Air Sampling

BREATHING ZONE AIR SAMPLING

Breathing zone air samplers were assigned to identified site personnel. These air samplers provide better estimates of actual intakes due to local generated sources than would general area air sampling. Hence estimates of intakes are best made on the basis of BZA data rather than on the general area air sampling program. Interpretation of BZA results is on the basis of comparing activity deposition on the filter as compared to the intake retention function (IRF) which the BZA represents. Hence, an estimate of the exposure an individual receives based on BZA data can be given as follows:

$$E = I\left(\frac{2000MPC\text{-}h}{AIL}\right)$$

Where: E is the exposure (MPC-h),
I is the intake corresponding to the exposure, E,
AIL is the annual intake limit based on a continuous exposure to 2000 MPC-h in any year of practice, and
MPC is the maximum permissible concentration as defined under 10CFR20.

The intake can be represented by the ratio of the activity deposition and the intake retention function as follows:

$$I = \frac{A}{IRF}$$

Where: A is the activity deposited on the filter and all other variables are as previously defined.

The intake retention function defined here for a BZA is simply the Flow rate of the BZA (F_{BZA}) as compared to the breathing rate of reference man (F_{RM}). In the case depicted here the IRF can be written as follows:

$$IRF = \frac{F_{BZA}}{F_{RM}}$$

Substituting the various equations yields the following relationship for exposure:

$$E = \left(\frac{A}{AIL}\right)\left(\frac{F_{RM}}{F_{BZA}}\right)(2000MPC\text{-}h)$$

The reference man breathing rate is 20 lpm; the breathing zone air samplers were calibrated to 2 lpm; the activity is the activity on the filter; and the annual intake limit is based on reference man inhaled volume (2.5E9 ml) in a occupational year and the MPC (the value of MPC is for the insoluble case) as follows:

Nuclide	AIL (μCi)
^{235}U	0.25
^{238}U	0.25

Substituting all appropriate values the preceding equation becomes:

$$E(MPC\text{-}h) = 8E4 * A$$

Each BZA was calibrated prior to issuance and allowed to run during the entire work evolution. Each filter (absolute) was analyzed on a gas flow proportional counter for total alpha and beta activity. In 4 of 5 cases the alpha and beta a ctivity was reported at the Minimum Detectable Activity as 3.5 E-7 μCi. This corresponds to intakes at < 2.8E-2 MPC-hr. The fifth sample indicated alpha activity of 5.14E-7 with a corresponding exposure of 4.1E-2 MPC-h. It should be noted that the any MPC-h value less than 2 MPC-h is not recordable. (Code of Federal Regulations Chapter 10 Part 20)

BZA Calibration Data

BZA Sampling Pump: Gillian High Flow Sampler Model # HFS113A, P/N D80070
Calibrator: Buck Calibrator (20cc/m - 6 lpm) Gilian Instrument Corp., P/N D800286
Calibration Date: June 6, 1992

S/N:	9360	9366	9365	9359	9364
ID	H-2	N/A	H-7	H-1	H-6
Trial #					
1	2.014	2.013	2.001	2.013	2.070
2	2.014	2.052	2.005	1.999	2.069
3	2.027	2.040	2.000	2.000	2.068
4	2.013	2.040	2.010	1.997	2.070
5	2.018	2.043	1.999	2.001	2.079
6	2.021	2.041	2.001	2.009	2.073
mean	2.018	2.038	2.003	2.003	2.072
S.D.	0.005	0.013	0.004	0.006	0.004

Note: All Flow rates are expressed in lpm.

BZA Issuance Information

Name	Company	BZA ID
Brown, Al	Texas Instruments	H-2
Bianco, Lou	Franklin Environmental	9366
Mulligan, Lee	Franklin Environmental	H-7
Austin, Marcia	CPS, Inc.	H-6
England, Mike	Franklin Environmental	H-1

BZA Counting Data

Counting System: NMC PC-5 for alpha counting, NMC DS-3 for Beta counting
Count Date: 6/9/92
Backgroung Count Time: 5 min.
Sample Count Time: 5 min
Alpha Efficiency: 0.35 c/d
Beta Efficiency: 0.28 c/d
Background Counts, Beta: 168 cts
Background Counts, Alpha: 0

BZA #	9366	H-1	H-2	H-6	H-7
Sample Counts, Alpha:	0	0	0	0	2
Net Counts, Alpha:	0	0	0	0	2
Net Counting Rate, Alpha:	0	0	0	0	0.4
Activity, Alpha (μCi):	<MDA	<MDA	<MDA	<MDA	5.14E-7
Sample Counts, Beta:	175	176	158	169	173
Net Sample Counts, Beta:	35	10	0	1	5
Net Counting Rate, Beta:	1.4	2	0	0.2	1
Activity, Beta (μCi):	<MDA	<MDA	<MDA	<MDA	<MDA
Exposure (MPC-h):	< 2.5 E-2	< 2.5E-2	<2.5 E-2	<2.5E-2	4.1E-2

APPENDIX B-1

DIRECT RADIATION READINGS OF TRENCH AND TEST PITS AT VARIOUS ELEVATIONS

TRENCH SURVEY RESULTS

(All survey readings performed with the NaI 1x1 survey meter)
All readings in μR/hr

SAMPLE LOCATION	SURFACE	12"	24"	EXC. DIRT
B-1	13	17	20	14
B-2	13	13.5	13.5	12
B-3	12	12.5	14	12
B-4	13	14	14.5	12.5
B-5	13	13	13	12
B-6	12	13	14.5	12
B-7	12	12	15	12
B-8	12	13	14.5	12
C-1	11	13	15	12
C-2	14	16	17	12
C-3	17	20	25	15
C-4	15	19	20	16
C-5	15	15	20	15
C-6	13	13	16	14
C-7	17	17	18	13
C-8	13	15	17	12
C-9	13	15	16	13

SAMPLE LOCATION	SURFACE	12"	24"	EXC. DIRT
TP-4	20	25	25	30
TP-5	12	13	14	11
TP-6	12	12	13	12
TP-7	11	13	10	12
D-1	11	13	14	
D-2	12	14	16	
D-3	* 10.5	12	13	
D-4	11	12	12	
D-5	14	14	14	
D-6	20	25	25	*D-Special Sample
D-7	12	12	12	
D-8	12	12	13	

APPENDIX B-2

LOCKHEED ANALYTICAL LABORATORY RESULTS

Sample Preparation and Screening.

The samples consisted of wet soil and gravel. The samples were dried at 103°C overnight, sieved through a 4 mm sieve to remove gravel and other large particles. Composite numbers 1-3 showed little or no activity on the material on the top of the 4 mm screen. The material which was sieved through the 4 mm sieve was used for analysis. Composite Number 4 was sieved in the same manner. Metal turnings and shavings were evident in the material on the top of the 4 mm sieve. The metal shavings exhibited a significant portion of the activity of the sample. The metal shavings were added back to the sieved sample in the same ratio as they were taken out. As composite number 4 was obviously not homogeneous, duplicate aliquots of this sample were prepared for dissolution with the sample size doubled to help achieve a representative sub-sample for analysis. An aliquot of the dissolved material was taken for analysis. All results are reported on a dry weight basis.

Total Uranium Analysis.

There were no problems with the total uranium analysis. All QC met criteria.

Thorium isotopic Analysis.

Two different aliquot sizes were taken for Thorium analysis on the composite four sample. The larger sample size resulted in an unacceptable sample to spike ratio and the data is unacceptable. The data reported is on the smaller sample portion as the spike to sample was in the acceptable range. The blank showed a small amount of natural thorium contamination, which is not significant for the thorium levels determined in the samples. The Laboratory Control Sample and the Duplicate samples were within acceptance criteria.

Uranium Isotopic Analysis.

The Uranium analysis were repeated. The yeilds on the repeat samples were in the acceptable range except for the Composite four sample. The composite four sample was analyzed in du[illegible]e. The duplicate results for the composite four sample ar[illegible] [illegible]chin the acceptance limits. The blank showed a trace of nat[illegible]ral uranium contamination, which is usual for smaples which require dissolution with mineral acids. The amount of background uranium present is not significant in comparison to the amount of uranium determined in the samples. The LCS is within QC limits.

Job Report for: TEX-INST-....06102

Client Sample ID: COMPOSITE #1
Date Collected: 07-JUN-92
Matrix: SOIL

LAL Sample ID: A25476
Date Received: 10-JUN-92
Job Name: TEX-INST-....06102

Constituent	Batch	Activity	Estimated Uncertainty	MDA	Data Qual	Units
Gamma Spec. Analysi	R0064_8	0.0	0.0	0.0		pCi/g
U-234	R0108_2	11	0.15	0.014		pCi/g
U-235	R0108_2	0.91	0.042	0.005		pCi/L
U-238	R0108_2	4.3	0.090	0.018		pCi/g
Th-228	R0108_2	1.3	0.050	0.030		pCi/g
Th-230	R0108_2	1.6	0.050	0.005		pCi/g
Th-232	R0108_2	1.1	0.040	0.010		pCi/g
Uranium	R0168_10	9.1	0.31	0.097		ug/g

Comments on Data Qualifiers:

Client Sample ID: COMPOSITE #2
Date Collected: 07-JUN-92
Matrix: SOIL

LAL Sample ID: A25477
Date Received: 10-JUN-92
Job Name: TEX-INST-....06102

Constituent	Batch	Activity	Estimated Uncertainty	MDA	Data Qual	Units
Gamma Spec. Analysi	R0064_8	0.0	0.0	0.0		pCi/g
U-234	R0108_2	20	0.23	0.019		pCi/g
U-235	R0108_2	1.6	0.064	0.019		pCi/g
U-238	R0108_2	7.0	0.13	0.007		pCi/g
Th-228	R0108_2	0.90	0.043	0.033		pCi/L
Th-230	R0108_2	1.2	0.050	0.020		pCi/g
Th-232	R0108_2	0.69	0.040	0.010		pCi/L
Uranium	R0168_10	14	0.47	0.099		ug/g

Comments on Data Qualifiers:

Client Sample ID:	COMPOSITE #3	LAL Sample ID:	A25478
Date Collected:	07-JUN-92	Date Received:	10-JUN-92
Matrix:	SOIL	Job Name:	TEX-INST-....06102

Constituent	Batch	Activity	Estimated Uncertainty	MDA	Data Qual	Units
Gamma Spec. Analysi	R0064_8	0.0	0.0	0.0		pCi/g
U-234	R0108_2	16	0.32	0.017		pCi/g
U-235	R0108_2	1.8	0.11	0.046		pCi/g
U-238	R0108_2	32	0.45	0.017		pCi/g
Th-228	R0108_2	1.5	0.070	0.030		pCi/g
Th-230	R0108_2	1.7	0.070	0.020		pCi/g
Th-232	R0108_2	1.8	0.070	0.030		pCi/g
Uranium	R0168_10	55	1.9	0.099		ug/g

Comments on Data Qualifiers:

lient Sample ID: COMPOSITE #4 LAL Sample ID: A25479
ate Collected: 07-JUN-92 Date Received: 10-JUN-92
atrix: SOIL Job Name: TEX-INST-....06102

Constituent	Batch	Activity	Estimated Uncertainty	MDA	Data Qual	Units
amma Spec. Analysi	R0064_8	0.0	0.0	0.0		pCi/g
-234	R0108_2	1100	26.	1.7		pCi/g
-235	R0108_2	79	7.0	1.7		pCi/g
-238	R0108_2	3200	45.	1.7		pCi/g
h-228	R0108_2	110	2.6	0.70		pCi/g
h-230	R0108_2	4.8	0.55	0.45		pCi/g
h-232	R0108_2	110	2.6	0.20		pCi/g
ranium	R0168_10	800	27.	0.36		ug/g

omments on Data Qualifiers:

RADIOCHEMICAL QC DATA SUMMARY

TEX-INST-....06102

Reagent Blank Analysis

Analyte	Batch ID	Minimum Detectable Activity pCi/g	Acceptance Limit pCi/g	Date Analyzed	Reagent Blank Result pCi/g
Radium-226					
U-234	R0108_2	.012	0.6	6-18-92	0.4
U-238	R0108_2	0.005	0.6	6-18-91	0.08
Th 232	R0108_2	0.004	0.1	6-18-92	0.000
U-Total µg/g	R0168_10	0.1	0.1	6-13-92	0.009

Duplicate Sample Analysis

Analyte	Batch ID	Client Sample ID	LAL Sample ID	Date Analyzed	QC Sample Analyses			
					Sample Result pCi/L	Duplicate Result pCi/L	Relative Percent Difference (%)	Data Qualifier
Ra-226								
U-234	R0108_2	Comp 4	A25479	6-18-92	1120	967	14	
U-238	R0108_2	Comp 4	A25479	6-18-92	3210	2780	13	
Th-232	R0108_2	Comp 4	A25479	6-18-92	112	108	4	
U-Total µg/g	R0168_10	Comp 4	A25479	6-18-92	802	740	8	

Laboratory Control Sample

Analyte	Batch	Date Analyzed	QC Sample Analyses			
			Laboratory Control Sample Result pCi/L	Laboratory Control Sample Value pCi/L	(%) Recovery	Data Qualifier
Ra-226						
U-234	R0108_2	6-18-92	5.65	5.4	103	
U-235	R0108_2	6-18-92	5.50	5.40	102	
Th-232	R0108_2	6-18-92	5.31	5.45	97	
U-total µg/g	R0168_10	6-13-92	34	36.6	93	

APPENDIX B-3

GROSS ALPHA SCREENING PROCEDURES AND RESULTS

APPENDIX B-3

GROSS ALPHA COUNTING PROCEDURES AND RESULTS

FIELD METHOD

The gross alpha counting technique will be used to limit volumes of soil excavated for disposition. As excavation is performed, in defined areas, soil samples will be collected and analyzed in a field laboratory. The purpose of this screening is to ensure that each area is below the 30 pCi/g level.

In addition, this technique can be used for the post excavation survey. The same counting technique will apply. The samples, in this case, will be vertical composites taken at all grid locations and at the center of each grid. Confirmatory uranium isotopic analysis will be performed on 5% of the total samples.

This gross alpha counting technique was used during the pilot study at Texas Instruments Incorporated and the results correlated very well with the isotopic uranium analysis performed by Lockheed.

INSTRUMENTATION

The technique employed was a gross alpha counting of a soil sample in intimate contact with a ZnS(Ag) detector. Using this method the ZnS(Ag) disc is disposable.

Assuming a detector response due to a thick source in contact with ZnS(Ag) is described by:

$$y(\text{cpm}) = C(\text{Alpha/min/mg})\ A\ (\text{cm}^2)\ R_s\ (\text{mg/cm}^2)\ /4.$$

(Skrable, K.W., Phoenix, K.A. , "Theoretical Response of a ZnS(Ag) Scintillation Detector to α-emitting sources and Suggested Applications", Health Physics, Vol. 60, No. 1991)

SAMPLE COUNTING

The analytical procedure is as follows:

1) The sample is prepared in a sample planchet under original field condition.

2) The range of the alphas in source material, R_s, was calculated using Zeigler's theoretical elemental ranges. The elemental ranges were weighted by the elemental mass fractions as determined for a standard soil by atomic absorption analysis.

3) Since the relative alpha energies were varied, we assumed an average energy of 5.5 MeV. The average energy of all alphas emitted by the U-238 chain is about 5.4 MeV, the average alpha energy for the Th-232 chain is about 5.8 MeV.

4) The water content was estimated by drying an aliquot of representative samples 1-2 days at 50-75° C. Due to past experience, dry soil was assumed to still have 10% water content. Both this 10% and the fraction lost during drying were included in the mass fractions for hydrogen and oxygen used in (2) above.

5) Uncertainties tabulated with the results are due solely to propagated counting error. Due to the assumptions made, especially in (3) above, an additional uncertainty could be assumed as a conservative measure.

Texas Instruments Incorporated, Attleboro, MA
Gross Alpha Screening Results

Sample Count Time (min): 45 — Area (cm2): 20.3
Background Rate (cpm): 0.02688 — Bkg Time (min): 930

Sample ID	Wet Sample Mass (gm)	Dry Sample Mass (gm)	Frac. H2O Content	Theor. Range (mg/cm2)	Gross Alpha Counts	+/-	1 Sigma	Total Spec. Alpha Act. (pCi/gm) Activity	+/-	1 Sigma	MDA (pCi/gm)
TP-1	12.274	10.871	0.114	5.401	32	+/-	5.66	11.24	+/-	2.07	0.0015
TP-2	10.018	8.513	0.150	5.342	45	+/-	6.71	16.17	+/-	2.48	0.0015
TP-3	14.33	12.224	0.147	5.347	48	+/-	6.93	17.26	+/-	2.56	0.0015
A-1	12.754	11.256	0.117	5.396	26	+/-	5.10	9.06	+/-	1.87	0.0015
A-2	12.54	10.845	0.135	5.366	29	+/-	5.39	10.21	+/-	1.98	0.0015
A-3	14.222	12.775	0.102	5.422	57	+/-	7.55	20.30	+/-	2.75	0.0015
A-4	15.96	14.693	0.079	5.459	76	+/-	8.72	27.02	+/-	3.15	0.0015
A-5	15.78	14.283	0.095	5.433	46	+/-	6.78	16.26	+/-	2.46	0.0015
A-6	13.806	11.776	0.147	5.347	40	+/-	6.32	14.31	+/-	2.33	0.0015
A-7	13.427	11.857	0.117	5.396	124	+/-	11.14	44.88	+/-	4.07	0.0015
Special-2	15.301	13.262	0.133	5.370	9120	+/-	95.50	3349.61	+/-	35.08	0.0015
EXP-B	14.726	12.912	0.123	5.386	46	+/-	6.78	16.40	+/-	2.49	0.0015
EXP-C	17.321	15.584	0.100	5.424	142	+/-	11.92	51.20	+/-	4.33	0.0015
C-1	15.266	13.941	0.087	5.447	235	+/-	15.33	84.66	+/-	5.55	0.0015
C-2	16.51	14.725	0.108	5.411	57	+/-	7.55	20.34	+/-	2.75	0.0015
C-3	13.986	12.255	0.124	5.385	215	+/-	14.66	78.30	+/-	5.37	0.0015
C-4	13.064	10.947	0.162	5.323	211	+/-	14.53	77.74	+/-	5.38	0.0015
C-5	15.665	14.655	0.064	5.485	80	+/-	8.94	28.34	+/-	3.22	0.0015
C-6	16.79	15.609	0.070	5.475	117	+/-	10.82	41.72	+/-	3.90	0.0015
C-7	16.798	15.287	0.090	5.441	181	+/-	13.45	65.17	+/-	4.88	0.0015
C-8	13.665	11.97	0.124	5.385	73	+/-	8.54	26.30	+/-	3.13	0.0015
C-9	16.438	14.643	0.109	5.409	223	+/-	14.93	80.87	+/-	5.45	0.0015

Texas Instruments Incorporated, Attleboro, MA
Gross Alpha Screening Results

Sample Count Time (min): 90
Background Rate (cpm): 0.02688

Area (cm2): 20.3
Bkg Time (min): 930

Sample ID	Wet Sample Mass (gm)	Dry Sample Mass (gm)	Frac. H2O Content	Theor. Range (mg/cm2)	Gross Alpha Counts	+/-	1 Sigma	Total Spec. Alpha Act. (pCi/gm) Activity	+/-	1 Sigma	MDA (pCi/gm)
B-1	13.297	12.308	0.074	5.468	48	+/-	6.93	8.22	+/-	1.25	0.0015
B-2	14.692	13.553	0.078	5.462	62	+/-	7.87	10.76	+/-	1.42	0.0015
B-3	14.355	12.484	0.130	5.374	94	+/-	9.70	16.81	+/-	1.78	0.0015
B-4	14.619	13.344	0.087	5.446	157	+/-	12.53	27.99	+/-	2.27	0.0015
B-5	13.987	11.468	0.180	5.294	49	+/-	7.00	8.68	+/-	1.31	0.0015
B-6	14.925	13.234	0.113	5.402	88	+/-	9.38	15.62	+/-	1.71	0.0015
B-7	13.288	11.744	0.116	5.398	84	+/-	9.17	14.91	+/-	1.68	0.0015
B-8	12.933	10.885	0.158	5.329	78	+/-	8.83	13.99	+/-	1.64	0.0015
TP-4	16.668	15.048	0.097	5.429	650	+/-	25.50	117.63	+/-	4.63	0.0015
TP-5	14.356	12.839	0.106	5.415	87	+/-	9.33	15.40	+/-	1.70	0.0015
TP-6	12.981	11.629	0.104	5.418	177	+/-	13.30	31.78	+/-	2.42	0.0015
TP-7	12.277	10.738	0.125	5.383	131	+/-	11.45	23.56	+/-	2.10	0.0015
D-1	16.525	15.258	0.077	5.464	81	+/-	9.00	14.18	+/-	1.63	0.0015
D-2	16.017	14.197	0.114	5.402	96	+/-	9.80	17.08	+/-	1.79	0.0015
D-3	14.474	12.86	0.112	5.405	130	+/-	11.40	23.28	+/-	2.08	0.0015
D-4	15.067	13.515	0.103	5.420	136	+/-	11.66	24.31	+/-	2.12	0.0015
D-5	15.375	14.011	0.089	5.444	69	+/-	8.31	12.06	+/-	1.51	0.0015
D-6	14.65	13.12	0.104	5.417	533	+/-	23.09	96.59	+/-	4.20	0.0015
D-7	15.888	14.048	0.116	5.398	153	+/-	12.37	27.51	+/-	2.26	0.0015
Special	17.34	15.361	0.114	5.401	17877	+/-	133.70	3263.79	+/-	24.41	0.0015

APPENDIX B-4

GROSS ALPHA SCREENING PROCEDURES AND RESULTS

APPENDIX B-4

COMPARATIVE ANALYSIS OF ALPHA SCREENING TECHNIQUE TO LOCKHEED ANALYTICAL LABORATORIES DATA

SAMPLE	GROSS ALPHA AVERAGES (pCi/g)	LAL TOTAL U ISOTOPES[a] (pCi/g)
Comp. 1	18.67+/- 10.6[b]	16.2
Comp. 2	33.8+/-24.6[c]	28.6
Comp. 3	36.67+/-35.64[d]	49.8
Comp. 4	3306+/-60[e]	4379
Exp. B	16.4[f]	
Exp. C	51.2[g]	
Avg. C	55.94+/- 26.5[h]	
Avg. B	14.62+/-6.28[i]	

a. The total pCi/g was obtained by summing the pCi/g for the U-234, U-235 and U-238.
b. Gross alpha number obtained by averaging TP-1, 2, 3 and trench A data. Error is in averaging only.
c. Gross alpha number obtained by averaging composite of trench B and composite of trench C refered to as EXP-B and EXP-C. Note a similar number is obtained by averaging all of the trench C and trench B data.
d. Gross alpha number obtained by averaging TP-4,5,6,7 and trench D data.
e. Gross alpha number obtained by averaging Special and Special 2.
f. Gross alpha obtained from a composite of the B trench.
g. Gross alpha obtained from a composite of the C trench.
h. Average of all the trench C data.
i. Average of all the trench B data.

Texas Instruments Incorporated

Remediation Plan

Prepared by Creative Pollution Solutions, Inc.

REMEDIATION PLAN FOR THE IDENTIFIED BUILDING 12 BURIAL AREA

Executive Summary

This remediation plan was designed to meet the criteria established by the U. S. Nuclear Regulatory Commission (NRC) as promulgated in their branch technical position. The plan is intended to affect the area identified as the building 12 burial site. The basis of this plan was established on two studies of the site. The first study was performed by Oak Ridge Associated Universities (ORAU) as commissioned by the NRC in 1984. The second study was conducted by Creative Pollution Solutions, Inc. (CPS) for Texas Instruments Incorporated (performed in June/July 1992) in part to assess the feasibility of remediation. Two reports were generated following this study: a report on costs of remediation options and a report on the radiological characterization of the aforementioned site.

This remediation plan includes: a) pre-excavation survey to ensure all affected areas are better defined in terms of subsurface contamination, b) physical site layout, c) physical excavation, d) In- situ radiological screening, and e) post remediation surveys.

I. INTRODUCTION

GENERAL

The area which was identified as the former burial area which is located between Buildings 11 and 12 was the focus of this radiological characterization. This area is presently used for several purposes. The area is primarily a well landscaped level parcel with large rock formations and flower beds. The area includes several paved parking lots to the north and south west and side walks inter dispersed. The site is bordered in the northwesterly direction by shrubs, and a wooded low lying wetland.

The technical data used for this radiological characterization is derived from two major sources, the first is the 1984 Oak Ridge Associated Universities (ORAU) study and the second is the limited trench sampling conducted by Creative Pollution Solutions, Inc. (CPS) in June 1992. The isotopic analyses of the CPS trench sample composites were performed by Lockheed Analytical Inc.. Gross alpha counting was performed on all trench grab samples for the purpose of confirmation and correlation with isotopic data for future use as a field screening technique during the remediation process.

OAK RIDGE ASSOCIATED UNIVERSITIES (ORAU)

The ORAU study employed a grid sampling technique which established reference coordinates within the study area. The grid network established 480 sample grids. A walkover surface scan using portable NaI(Tl) gamma scintillation detectors was conducted at 1-2 meters over the entire gridded area. Exposure rates were taken at both contact and at 1 meter elevations on each grid coordinate as well as areas identified during the surface walkover scan. Surface soil samples were taken at grid coordinates and assayed for Uranium 238 and 235 as well as Thorium 232 and Radium 226. The surface exposure rate survey identified 21 isolated locations at which elevated (greater than background) exposure rates were identified. These 21 locations were further characterized by soil samples ranging in depth from 2 to 40 cm. In addition, 25 boreholes were used to further characterize areas which exhibited elevated surface exposure rates and/or were questionable areas found by ground penetrating radar. The boreholes ranged in depth from 1.0 meters to an average of 3.5 meters and a maximum on one borehole of 5.0 meters.

CREATIVE POLLUTION SOLUTIONS, INC. (CPS)

The CPS exercise employed a trenching technique and subsequent sample composited from extracted materials. The trenches, a total of four, were excavated with a conventional backhoe to a depth of 2 feet. They ran in parallel within the study area and in a southwest to northeasterly direction. The trenches were approximately 100 feet long and were segmented in areas which encroached on utilities. In addition to the trenches, 7 test pits were excavated in areas to the northeast and southwest of the trenches. (CPS 92)

The CPS study was intended to provide the following information:

- Confirmation of the data in the Oak Ridge Associated Universities (ORAU) study (RSAP/SMBP-8, 1985);

- Comparison of composite sample data between ORAU and Lockheed Analytical Laboratories, Inc. (LAL) data;

- Determination of acceptability for disposal of the contaminated soil and debris;

- Identification of remediation options and the estimated costs for each option,

- Correlation of gross alpha screening data with ORAU and LAL data and as a demonstration of a rapid field screening technique to be employed during remediation; and

- Demonstration of the feasibility of remediation.

II. CRITERIA

The remediation plan is based on option 1 of the "Branch Technical Position" as published in the Federal Register 10/23/81. Based upon site characterization, the concentration should not exceed 30 pCi/g.

III. PRE-EXCAVATION SURVEY

A pre-excavation Survey will be performed in order to complement the ORAU report. The focus of the pre-excavation survey will be subsurface sampling. The sampling will be performed over the area defined in the ORAU report (see diagram 1). This area is approximately 7500 m^2. Approximately fifty randomly selected soil samples will be taken in the 7500 m^2 area. These samples will be vertical composites to a depth of 1 meter. Gross alpha screening (see Appendix B) will be performed on all samples. Ten percent of the samples will be analyzed for isotopic uranium distribution by a certified laboratory.

IV. EXCAVATION

General

The planned excavation of the Former Burial Area (FBA) was designed based primarily on the Oak Ridge Associated Universities report along with the study performed by Creative Pollution Solutions, Inc.

The excavation will be performed in a two phase approach. This two phase approach will involve the removal of approximately 6000 ft^3 of soil. In most cases the contamination is within the top twc feet of soil. Phase I will be the excavation and removal for disposition those areas identified within diagram 2. During the excavation the soil will be mechanically screened (3/4" mesh) to remove aggregate. Conventional radiological monitoring will be performed on all collected aggregate. A field radiological screening technique (described in the next section) will also be established to determine the extent of excavation required. This radiological screening involves monitoring and sampling within the excavated areas.

Phase II will be performed in the areas defined in diagram 3. This phase is designed to remove potentially contaminated debris identified by the ORAU site study. As defined in phase I mechanical screening will be employed to remove potentially contaminated debris. Conventional radiological monitoring will be performed on all collected debris to determine disposition. In addition, if contaminated soils are identified during the phase II work they will be processed for disposal.

Field Screening

As the excavation proceeds, radiological field screening will be performed to ensure that the excavation of each area is complete. The field screening will be a two phase approach: (1) Field survey of the excavated area with a GM pancake probe survey meter for preliminary screening to determine if further excavation is immediately required and then followed by (2) a field gross alpha screening using a ZnS soil counting method to determine the lower bounds of excavation.

<u>Field GM screening</u>

The screening method using a pancake G-M survey meter has been demonstrated to detect levels on the order of 100 pCi/g for this site (Appendix A). This method provides for quick and reliable, in-situ measurements to better define extent of phase I excavation.

<u>Gross Alpha Counting Technique</u>

If the field GM survey shows no apparent contamination, samples will be drawn from each side and at the bottom of each excavated area and will be analyzed in the field using a gross alpha counting technique (Appendix B). This technique has been demonstrated to detect levels at or near natural background. This technique was tested in the pilot study at Texas Instruments Incorporated and the results of

the gross alpha counting correlated very well with the isotopic Uranium analysis performed by Lockheed. (See table 1 in Appendix B) This technique will aid in decision making regarding excavation since it will detect levels at or below the established level of 30 pCi/g total uranium.

Site Restoration

After all identified areas are mitigated, as discussed above, affected areas will be backfilled. Soil from the phase II portion may be used to backfill excavated areas. In addition, clean soil will be used to supplement the remaining areas.

Health and Safety

Breathing zone air samples analyzed after the pilot study showed that the highest exposure during the pilot study was 4.1E-2 MPC-h. It should be noted that any MPC-h value less than 2 MPC-h is not recordable. Since airborne concentrations are very low the excavation work will only require level D protection. As a precaution breathing zone air sampling and area sampling will also be performed. The site specific health and safety plan will be available prior to the excavation.

V. FINAL SURVEY

A post verification survey of the defined area will be performed for the Building 12 Burial Area. This survey will cover an area of approximately 7500 m^2 (Diagram 1). The sampling grid established in the ORAU report will be used to aid in identifying sampling locations. All sampling will be performed on all grid coordinates and at the center of each grid (see diagram 4). The sampling will include: (1) external exposure rate measures taken at the surface and at 1 meter elevations performed in accordance with the procedure established in the ORAU study and (2) soil sample composites to a depth of 1 meter or refusal.

The analysis of the soil sample composites shall be performed using the gross alpha screening technique described in this document. In addition, 5% of the samples, randomly selected, will be sent to a certified laboratory for isotopic analysis. In addition, any samples exceeding 30 pCi/g total uranium on the gross alpha screening shall be sent off site for full analysis by a properly certified outside laboratory.

For each 10 m^2 area an average concentration (pCi/g) will be determined by averaging all samples taken in that 10 m^2 area. This average shall be less than 30 pCi/g total uranium.

VI. REFERENCES

The following documents were used in the preparation of this plan:

NUREG/CR-2082 "Monitoring For Compliance With Decommissioning Termination Survey Criteria";

Branch Technical Position entitled "Disposal of Onsite Storage of Thorium or Uranium Wastes From Past Operations", published in the Federal Register 10/23/81.

Radiological Survey of the Texas Instruments Site Attleboro, Massachusetts prepared by Radiological Site Assessment Program Oak Ridge Associated Universities, Jan. 1985. RSAP/SMPB-8.

Radiological Characterization of Texas Instruments, Incorporated prepared by Creative Pollution Solutions, Inc., July 1992.

Preliminary Cost Estimates of Various Remediation Options for Texas Instruments Incorporated prepared by Creative Pollution Solutions, Inc.

Skrable, K.W., Phoenix, K.A. , "Theoretical Response of a ZnS(Ag) Scintillation Detector to α-emitting sources and Suggested Applications", Health Physics, Vol. 60, No. 1991

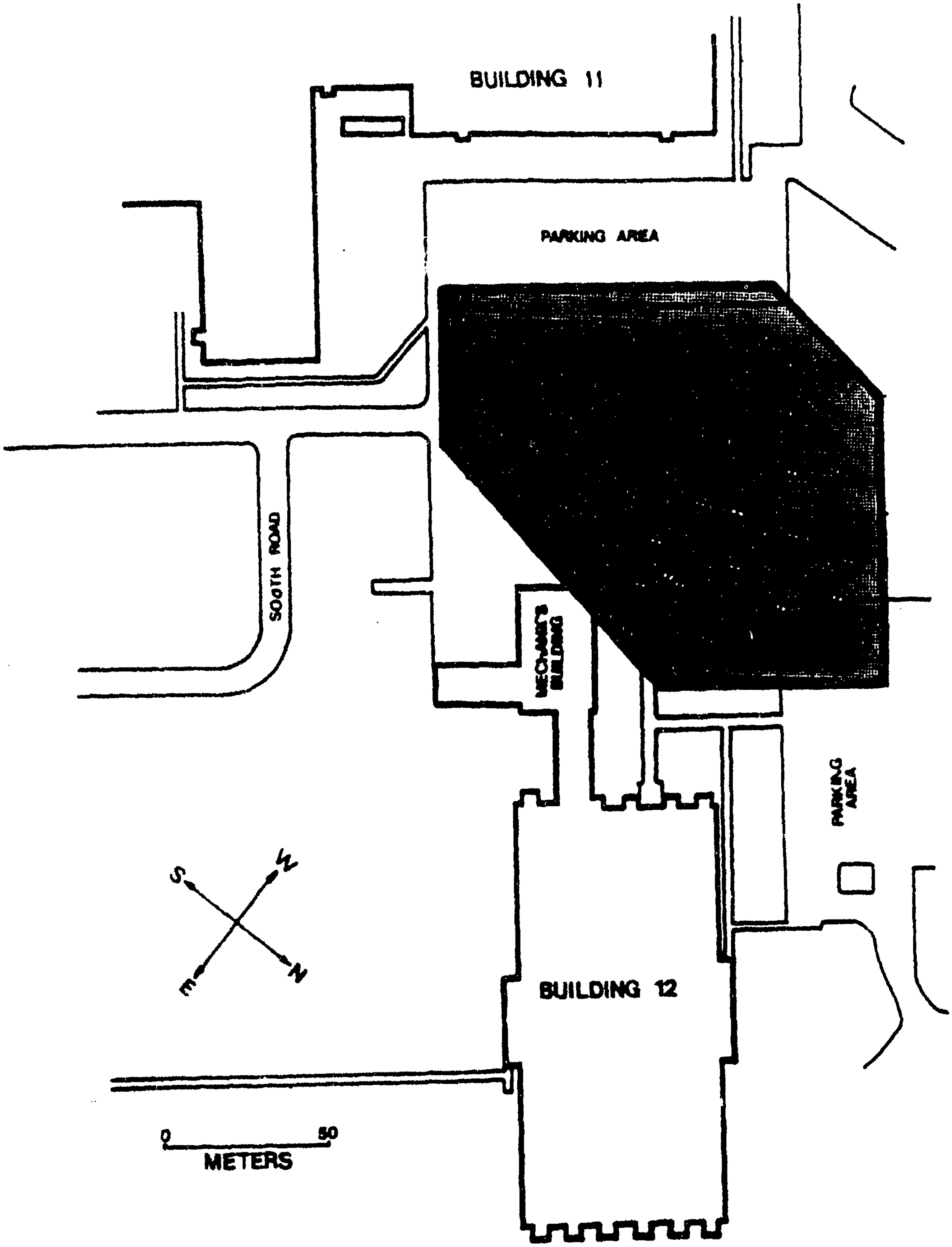
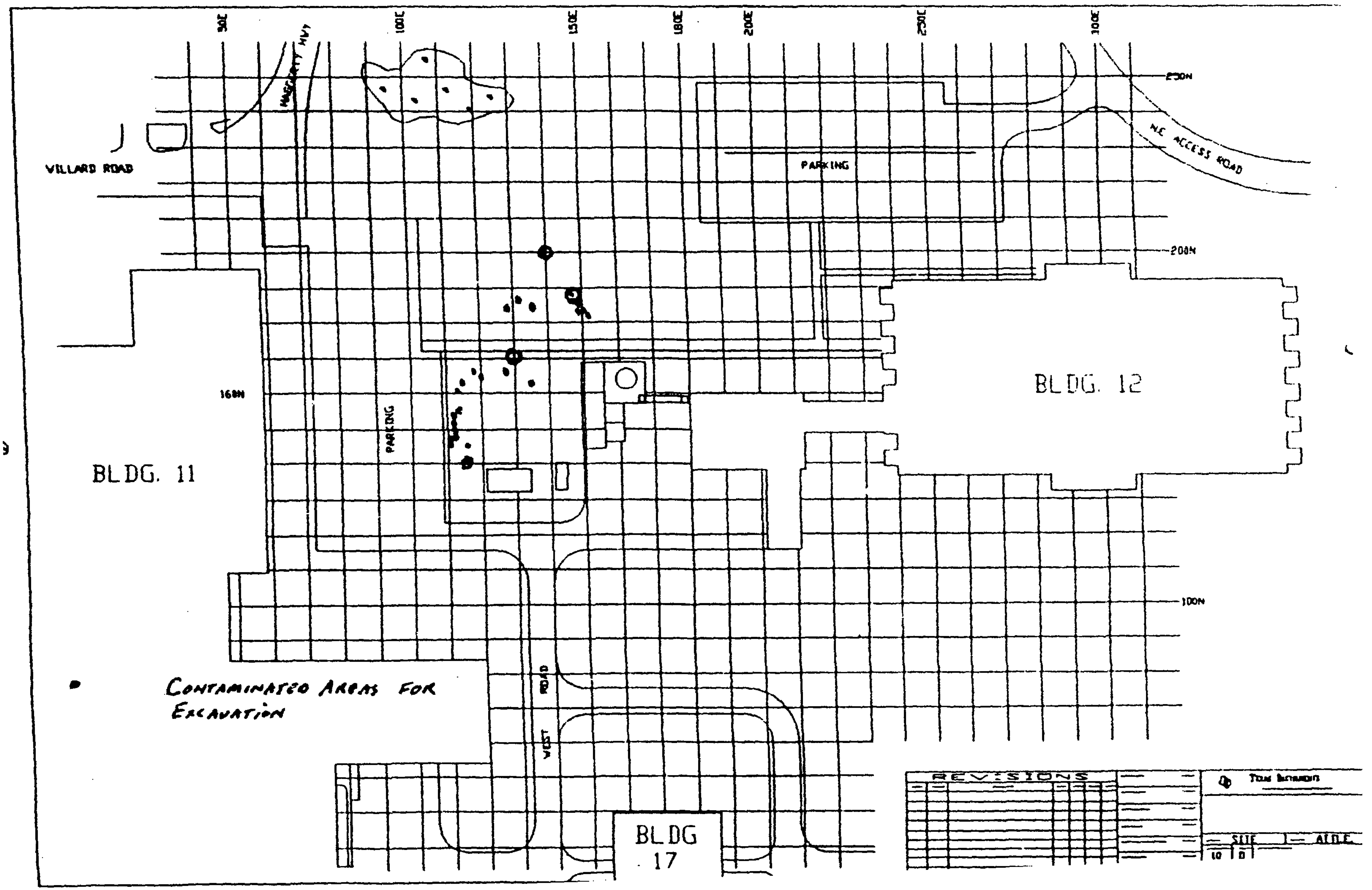
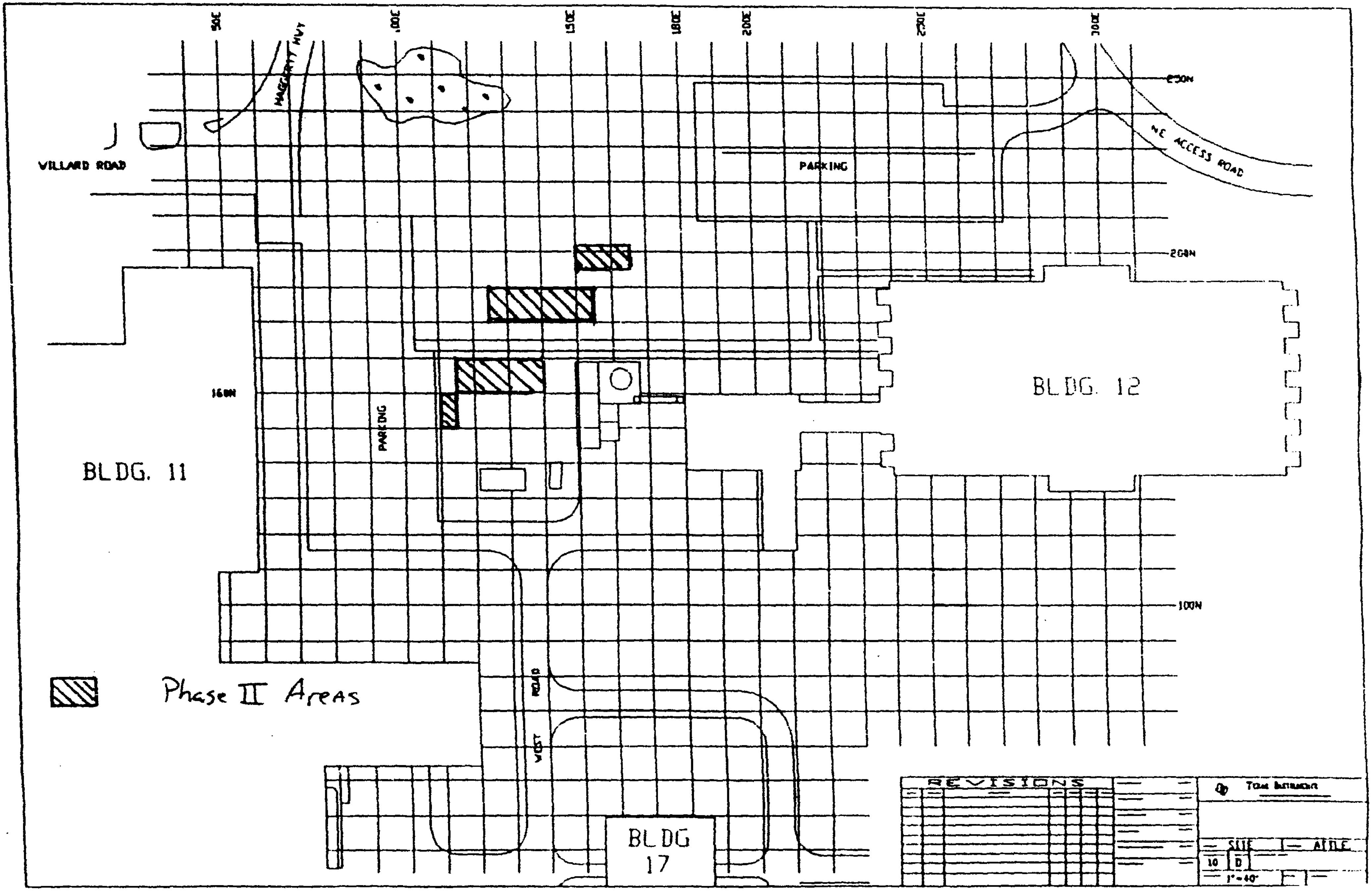

BUILDING 11
PARKING AREA
SOUTH ROAD
MECHANIC'S BUILDING
PARKING AREA
BUILDING 12
S
W
E
N
0
50
METERS

Diagram 1.



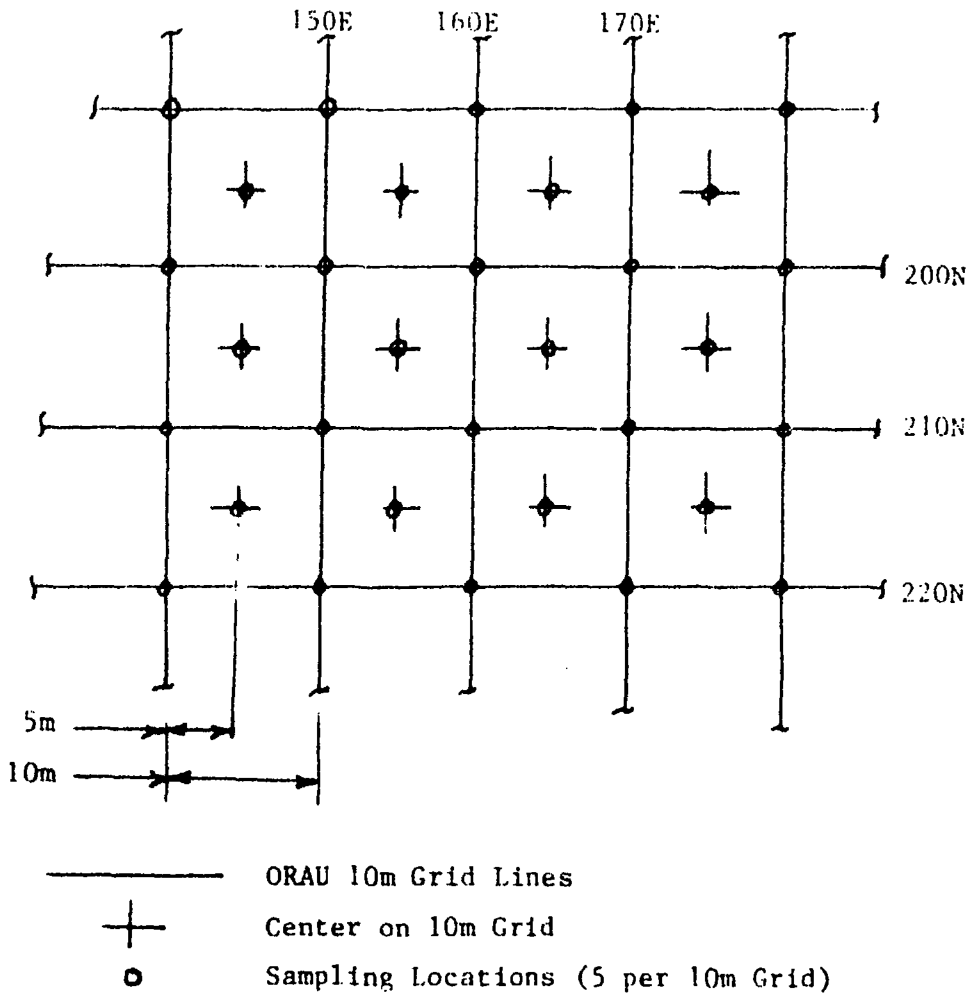
50E
100E
150E
180E
200E
250E
300E
250N
200N
160N
100N
VILLARD ROAD
PARKING
N.E. ACCESS ROAD
BLDG. 11
BLDG. 12
BLDG 17
WEST ROAD
CONTAMINATED AREAS FOR EXCAVATION
REVISIONS



50E
100E
150E
180E
200E
250E
300E
250N
200N
160N
100N
VILLARD ROAD
PARKING
NE ACCESS ROAD
PARKING
BLDG. 11
BLDG. 12
BLDG 17
ROAD
WEST
Phase II Areas
REVISIONS
SITE
TITLE
1"=40'

Diagram 4

Example Sampling Scheme for Subsurface Soil using 5 meter on center locations on the ORAU 10 meter grid map



Appendix A

GM FIELD SCREENING

A technique for the use of hand held GM survey meter is desirable for the purpose of quick field determinations of remediation attainment. Due to the emission of alpha and beta/gamma radiations from the uranium and it's progeny the use of GM detectors becomes a desirable option for gross screening of materials to determine the presence of contamination in levels which exceed the natural abundances.

In an effort to better quantify the levels and extent of contamination in the TI soil matrix which can be identified by a conventional hand held GM survey meter a simple response determination was done. One of the composite samples analyzed by LAL was prepared in an infinitely thick geometry for the detection of betas (greater than 0.6 inches).

SARGENT'S RULE
E > 0.8 Mev

$$R = 0.526\ E\ (-0.094)$$

Where R is in grams/cm^2

$$R = 0.526\ (2.3)^{-0.094}$$

$$R = 0.4863\ \text{grams/cm}^2$$

for soil density of 2.0 grams/cm^3

$$R = 0.243\ \text{cm}\ (0.618\ \text{inches})$$

From this sample gross GM detector response was recorded when the detector was placed directly in contact with the soil. A layer of mylar was used to prevent detector contamination. To determine if equilibrium detector response conditions existed the sample volume (thickness) was reduced incrementally while recording the detector response in CPM. The attached graph shows the detector response to a composite field sample of 4700 pCi/gm.

The response uniformity of the GM down to a sample thicknesses of only a few centimeters indicates the ability to achieve equilibrium conditions within a sample volume of 100 cm^3 (50 grams). Based on the detector surface area and the sample volume at which non equilibrium conditions were observed, it was experimentally determined the approximate range or thickness of soil in this sample matrix necessary to achieve equilibrium conditions is less than 1 centimeter which supports the

theoretical calculation shown above. Using the sample activity of 4700 pCi/gram (LAL) and an approximate effective sample volume (based on the detector window area) and the effective range determined experimentally the resulting mass of soil is approximately 20 grams. Using the LAL result of 4700 pCi/gram times the sample mass of 20 grams equals 9.4E4 pCi(2.08E5 DPM)/effective sample. With the detector response of 4500 CPM the effective efficiency of:

4500 cpm/2.08E5 dpm = 2.15E-2
or
Effective efficiency = 2.15%

This exercise demonstrates the sensitivity of the GM to small sample volumes and low concentrations. If a criteria of 2 times background is used as a field screening action point then the following assumption could be made:

Background of GM = 50 CPM
2 x 50 CPM = 100 CPM or 50 CPM net

50 CPM(net) / 0.0215 cpm/dpm = 2.32E3 DPM
or
2.32E3 DPM / 2.22 DPM/pCi = 1.05E3 pCi/sample
With effective sample volume of 20 grams

1.05E3pCi / 20 grams = 52.4 pCi/gram

If the conservative assumption was made that gross GM screening could effectively see contamination in excess of twice background then the assumption of no detectable GM field screening results above twice background could be effectively instituted as a technique for determining when to end remediation in a given location and use more sensitive analytical procedures to determine actual residual contamination conditions as they apply to the release criteria. This screening technique will eliminate excessive soil volumes and delays in determinations of the extent to which each location should be mitigated. The cost savings in laboratory sample analysis alone justifies the use of such a technique not to mention the delays in site excavation work performed by contractors.

Appendix B

GROSS ALPHA COUNTING

FIELD METHOD

The gross alpha counting technique will be used to limit volumes of soil excavated for disposition. As excavation is performed, in defined areas, soil samples will be collected and analyzed in a field laboratory. The purpose of this screening is to ensure that each area is below the 30 pCi/g total uranium level.

In addition, this technique can be used for the post excavation survey. The same counting technique will apply. The samples, in this case, will be vertical composites (to a depth of 1 meter or refusal) taken at all grid intersections and at the center of each grid. Confirmatory uranium isotopic analysis will be performed on 5% of the total samples.

This gross alpha counting technique was used during the pilot study at Texas Instruments Incorporated and the results correlated very well with the isotopic uranium analysis performed by Lockheed.

INSTRUMENTATION

The technique employed was gross alpha counting of a soil sample in intimate contact with a ZnS(Ag) detector. Using this method the ZnS(Ag) disc is disposable.

Assuming a detector response due to a thick source in contact with ZnS(Ag) is described by:

$$y(\text{cpm}) = C(\text{Alpha/min/mg})\ A\ (\text{cm}^2)\ R_s\ (\text{mg/cm}^2)\ /4.$$

(Skrable, K.W., Phoenix, K.A. , "Theoretical Response of a ZnS(Ag) Scintillation Detector to α-emitting sources and Suggested Applications", Health Physics, Vol. 60, No. 1991)

SAMPLE COUNTING

The analytical procedure is as follows:

1) The sample is prepared in a sample planchet under original field condition.

2) The range of the alphas in source material, R_s, was calculated using Zeigler's theoretical elemental ranges. The elemental ranges were weighted by the elemental mass fractions as determined for a standard soil by atomic absorption analysis.

3) Since the relative alpha energies were varied, we assumed an average energy of 5.5 MeV. The average energy of all alphas emitted by the U-238 chain is about 5.4 MeV, the average alpha energy for the Th-232 chain is about 5.8 MeV.

4) The water content was estimated by drying an aliquot of representative samples 1-2 days at 50-75° C. Due to past experience, dry soil was assumed to still have 10% water content. Both this 10% and the fraction lost during drying were included in the mass fractions for hydrogen and oxygen used in (2) above.

5) Uncertainties tabulated with the results are due solely to propagated counting error. Due to the assumptions made, especially in (3) above, an additional uncertainty could be assumed as a conservative measure.

COMPARATIVE ANALYSIS OF ALPHA SCREENING TECHNIQUE TO LOCKHEED ANALYTICAL LABORATORIES DATA

SAMPLE	GROSS ALPHA AVERAGES (pCi/g)	LAL TOTAL U ISOTOPES[a] (pCi/g)
Comp. 1	18.67+/- 10.6[b]	16.2
Comp. 2	33.8+/-24.6[c]	28.6
Comp. 3	36.67+/-35.64[d]	49.8
Comp. 4	3306+/-60[e]	4379
Exp. B	16.4[f]	
Exp. C	51.2[g]	
Avg. C	55.94+/- 26.5[h]	
Avg. B	14.62+/-6.28[i]	

a. The total pCi/g was obtained by summing the pCi/g for the U-234, U-235 and U-238.
b. Gross alpha number obtained by averaging TP-1, 2, 3 and trench A data. Error is in averaging only.
c. Gross alpha number obtained by averaging composite of trench B and composite of trench C referred to as EXP-B and EXP-C. Note a similar number is obtained by averaging all of the trench C and trench B data.
d. Gross alpha number obtained by averaging TP-4,5,6,7 and trench D data.
e. Gross alpha number obtained by averaging Special and Special 2.
f. Gross alpha obtained from a composite of the B trench.
g. Gross alpha obtained from a composite of the C trench.
h. Average of all the trench C data.
i. Average of all the trench B data.

U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 70-33/92-02

Docket No. 70-33

License No. SNM-23 Priority 1 Category UHFF

Licensee: Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02702

Facility Name: HFIR Project

Type of Meeting: Management Meeting

Meeting Date: July 14, 1992

Inspector: J. Roth 7/27/92
J. Roth, Project Engineer Date
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Branch
Division of Radiation Safety and Safeguards

Approved By: W. J. Pasciak 7-30-92
W. J. Pasciak, Chief Date
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Branch
Division of Radiation Safety and Safeguards

Meeting Summary: A management meeting was held at Region I, King of Prussia, Pennsylvania on July 14, 1992 at the licensee's request to discuss the status of the licensee's actions with regard to cleaning up identified areas of contaminated soil at the Attleboro, Massachusetts site.

DETAILS

1.0 Meeting Attendees

1.1 Texas Instruments

M. J. Elliott, Manager of Environmental Engineering
F. J. Veale, Jr., Esq., Environmental Attorney and Manager of Safety, Industrial Hygiene and Environmental Engineering

1.2 Nuclear Regulatory Commission

R. Cooper, Director, Division of Radiation Safety and Safeguards
J. Joyner, Chief Facilities Radiological Safety and Safeguards Branch
J. Kinneman, Chief, SDMP Task Force
M. Miller, Senior Health Physicist
W. Pasciak, Chief, Facilities Radiation Protection Section
J. Roth, Project Engineer
J. Shephard, Project Manager, NMSS

2.0 Summary of Discussion

Mr. Cooper opened the meeting and thanked the licensee's representatives for attending the meeting. The purpose of the meeting was for the licensee to present the status of plans for remediating contaminated areas of the site as provided in the Interim Status Report dated June 30, 1992 (attached). These contaminated areas were previously identified by the NRC as a result of a confirmatory survey conducted during 1984. Messrs. Elliott and Veale provided, (1) results obtained of a pilot characterization study conducted to define the limits of contaminated areas on the site (copy attached); (2) information concerning a remediation plan that has been written (copy attached); (3) current information with regard to the status of a previously requested license modification dated July 25, 1991; and (4) information on the status of the revised financial assurance plan for the facility.

In addition, Mr. Veale provided an update on actions taken by Texas Instruments and others with regard to the Shpack landfill located in Norton, Massachusetts and discussions held with the Department of Energy concerning inclusion of the Attleboro site in the Department's Formerly Utilized Sites Remediation Action Program (FUSRAP).

3.0 Conclusions

Mr. Cooper concluded the meeting by thanking the licensee's represe tives for the information provided. The licensee representatives agreed to:

-- provide the NRC with a copy of a milestone chart for remediation activities.

-- provide the NRC with a copy of the site Health and Safety Program Plan to be used during remediation activities.

The NRC will prepare a license amendment reducing the authorized quantity of uranium-235 based on the original licensee request dated July 25, 1991.

Attachments:
1. June 30, 1992 Letter, M. J. Elliott to J. Roth
2. Radiological Characterization of Texas Instruments, Incorporated Attleboro Industrial Facility
3. Texas Instruments Incorporated Remediation Plan

NOV. 27 1992

Docket No. 70-33

Mr. Frank J. Veale, Jr.
Manager, Environmental Engineering/
Industrial Hygiene
Metals and Controls Group
Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02703

Dear Mr. Veale:

Subject: NRC Inspection No. 70-33/92-03

An announced safety inspection of your site remediation activities was conducted at your facility by Mr. J. Roth on November 3, 1992. The inspection findings were discussed with you, Mr. R. Churchill, and members of your staff on November 3, 1992 during the inspection.

Areas reviewed during the inspection were important to health and safety and are discussed in the enclosed inspection report. These areas included review of remediation activities completed to date, personnel and environmental air sampling results and your plans for future remediation actions.

During the inspection, it was determined that your remediation activities were proceeding on schedule and you expected this phase of activities to be completed by November 16, 1992. In addition, you committed to provide a survey report to the NRC Region I office by December 1, 1992. Within the scope of this inspection, no safety concerns or violations of regulatory requirements were identified.

04-1

No response to this letter is required. Your cooperation with us is appreciated.

Sincerely,

Original Signed By;
James H. Joyner

James H. Joyner, Chief
Facilities Radiological Safety
and Safeguards Branch
Division of Radiation Safety
and Safeguards

Enclosure: NRC Region I Inspection Report No. 70-33/92-03

cc w/encl:
Public Document Room (PDR)
Local Public Document Room (LPDR)
Nuclear Safety Information Center (NSIC)
Commonwealth of Massachusetts (2)

NOV. 27 1992

bcc w/encl:
Region I Docket Room (with concurrences)
J. Roth, DRSS
M. Landis, ORISE
J. Shepard, NMSS
V. McCree, OEDO

RI:DRSS	RI:DRSS	RI:DRSS
Roth/tmh	Pasciak	Joyner
11/23/92	11/ /92	11/27/92

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 70-33/92-03

Docket No. 70-33

License No. SNM-23 Priority 1 Category UHFF

Licensee Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02702

Facility Name: HFIR Project

Inspection At: Attleboro, Massachusetts

Inspection Conducted: November 3, 1992

Inspector: J. Roth 11/23/92
J. Roth, Project Engineer — Date
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Branch
Division of Radiation Safety and Safeguards

Approved by: W. J. Pasciak 11-24-92
W. J. Pasciak, Chief — Date
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Branch
Division of Radiation Safety and Safeguards

Areas Inspected: Special, announced inspection by a region-based inspector to determine the status of remediation activities at the site.

Results: The remediation activities were proceeding on schedule and the licensee expected to have the remediation activities completed by November 16, 1992 and a survey report issued to the NRC by December 1, 1992. Within the scope of the inspection, no safety concerns or violation of regulatory requirements were identified.

Details

1.0 Individuals Contacted

R. L. Churchill, Program Manager
M. J. Elliott, Manager of Environmental Engineering
M. Henault, Remediation Contractor
F. J. Veale, Manager of Safety, Industrial Hygiene and Environmental Engineering

2.0 Site Tour

During this inspection, the inspector observed remediation activities in process. It was noted that the entire area between the Building 11 and Building 12 parking lots was affected by these activities. The affected area covered about 2.5 acres. Of this, about 0.5 acres was excavated to about 10 feet deep as shown in Attachment 1. Piles of overburden soil covered about one acre.

The inspector noted that the licensee had established a contamination control change line; that individuals working in the affected area were wearing breathing zone air samplers; and that at least four environmental air samples had been installed in the area. One environmental air sampler was located in the Northeast corner of the site, another was located on the north edge of the site, and, a third sampler was located on the south edge of the site. The last sampler was relocated, as necessary adjacent to work areas.

3.0 Review of Air Sampling Results

3.1 Breathing Zone Air Samples

The inspector reviewed the licensee's records of breathing zone air sampling results for the time period September 15 to October 31, 1992. The results indicated that the workers were not exposed to any significant airborne radioactivity. The maximum exposure was about 2 maximum permissible concentration - hours (mpc-hrs) exposure for uranium. The maximum permissible concentration for insoluble uranium specified in 10 CFR 20, Appendix B, Table 1. Column 1 is 1.0E-10 microcuries per cubic centimeter. No inadequacies were identified.

3.2 Environmental Air Samples

The inspector reviewed the licensee's records of environmental air sampling results for the time period September 15 to October 31, 1992. Typical results indicated the presence of about one to two percent of the maximum permissible concentration (MPC) for uranium specified in 10 CFR 20, Appendix B, Table 2, Column 1 in air. The maximum air concentration measured was about 20% of the applicable MPC. The applicable MPC for insoluble uranium in air is 4.0E-12 microcuries per cubic centimeter.

4.0 Future Actions

4.1 Licensee

The licensee expected to complete site remediation activities by November 15, 1992. The final shipment of contaminated soil was expected to leave the site no later than November 16, 1992. Following the completion of remediation activities, the licensee expected to initiate the final "bottom of the hole" surveys. These surveys will include soil sampling and analyses. That survey report was expected to be completed and sent to the NRC Region I office for review on or before December 1, 1992.

Upon completion of verification surveys by the NRC, the licensee will fill the excavated areas on site and will conduct a final survey and soil sample analysis of the entire affected area. Upon completion of that survey, a final survey report will be prepared and submitted to the NRC. That report will also contain a residual radiation dose evaluation and a request for license termination.

4.2 NRC

Upon receipt of the "bottom of the hole" survey report, the NRC will evaluate the report and arrange for a verification survey to be conducted by the NRC contractor, the Oak Ridge Institute for Science and Education. That survey is expected to take place during the week of December 14, 1992. NRC also expects to conduct a final verification survey of the affected area of the site during the spring of 1993.

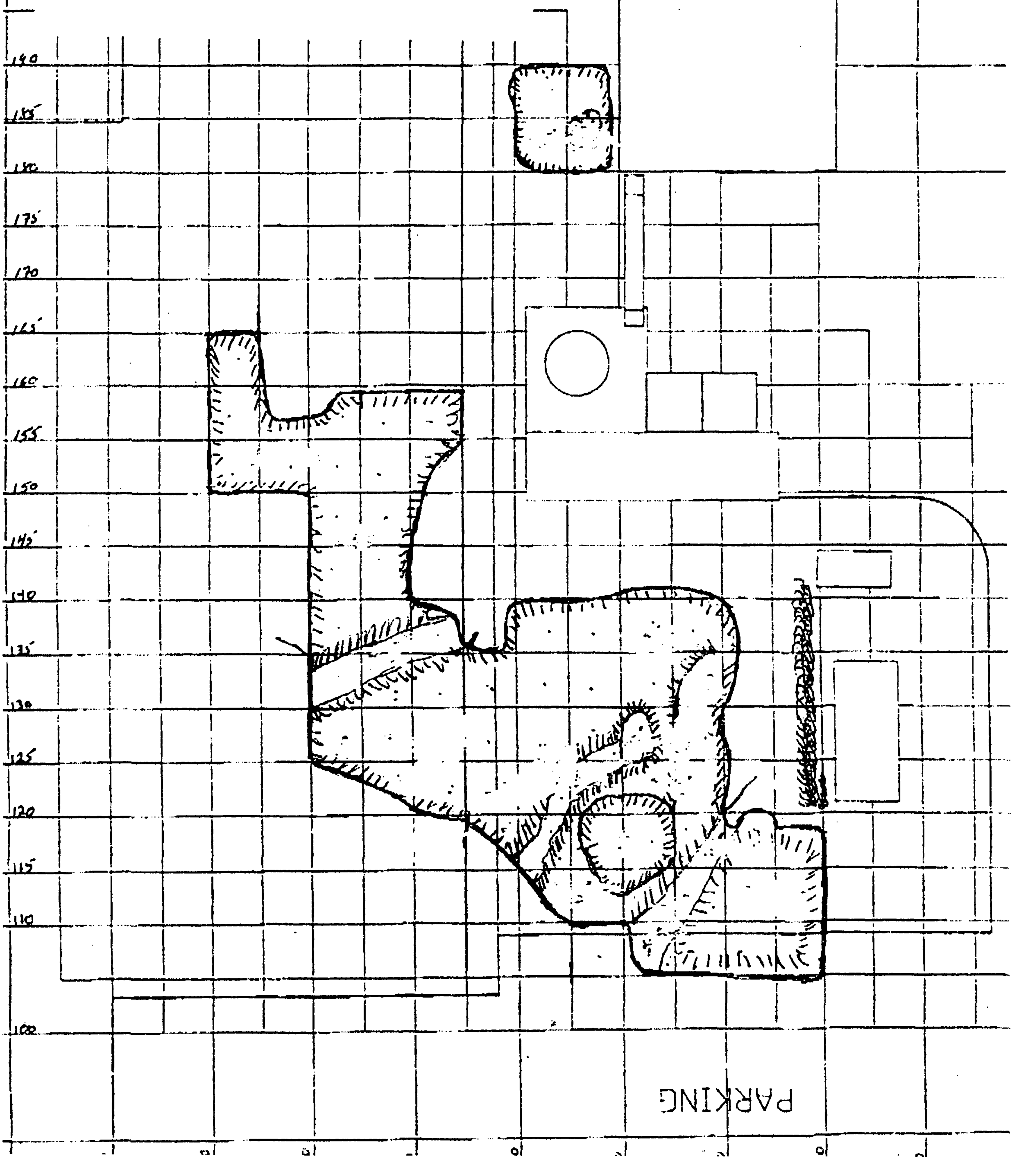
5.0 Licensee Discussions

In lieu of an exit interview, the inspector held continuing discussions with the individuals identified in Paragraph 1.0 throughout the inspection on November 3, 1992. These discussions provided the licensee representatives with the results of the inspection.

EXCAVATION AREA AS OF 11/6/92

APPROXIMATE ELEVATIONS SHOWN

Attachment 1



U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 70-33/92-03

Docket No. 70-33

License No. SNM-23 Priority 1 Category UHFF

Licensee Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02702

Facility Name: HFIR Project

Inspection At: Attleboro, Massachusetts

Inspection Conducted: November 3, 1992

Inspector: J. Roth 11/23/92

J. Roth, Project Engineer
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Branch
Division of Radiation Safety and Safeguards

Date

Approved by: W. J. Pascak 11-24-92

W. J. Pasciak, Chief
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Branch
Division of Radiation Safety and Safeguards

Date

Areas Inspected: Special, announced inspection by a region-based inspector to determine the status of remediation activities at the site.

Results: The remediation activities were proceeding on schedule and the licensee expected to have the remediation activities completed by November 16, 1992 and a survey report issued to the NRC by December 1, 1992. Within the scope of the inspection, no safety concerns or violation of regulatory requirements were identified.

Details

1.0 Individuals Contacted

R. L. Churchill, Program Manager
M. J. Elliott, Manager of Environmental Engineering
M. Henault, Remediation Contractor
F. J. Veale, Manager of Safety, Industrial Hygiene and Environmental Engineering

2.0 Site Tour

During this inspection, the inspector observed remediation activities in process. It was noted that the entire area between the Building 11 and Building 12 parking lots was affected by these activities. The affected area covered about 2.5 acres. Of this, about 0.5 acres was excavated to about 10 feet deep as shown in Attachment 1. Piles of overburden soil covered about one acre.

The inspector noted that the licensee had established a contamination control change line; that individuals working in the affected area were wearing breathing zone air samplers; and that at least four environmental air samples had been installed in the area. One environmental air sampler was located in the Northeast corner of the site, another was located on the north edge of the site, and, a third sampler was located on the south edge of the site. The last sampler was relocated, as necessary adjacent to work areas.

3.0 Review of Air Sampling Results

3.1 Breathing Zone Air Samples

The inspector reviewed the licensee's records of breathing zone air sampling results for the time period September 15 to October 31, 1992. The results indicated that the workers were not exposed to any significant airborne radioactivity. The maximum exposure was about 2 maximum permissible concentration - hours (mpc-hrs) exposure for uranium. The maximum permissible concentration for insoluble uranium specified in 10 CFR 20, Appendix B, Table 1, Column 1 is 1.0E-10 microcuries per cubic centimeter. No inadequacies were identified.

3.2 Environmental Air Samples

The inspector reviewed the licensee's records of environmental air sampling results for the time period September 15 to October 31, 1992. Typical results indicated the presence of about one to two percent of the maximum permissible concentration (MPC) for uranium specified in 10 CFR 20, Appendix B, Table 2, Column 1 in air. The maximum air concentration measured was about 20% of the applicable MPC. The applicable MPC for insoluble uranium in air is 4.0E-12 microcuries per cubic centimeter.

4.0 Future Actions

4.1 Licensee

The licensee expected to complete site remediation activities by November 15, 1992. The final shipment of contaminated soil was expected to leave the site no later than November 16, 1992. Following the completion of remediation activities, the licensee expected to initiate the final "bottom of the hole" surveys. These surveys will include soil sampling and analyses. That survey report was expected to be completed and sent to the NRC Region I office for review on or before December 1, 1992.

Upon completion of verification surveys by the NRC, the licensee will fill the excavated areas on site and will conduct a final survey and soil sample analysis of the entire affected area. Upon completion of that survey, a final survey report will be prepared and submitted to the NRC. That report will also contain a residual radiation dose evaluation and a request for license termination.

4.2 NRC

Upon receipt of the "bottom of the hole" survey report, the NRC will evaluate the report and arrange for a verification survey to be conducted by the NRC contractor, the Oak Ridge Institute for Science and Education. That survey is expected to take place during the week of December 14, 1992. NRC also expects to conduct a final verification survey of the affected area of the site during the spring of 1993.

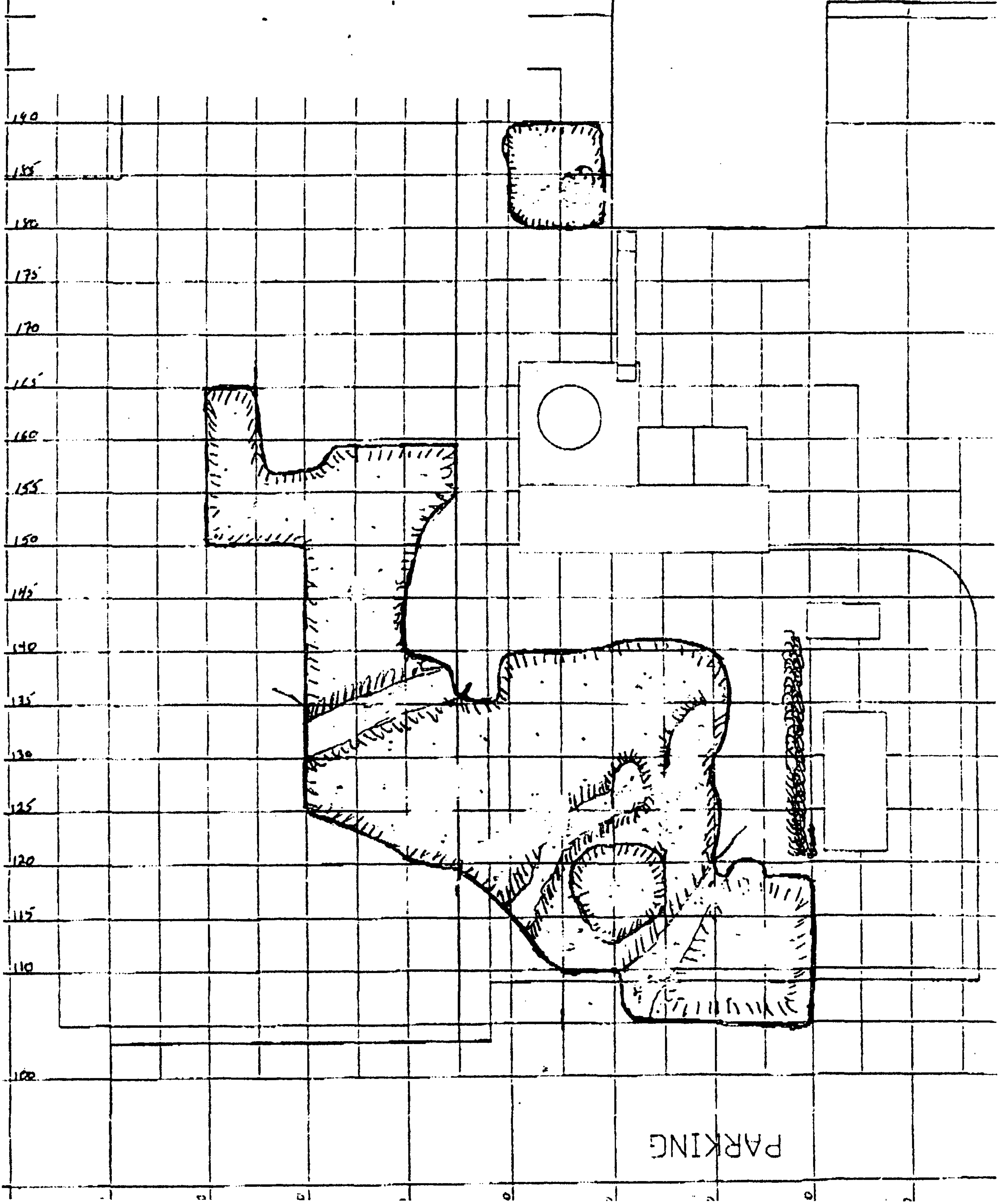
5.0 Licensee Discussions

In lieu of an exit interview, the inspector held continuing discussions with the individuals identified in Paragraph 1.0 throughout the inspection on November 3, 1992. These discussions provided the licensee representatives with the results of the inspection.

Attachment 1

EXCAVATION AREA AS OF 11/6/92

APPROXIMATE ELEVATIONS SHOWN



DEC 30 1992

Docket No. 70-33

Mr. Frank J. Veale, Jr.
Manager, Environmental Engineering/
Industrial Hygiene
Metals and Controls Group
Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02703

Dear Mr. Veale:

Subject: NRC Inspection No. 70-33/92-04

An announced safety inspection of your site remediation activities was conducted at your facility by Mr. J. Roth on December 14-16, 1992. The inspection findings were discussed with you, Mr. W. Schuele, and members of your staff on December 16, 1992 during the inspection.

The area reviewed during the inspection was important to health and safety and is discussed in the enclosed inspection report. This area was the observation of a confirmatory survey conducted by the NRC contractor, the Oak Ridge Institute for Science and Education.

All operations of the facility have been terminated with the exception of decommissioning and decontamination activities. Preliminary results of the surveys conducted by the NRC contractor during this inspection indicated that you appeared to have completed cleanup of the bottom of the excavated area of the former burial site in an appropriate manner. However, the existence of elevated radiation levels on the walls of the excavated area indicated that not all radioactive material, above the guidance values approved in your Remediation Plan (30 picocuries total uranium per gram of soil), had been removed. It is our understanding that you will remove this material, resurvey the edges of the excavated area and provide this office with a revised final survey report. Within the scope of this inspection, no safety concerns or violations of regulatory requirements were identified.

IE07

No response to this letter is required. Your cooperation with us is appreciated.

Sincerely,

Original Signed By:
James H. Joyner

James H. Joyner, Chief
Facilities Radiological Safety
and Safeguards Branch
Division of Radiation Safety
and Safeguards

Enclosure: NRC Region I Inspection Report No. 70-33/92-04

cc w/encl:
Public Document Room (PDR)
Local Public Document Room (LPDR)
Nuclear Safety Information Center (NSIC)
Commonwealth of Massachusetts (2)

bcc w/encl:
Region I Docket Room (with concurrences)
J. Roth, DRSS
M. Landis, ORISE
J. Shepard, NMSS
V. McCree, OEDO
A. Jaberaboansuri, ORISE

RI:DRSS	RI:DRSS	RI:DRSS
Roth/mh	Pasciak	Joyner
12/30/92	12/30/92	12/30/92

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 70-33/92-04

Docket No. 70-33

License No. SNM-23 Priority 1 Category UHFF

Licensee Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02702

Facility Name: HFIR Project

Inspection At: Attleboro, Massachusetts

Inspection Conducted: December 14-16, 1992

Inspector: J. Roth, Project Engineer — Date
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Branch
Division of Radiation Safety and Safeguards

Approved by: W. J. Pasciak, Chief — Date
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Branch
Division of Radiation Safety and Safeguards

Areas Inspected: Special, announced inspection by a region-based inspector to observe a survey conducted by the NRC contractor, the Oak Ridge Institute for Science and Education (ORISE), to verify survey results provided by the licensee.

Results: Preliminary results of the ORISE survey indicated that the licensee appeared to have completed cleanup of the bottom of the excavated area in an appropriate manner. However, elevated radiation levels obtained on the walls of the excavated areas indicate that not all radioactive material, above the NRC approved guidance values, had been removed. No safety concerns or violations of regulatory requirements were identified.

DETAILS

1.0 Individuals Contacted

M. Elliot, Manager, Environmental Engineering
M. Griffin, Project Manager
T. Gutman, Consultant
W. Lorenzen, Health Physicist
J. O'Donnell, Corporate Health Physicist
W. Schuele, Attleboro Site Manager
F. Veale, Jr., Manager, Environmental Engineering/Industrial Hygiene

Other licensee representatives, employees and remediation contractor employees were also interviewed during this inspection.

2.0 Background

On August 26, 1992, NRC issued Amendment No. 16 to Facility License SNM-23. This amendment authorized the licensee to perform remediation of the on-site low level radwaste burial site in accordance with the "Remediation Plan for the Identified Building 12 Burial Area" (Remediation Plan) and the "Radiological Health and Safety Plan dated July 30, 1992." The licensee performed the remediation activities between August 27 and November 13, 1992 and provided the NRC with the "Post Excavated Radiological Survey Report" dated November 28, 1992. This report, provided as Attachment 1, was used as the basis for preparation of the "Confirmatory Radiological Survey Plan for the Texas Instruments Incorporated Burial Site, Attleboro, Massachusetts" which was submitted to the NRC Region ' office by the NRC contractor, the Oak Ridge Institute for Science and Education (ORISE) by letter dated December 10, 1992 (see Attachment 2). This plan was approved by the NRC and the confirmatory survey was conducted December 14-16, 1992.

3.0 Conduct of the Verification Survey

ORISE personnel conducted the verification survey discussed in Paragraph 2.0. Available surfaces of the excavated and adjacent areas were scanned using gamma scintillation or GM detectors. Soil samples were taken from randomly selected locations within the excavated areas. Additional soil samples also were taken within the excavated areas at locations that exhibited elevated radiation readings during the scanning, or were identified as elevated in the licensee's report. Each of these samples was split with the licensee and will be analyzed to verify the licensee's analytical ability. The results will be included in correspondence to the licensee when the analyses are completed.

4.0 Preliminary Survey Results

Preliminary results indicated that the licensee appeared to have completed cleanup of the bottom of the excavated area in an appropriate manner. However, elevated radiation levels (ranging from 2½ to 40 times background) identified on the walls of the excavation (see Attachment 3) indicated that radioactive material, above the 30 picocuries total uranium per gram of soil guidance value contained in the NRC approved Remediation Plan, may not have been removed from the burial site. As a result, the licensee was requested by the inspector to perform additional remediation activities.

5.0 Additional Actions Required

5.1 Licensee

Upon completion of the additional remediation activities, the licensee is expected to resurvey the excavated areas and provide the NRC with a revised final survey report of the remediated area.

5.2 NRC

Upon receipt of the licensee's final survey report, the NRC contractor will visit the site, resurvey the applicable areas and will perform final confirmatory surveys on the surface of the remediated area.

6.0 Exit Interview

The inspector met with the licensee representatives denoted in Paragraph 1.0 at the conclusion of the inspection on December 16, 1992. The ORISE team leader and the inspector summarized the results of the confirmatory survey conducted by ORISE personnel. The inspector thanked the licensee for providing the survey team logistical support and backup when required.

During the exit interview, the inspector provided the licensee with guidance in regard to soil sample result averaging. It was stated that since the soil samples were taken at the grid block intersections, the average residual uranium value for each adjacent four grid blocks also had to meet the 30 picocuries total uranium per gram of soil criteria. In addition, the licensee was reminded that the results of groundwater monitoring for total uranium had to be incorporated into the final report.

TEXAS INSTRUMENTS

November [illegible], 1992

OVERNIGHT MAIL

Mr. Jerry Roth
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406-14[illegible]

Dear Mr. Roth:

The attached report is being submitted to the U.S. Nuclear Regulatory Commission (NRC) by Texas Instruments Incorporated (TI), Materials & Controls Group located in Attleboro, Massachusetts. It summarizes the results of radiological surveys performed on TI property at the former burial site location near Building 12.

The radiological survey report documents the effectiveness of remediation activities carried out in accordance with a plan submitted to the NRC on July [illegible], 1992 and subsequently approved by the NRC on August 26, 1992.

As we discussed during a site inspection on November 3, 1992, the excavated area will remain exposed to facilitate confirmatory sampling by Oak Ridge Institute of Science and Education.

If there are any questions or concerns regarding the enclosed report, please do not hesitate to call me at (508) 699-18[illegible].

Sincerely yours,

Michael [illegible]. Elliott
Environmental Engineering Manager

Attachment

cc: Mr. James D. Berger, ORISE
Mr. Daniel V. Bartosh, Jr., TI Dallas
Mr. Francis J. Veale, Jr., TI Attleboro

POST EXCAVATION RADIOLOGICAL SURVEY REPORT

TEXAS INSTRUMENTS INCORPORATED
BURIAL SITE
Attleboro, Massachusetts

Prepared by

Creative Pollution Solutions, Inc.

11/28/92

INTRODUCTION

The post excavation survey for the Texas Instruments Incorporated Building 12 Burial Site was designed in accordance with the Remediation Plan (approved 8/29/92). The remediation of the site included at least all areas outlined in the initial plan. When necessary, additional areas were excavated. The average depth of the excavated area is approximately 1.5 meters. In many areas groundwater was reached. Excavated material was either processed to remove aggregate and/or staged for disposition. A volume of approximately 90,000 ft^3 of material was excavated of which approximately 58,000 ft^3 was sent to EnviroCare of Utah via rail for final disposition. Figure 1 in Appendix A in this report shows the area of excavation. The excavated area will not be backfilled (except around an exposed fire hydrant) until after ORISE completes necessary sampling to confirm the post excavation survey.

The post excavation survey consists of two parts: a walkover surface scan of the affected area and surface soil sampling of the excavated area.

SURFACE SOIL SAMPLING WITHIN THE EXCAVATED AREA

The soil sampling plan for the excavated area consisted of surface soil samples at each corner and in the middle of each 10 meter x 10 meter grid cell. Wherever possible surface (0-15cm) soil samples of approximately 1 kg each were collected at these points. In some cases excavation equipment had to be used to extract a sample from beneath the standing water. A map of sample locations along with sample results are shown in Appendix A. All of the samples from the excavated area were analyzed using gross alpha screening. The average of all gross alpha screening samples within the excavated area is less than 30 pCi/g (Note: 30 counts/10 min approximately equals 30 pCi/g as correlated with Babcock and Wilcox gamma spectroscopy data (see Appendix C). The gross alpha screening methodology is described in Appendix B.

SURVEY OF AFFECTED AREA

A walkover surface scan using portable NaI(Tl) gamma scintillation detectors was conducted at 1 meter intervals over the entire affected area. The affected areas consist of any areas in the defined exclusion area (see Health and Safety Plan, 8/92). The grid system established in the ORAU[1] Radiological Survey (1985) was used. A walkover of the excavated area was not possible because of the elevated water table and accumulation of surface water run-off in this area. The walkover survey data is provided in Appendix D.

These surveys were conducted with a Ludlum model 44-2 1" by 1" NaI(Tl) probe coupled to a Ludlum model 2221 Portable Scaler/ratemeter. The purpose of these surveys was to determine and locate any radiological anomalies. The NaI type detectors are inherently highly energy

dependent, but are useful due to its general greater sensitivity. The use of such instruments are well suited for the identification of anomalies, however, care must be given when interpreting the response in terms of exposure rates (μR/h). In this regard, a linear response check was performed using a ^{60}Co Source, the results of which are included within Appendix D. The energy distribution of photons encountered in field are characterized by a much lower photon energy distribution which is further confounded by a large degradation of this spectral distribution due to the source incorporation in a soil matrix. The interpretation of exposure rate from this instrument, short of an exhaustive study, is to assume from previous studies (ORAU) that a nominal background exposure rate of 11 μR/h exists and that a the NaI(Tl) background response correlates to this value. Even under this presumption certain errors will exist such as variation of background with time. Not withstanding a response factor from 0.0039 to 0.0034 with an average of 0.0037 is established.

APPENDIX A

EXCAVATION FLOOR SAMPLING ALPHA SCREENING RESULTS

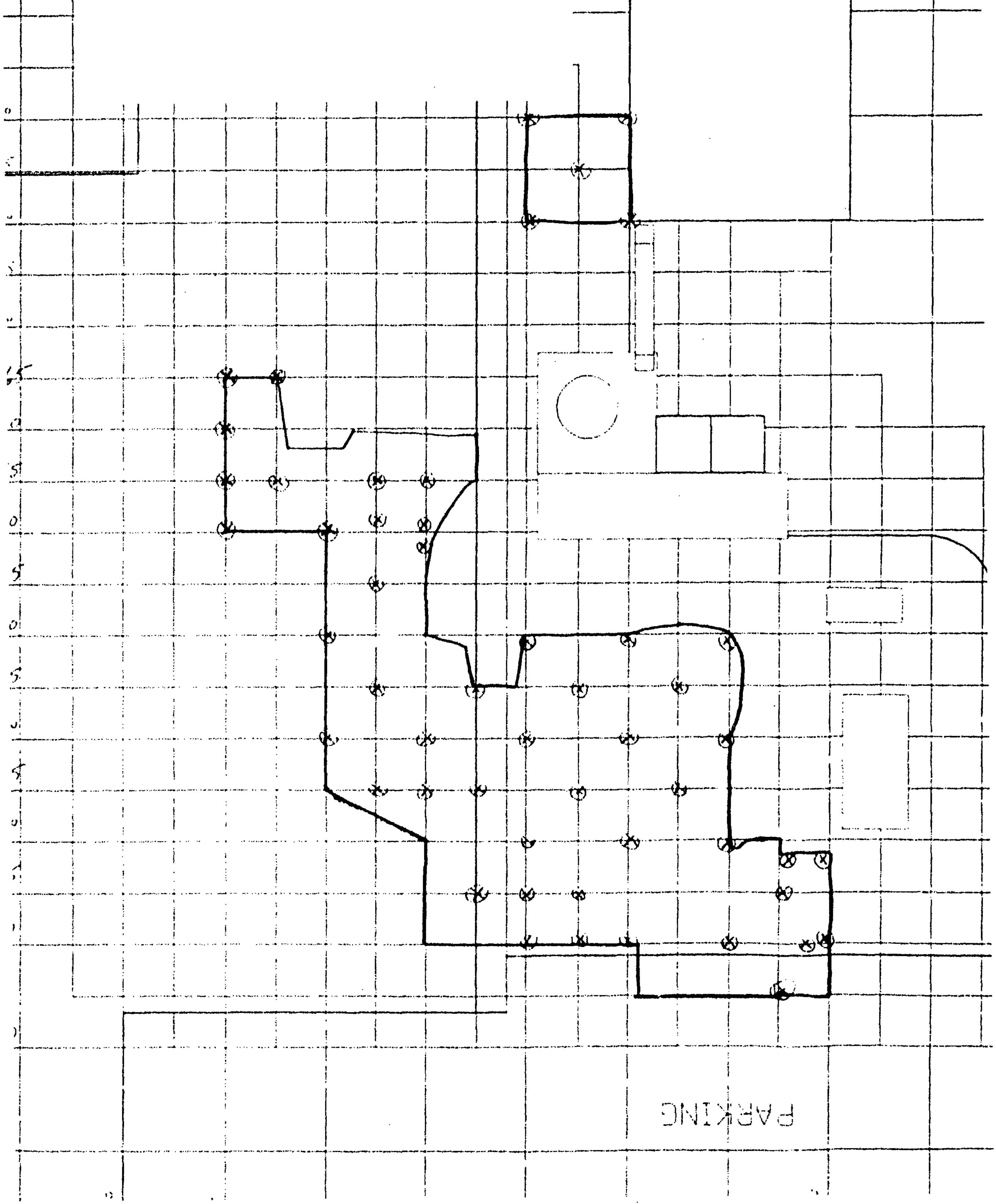
North	East	Alpha Screen (pCi/g)
200	150	29
200	155	7
200	160	16
200	165	19
195	155	11
195	165	10
190	130	17
190	140	12
190	150	28
185	125	**45**
185	135	**50**
185	145	**8**
185	152	**50**
185	155	**21**
180	125	15
180	130	14
180	150	4
180	152	48
180	155	11
175	115	14
175	125	12
175	135	14
170	110	53
170	115	22
170	120	34
170	130	7
170	140	16
170	180	22
170	190	46

North	East	Alpha Screen (pCi/g)
165	110	34
165	115	18
165	125	11
165	135	22
165	185	30
160	110	22
160	120	17
160	130	27
160	140	24
160	180	33
160	190	23
155	125	12
155	135	25
150	110	26
150	120	27
150	130	21
150	140	55
145	105	9
145	115	18
145	120	17
142	110	24
140	110	42
140	120	9

Average of values = 23.10 pCi/g
Standard deviation = 13.23

SURFACE SOIL SAMPLING LOCATIONS

⊗ - Sample Locations



APPENDIX B

ALPHA SCREENING METHODOLOGY

The alpha screening technique employed was gross alpha counting of a soil sample in intimate contact with a ZnS(Ag) detector. Using this method the ZnS(Ag) disc is disposable.

The method employed in the field was as follows:

1) Approximately 1 kg soil sample obtained

2) Sample homogenized by mixing (in larger container if necessary)

3) An aliquot of the homogenized sample is then (approximately 20-40 grams) dried in an oven at about 100° C for approximately 10 minutes. The sample is then allowed to cool.

4) The sample is then sieved and placed in direct contact with the phosphor side of the ZnS dish assembly.

5) The sample is then place in direct contact with a photomultiplier tube and counted for 10 minutes.

The counts obtained have been correlated to both alpha spectroscopy and gamma spectroscopy. The correlation to gamma spectroscopy is attached in Appendix C and the correlation to alpha spectroscopy has been demonstrated in previous reports.

APPENDIX C

COMPARISON OF ALPHA SCREENING AND GAMMA SPECTROSCOPY

Since the post excavation survey results were obtained using alpha screening 10 split samples were sent to both ORISE and an outside laboratory to establish a correlation between the gamma spectroscopy data and the alpha screening data. The comparison with one set of gamma spectroscopy results are shown below

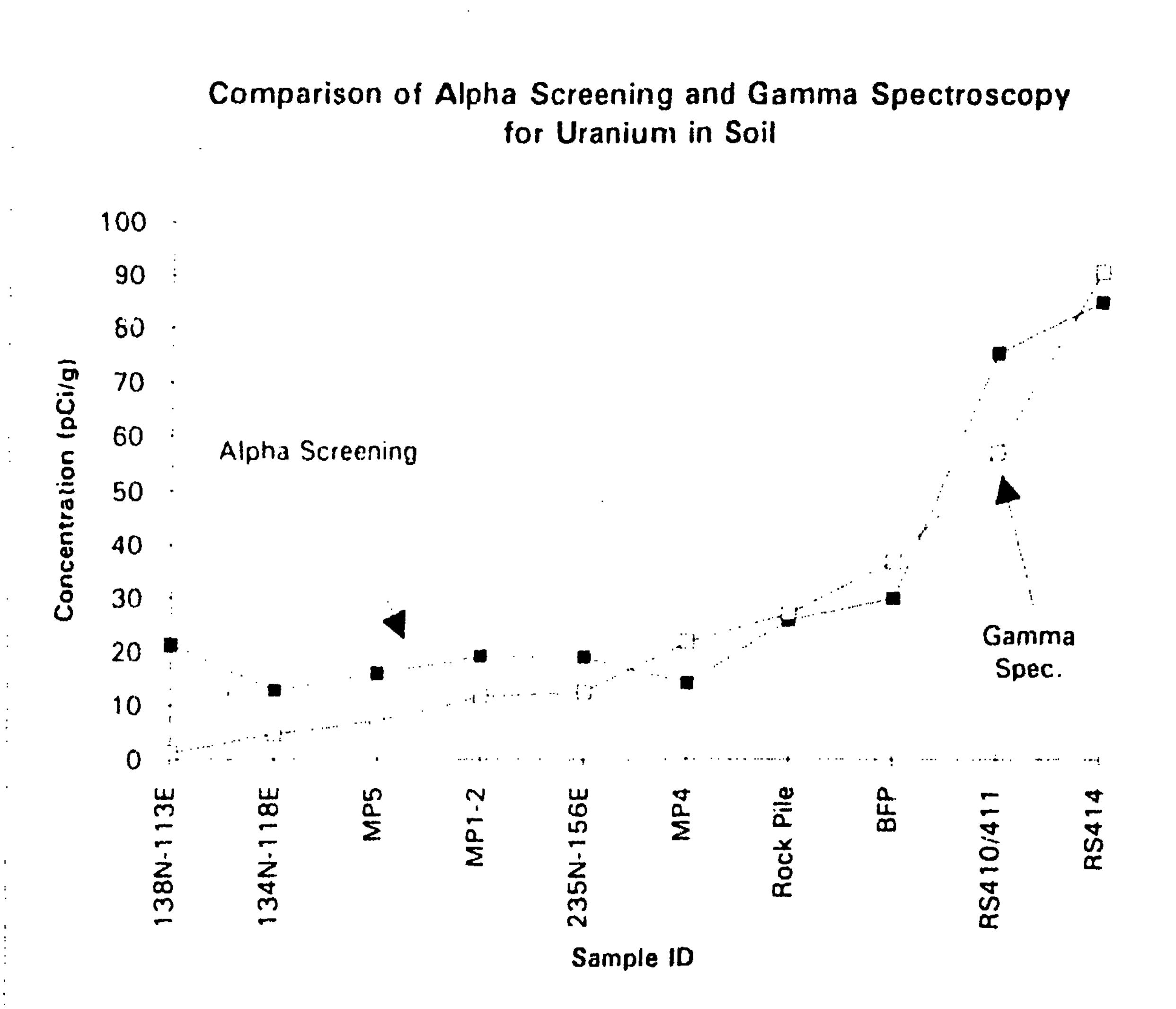
Notes regarding attached graph:

1) alpha screening result is based on an average of 5-10 samples

2) gamma spec data assumed an activity ratio (U-234/U-235) of 22.

Comparison of Alpha Screening and Gamma Spectroscopy for Uranium in Soil

SAMPLE ID	ALPHA SCREEN (TOTAL U pCi/g)	GAMMA SPEC (TOTAL U pCi/g)
138N-113E	21.4	1.25
134N-118E	12.8	4.65
MP5	15.9	7.1
MP1-2	19.2	11.65
235N-156E	19	12.49
MP4	14.2	21.82
Rock Pile	25.8	26.96
BFP	29.9	36.76
RS410/411	75.3	56.99
RS414	85	90.77



APPENDIX D

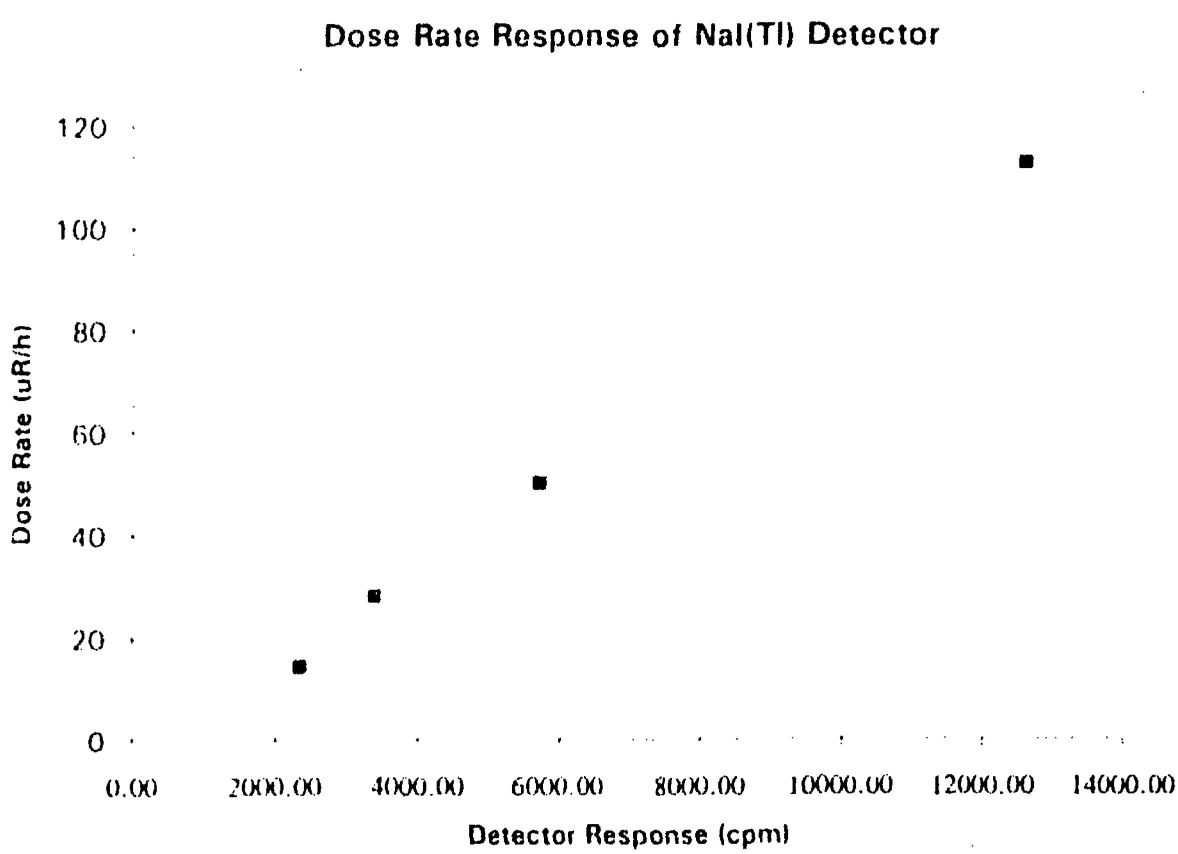
WALKOVER SURVEY RESULTS

NOTE: The attached represents the results of the walk over survey. The results presented are in the units of counts per minute (cpm)

Determination of the Response of the NaI(Tl) Detector for Radiological Field Surveys

	Bkg	2.5 meter	2.0 meter	1.5 meter	1.0 meter
1.00	5206.00	7455.00	8444.00	10938.00	17472.00
2.00	5283.00	7277.00	8564.00	10835.00	17646.00
3.00	5143.00	7441.00	8751.00	11107.00	17738.00
4.00	4959.00	7489.00	8552.00	10797.00	17744.00
5.00	5056.00	7589.00	8418.00	10864.00	17790.00
6.00	5105.00	7602.00	8334.00	10542.00	18064.00
Average	5125.33	7475.50	8510.50	10847.17	17742.33
Exp. Err	113.64	118.39	145.98	185.39	193.97
Th. Err.	71.59	86.46	92.25	104.15	133.20
Chi. Sq.	2.52	1.87	2.50	3.17	2.12

	2.5 meter	2.0 meter	1.5 meter	1.0 meter
Net Response, cpm	2350.17	3385.17	5721 83	12617.00
Dose Rate, uR/h	14.58	28.13	50	112.5
Calibration Factor, uR/h/cpm	0.0062038	0.0083083	0.0087385	0.0089165



Regression Statistics

Multiple R	0.9962444
R Square	0.9925029
Adjusted R Square	-1.333333
Standard Error	3.7517943
Observations	1

Analysis of Variance

	df	*Sum of Squares*	*Mean Square*	*F*
Regression	4	5590.341138	1397.58528	397.16
Residual	3	42.22788077	14.0759603	
Total	7	5632.569019		

	Coefficients	*Standard Error*	*t Statistic*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0					
Slope	0.0087835	0.000259572	33.8385201	5E-09	0.0079575	0.00961

Walk Over Surface Scan

Coordinates East / North	105	106	107	108	109	110	111	112	113
120									
121									
122									
123									
124									
125									
126									
127									
128							3200	3200	2500
129						2600	2800	2800	2500
130						2700	2600	2700	3500
131						3000	2800	2800	2900
132				2800	2500	2500	2500	2500	2500
133				2500	2600	3100	3100	3200	2900
134	tar	tar	tar	3000	3000	2800	3000	2800	2800
135	tar	3200	2500	3200	3100	3000	3100	3200	3000
136	tar	2900	3000	3300	3000	3000	3300	3100	3100
137	tar	3000	2900	3000	3100	3000	2900	3300	3200
138	2900	2900	3100	3100	3200	3100	3000	3000	3100
139	3500	3200	3000	3300	3000	3200	3000	3200	3200
140	3300	2800	3600	3900	3300	3300	3200	3300	3300
141	3300	3500	3500	3500	3700	3300	3800	3700	3700
142	tar	3300	3500	4000	3300	3000	3200	3100	3200
143	tar								
144	tar								
145	tar								
146	tar								
147	tar								
148	tar								
149	tar								
150	tar								
151	tar								
152	tar								
153	tar								
154	tar								
155	tar								
156	tar								
157	tar								
158	tar								
159	3200	3500	4000	3200	5500	5000			
160		3600	3900	4000	3900	3500			
161		3700	3800	4000	4000				
162		4100	4500	4000	3900				
163		3500	4000	3700	4000				
164		3900	3900	3900	3800				
165		3500	4000	3900	4100				
166		4000	3900	3500	3800				
167		3500	4200	3800	4000	3800			
168		3700	3800	3700	3800	3200			

Walk Over Surface Scan

Coordinates East / North	105	106	107	108	109	110	111	112	113
169				4100	4200	4100			
170				3900	3900	3900			
171				3400	3500	3700			
172				3600	3900	3700			
173				3400	3500	3600			
174				3300	3400	3500			
175				3200	3300	3400			
176				3100	3200	3200			
177				3300	3500	3500	3200		
178				3500	3500	3300	3500	3500	
179				3400	3300	3100	3300	3300	3200
180						3000	3600	3500	3400
181						3200	3200	3100	3700
182							3300	3400	3400
183									4000
184									
185									
186									
187									
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Walk Over Surface Scan

218									
219									
220									

Walk Over Surface Scan

Coordinates East / North	114	115	116	117	118	119	120	121	122
120									
121									
122									
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124									
125									
126									
127									
128	2500	2400	2500	2500					
129	2500	2900	2500	2800					
130	2600	2600	2500	2500	2500	2500	2400		
131	2500	2800	2500	2500	2400	2300	3000		
132	2500	2800	2800	2600	2500	2500	2500		
133	2900	3000	3100	2900	2500	2500	2500		
134	2700	2500	2700	2500	2500	2500	2500		
135	2800	3000	3000	3000	2900	2800	2800		
136	3300	3100	rock	rock	3200	2900	2900		
137	3200	3500	rock	rock	3100	3200	3000		
138	3100	3200	3100	2900	3000	3000	2900		
139	3100	3200	3100	3300	2500	3000	3000		
140	3500	3400	3400	3100	3000	3000	3000		
141	3800	3600	3300	3200	3500	3200	3300		
142	3400	3300	3000	3200	2900	2900			
143					2800	2800			
144						2900	2900	2700	2800
145						2800	3000	3100	3000
146						2900	3200	3000	3200
147							3000	3000	3100
148									
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Walk Over Surface Scan

Coordinates East / North	114	115	116	117	118	119	120	121	122
169									
170									
171									
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173									
174									
175									
176									
177									
178									
179	3200	3200	3300	3500	3500	3300	3400		
180	3400	3400	3000	3000	3000	3300	3500	3400	
181	3300	3200	3600	3200	3200	3000	3500	3600	3400
182	3300	3400	3400	3100	3000	3000	3200	3500	3200
183	3300	3300	3100	3200	3100	3000	3100	3300	3200
184	3100	3400	3000	3100	3200	3100	3100	3300	3200
185		3500	3200	3100	3300	3000	3200	3500	3200
186		3400	3100	3200	3300	3200	2900	3500	3500
187		3400	3200	3100	3500	3000	3000	3500	3200
188		3200	3100	3300	3500	3200	3000	3200	3400
189		3300	3200	3100	3000	3200	3200	3200	3200
190		3500	3200	3100	3000	3200	3000	3200	3700
191		3500	3200	3100	3200	3100	3500	3200	3700
192		3400	3200	3000	3500	3200	3200	3500	3700
193		3300	3400	3200	3500	3100	3200	3500	3700
194		3400	3400	3100	3200	3200	3400	3500	3400
195		3400	3400	3100	3000	3200	3500	3300	3300
196		3400	3200	3000	3100	3300	3500	3000	3500
197		3400	3400	3100	3100	3600	3500	3100	3500
198		3200	3300	3300	3400	3000	3100	3100	3300
199		3300	3300	3200	3300	3100	3100	3000	3300
200		3400	3100	3000	3000	3100	3300	3300	3400
201							3300	3400	3300
202							3200	3100	3400
203							3100	3200	3200
204							3200	3200	3100
205							3200	3100	3400
206							3100	3100	3200
207							3000	3100	3500
208							3000	3300	3500
209							3000	3200	3600
210							3500	3300	3200
211							3400	3200	3200
212		3300	3200	4400	3600	3400	3400	3500	3200
213		3200	3200	3700	3600	3300	3400	3300	3100
214		3400	3100	3600	3700	3500	3300	3200	3100
215		3300	3800	3600	4600	3400	3300	3300	3400
216		3300	3500	3800	3600	3800	3400	3400	3600
217		3900	4100	3900	3600	4000	4000	3800	3600

218		4100	4300	4100	4000	3800	3800	4000	3600
219		4000	3800	4200	4100	3800	3900	3800	3600
220		4000	4200	4600	4100	3800	3900	3600	3700

Walk Over Surface Scan

Coordinates East / North	123	124	125	126	127	128	129	130	131
120									
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141									
142									
143									
144	2900	3000	3000	3000	3000	3000	3000	2900	
145	3000	3200	3200						3000
146	3400	3400	3500						
147	3000	3100							
148									
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Walk Over Surface Scan

Coordinates East / North	123	124	125	126	127	128	129	130	131
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181									
182	3100								
183	3400								
184	3500	3200							
185	3700	3200							
186	3400	3600							
187	3500	3700	3400						
188	3500	3200	3400						
189	3400	3400	3700	3200					
190	3700	3400	3200	3600	3600				
191	3600	3600	3200	3700	3800	3700	3600	3700	4500
192	3500	3600	3600	3700	4300	3800	4000	5000	6500
193	3500	3900	3700	3600	4100	3800	4000	4500	3700
194	3300	3700	3600	3600	3600	3600	3500	4000	3600
195	3200	3500	3600	3300	3400	3600	3500	3700	3700
196	3500	3300	3100	3300	3400	3600	3400	3500	3700
197	3500	3700	3500	3300	3200	3700	3100	3500	3600
198	3500	3600	3400	3500	3400	3200	3100	3700	3600
199	3200	3200	3000	3300	3300	3200	3100	3600	3500
200	3300	3400	3200	3500	3300	3400	3400	3600	3400
201	3200	3400	3200	3400	3500	3400	3400	3700	3200
202	3300	3300	3800	3100	3600	3200	3200	3900	3100
203	3500	3100	3400	3200	3300	3000	3400	3300	3000
204	3300	3100	3500	3300	3400	3000	3500	3300	3400
205	3200	3200	3500	3400	3600	3200	3500	3600	3500
206	3100	3500	3400	3400	3100	3700	3400	3400	3600
207	3400	3300	3300	3400	3300	3500	3500	3600	3600
208	3400	3200	3400	3200	3700	3400	3400	3400	3200
209	3200	3300	3400	3300	3200	3500	3300	3200	3100
210	3300	3300	3400	3500	3200	3300	3200	3200	3100
211	3200	3200	3100	3200	3500	3600	3200	3300	3100
212	3200	3200	3300	3300	3300	3500	3100	3400	3200
213	3300	3300	3300	3200	3700	3500	3500	3300	3200
214	3300	3600	3300	3500	3200	3400	3500	3200	3400
215	3300	3700	3600	3700	3500	3600	3600	3600	3500
216	3800	3800	3500	3600	3500	3800	3600	3800	3500
217	4200	4000	3800	4000	3800	4000	4100	3800	3500

218	4000	3600	4000	3900	3600	3800	4000	3700	3500
219	4000	3600	3800	4200	3600	3800	3700	4600	3600
220	3600	3800	3600	3400	3600	3400	3600	3300	3100

Walk Over Surface Scan

Coordinates East / North	132	133	134	135	136	137	138	139	140
120									
121									
122									
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137									
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140									
141									
142									
143									
144									
145	3000	3000	2900	2900	3000	3000	3000	2900	3000
146	3000	3000	3000	2900	2900	3000	3000	2800	3000
147	3000	3000	2800	3000	3000	3000	3000	3000	3000
148	3000	3000	3000	3000	3100	3000	3200	2900	3000
149	3200						3200	3000	3000
150							3300	3200	3200
151									
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164									
165									
166									
167									
168									

Walk Over Surface Scan

Coordinates East / North	132	133	134	135	136	137	138	139	140
169									
170									4100
171									4200
172						sw	sw	sw	sw
173						sw	sw	sw	sw
174						sw	sw	sw	sw
175								3500	3400
176								3200	3400
177								3200	3500
178								3400	3500
179								3500	3600
180								3500	3700
181									
182									
183									
184									
185									
186									
187									
188									
189									
190			3800	4300	5500	3900	3700	4000	3700
191	4500	5500	3800	5500	4800	3400	3700	3900	4000
192	6100	5000	4100	3500	3800	3200	3700	3500	4000
193	5700	10000	3800	3400	3200	3400	3400	3500	3400
194	4400	4100	3700	3300	3200	3200	3200	3300	3500
195	3300	3400	3700	3200	3000	3300	3200	3400	3500
196	3200	3500	3500	3300	3000	3100	3100	3400	3400
197	3200	3100	3300	3500	3000	3200	3200	3300	3200
198	3500	3300	3400	3600	3200	3200	3300	3100	3300
199	3600	3300	3400	3500	3000	3900	3200	3200	3500
200	3500	3400	3400	3800	3700	3500	3200	3400	3200
201	3400	3400	3000	4000	3500	3300	3400	3100	3300
202	3600	3700	3400	3800	3400	3500	3400	3400	3300
203	3500	3600	3700	3900	3700	3200	3400	3400	3500
204	3500	3600	3800	4400	3500	3300	5800	3200	3400
205	3500	3600	4100	3600	3900	3500	3400	3500	3400
206	3700	3500	3800	3500	3700	3100	3100	3600	3500
207	3800	3700	3500	3400	3500	3200	3100	3400	3500
208	3400	3100	3200	3300	3200	3100	3300	3300	3300
209	3100	3200	3300	3500	3400	3300	3500	3400	3400
210	3300	3300	3400	3500	3300	3100	3300	3500	3500
211	3100	3100	3100	3200	3200	3200	3200	3200	3300
212	3100	3100	3300	3400	3300	3400	3600	3200	3400
213	3600	3200	3500	3600	3600	3400	3600	3300	3600
214	3500	3200	4000	3500	3800	3800	3800	3300	3600
215	3600	3400	4000	3600	3800	4000	3800	3500	3600
216	3700	4100	3700	4000	3900	4400	4100	3800	3800
217	3800	3800	3700	3900	3800	4200	4300	4000	

218	3500	3600	3400	3900	3200	4200	4200			
219	3600	3400	3200	3400	3000	3600				
220	3300	3100	3300	3100						

Walk Over Surface Scan

Coordinates East / North	141	142	143	144	145	146	147	148	149
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
135									
136									
137									
138									
139									
140									
141									
142									
143									
144									
145	2800	2900	3100	3100	3100	3000	3300	3200	3100
146	2700	3000	3300	3400	2900	3200	3700	3000	3200
147	2800	3000	3400	3500	2800	3400	3800	3300	3200
148	2800	3200	3300	3300	3100	3900	3700	3400	3300
149	2900	3000	3200	3300	3100	3500	3200	3500	3200
150	3200	3400	3200	3100	3000	3500	3500	3200	3000
151			3200	3200	3200	3000	2900	3200	3100
152			3000	3400	3200	3100	3000	3400	3100
153			3200	3200	3200	3100	3000	3200	3000
154			3500	3200	3300	3200	3400	3100	3900
155			3400	3200	3000	3200	3400	3100	3000
156			3300	3100	2700	3100	3200	3000	3000
157			3200	3200	2900	3100	3000	3000	3100
158			3400	3000	3000	3000	3000	3000	3200
159			3300	3000	3000	3000	3000	3100	3000
160			3200	3000	3200	3200	3100	3000	3900
161			3400	2900	3000	3100	3000	2900	3000
162			3500	3000	2900	3200	3000	3000	3000
163			3400	3000	3100	3200	3200	2900	3000
164			3500	3100	3000	3300	3400	3000	3200
165			3500	3300	3000	3300	3300	3200	3300
166			3200	3200	3000	3400	3200	3000	3300
167			3200	3300	3300	3200	3100	3000	3200
168			3000	3100	3200	3200	3200	3200	3000

Walk Over Surface Scan

Coordinates East / North	141	142	143	144	145	146	147	148	149
169			3000	3000	3100	3200	3300	3400	3300
170	3400	3300	3500	3200	3000	3100	3200	3000	2500
171	3800	3600	3500	3500	3000	3000	3200	3000	2900
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3400	3500	3400	4000	3400	3700	3500	3500	3400
176	3400	3500	3700	3500	3300	3500	3500	3400	3400
177	3500	3500	3600	3500	3300	3800	3500	4000	3900
178	3200	3700	3500	3800	9300	4000	3500	3800	3900
179	3700	3800	3500	3800	6500	4000	4200	3600	3500
180	3800	4000							
181									
182									
183									
184									
185									
186									
187									
188									
189									
190	3400	3600	3600	3600	3300	3200	3400		
191	3600	3700	3800	3400	3300	3400	3600		
192	3400	3600	3400	3600	3500	3500	3600		
193	3700	3600	3200	3500	3700	3700	3500		
194	3600	3600	3500	3600	3600	3400	3900		
195	3200	3700	3500	3500	3800	3600	4700		
196	3300	3500	5700	3500	3900	4200	3800		
197	3400	3300	3200	3600	3700	4800	3600		
198	3500	3300	3200	3400	3300	3700	3500	3600	3500
199	3500	3500	3300	3400	3400	3800	3200	3400	3400
200	3200	3200	3000	3300	3500	3200	3200	3400	3500
201	320	3300	3200	3200	3500	3100	3500	3500	3300
202	3000	3400	3200	3100	3400	3200	3400	3300	3600
203	3300	3000	3200	3100	3300	3000	3400	3400	3500
204	3300	3300	3300	3100	3300	3200	3400	3600	3500
205	3400	3400	3400	3400	3400	3500	3700	3400	3000
206	3400	3500	3300	3400	3500	4500	3600	3500	3500
207	3300	3400	3500	3400	3500	3400	3600	3600	3500
208	3500	3400	3600	3600	3300	3200	3700	3600	3500
209	3600	3600	4200	3600	3500	3400	3700	3500	3400
210	3400	3600	3400	3700	3500	3700	3700	3500	3500
211	3200	3500	3400	3500	3500	3500	3400	3200	3300
212	3200	3300	3600	3600	3400	3400	3400		
213	3400	3300	3500	3400	3300	3600			
214	3200	3500	3600						
215	3300	3600							
216	3600								
217									

Walk Over Surface Scan

218										
219										
220										

Walk Over Surface Scan

Coordinates East / North	150	151	152	153	154	155	156	157	158
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
135									
136									
137									
138									
139									
140									
141									
142									
143									
144									
145	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
146	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
147	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
148	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
149	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
150	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
151	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
152	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
153	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
154	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
155	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
156	drive	drive	drive	drive	drive	drive	drive	tank	tank
157	drive	drive	drive	drive	drive	drive	drive	tank	tank
158	drive	drive	drive	drive	drive	drive	drive	tank	tank
159	drive	drive	drive	drive	drive	drive	drive	tank	tank
160	drive	drive	drive	drive	drive	drive	drive	tank	tank
161	drive	drive	drive	drive	drive	drive	drive	tank	tank
162	drive	drive	drive	drive	drive	drive	drive	tank	tank
163	drive	drive	drive	drive	drive	drive	drive	tank	tank
164	drive	drive	drive	drive	drive	drive	drive	tank	tank
165	drive	drive	drive	drive	drive	drive	drive	tank	tank
166	drive	drive	drive	drive	drive	drive	drive	tank	tank
167	drive	drive	drive	drive	drive	drive	drive	tank	tank
168	drive	drive	drive	drive	drive	drive	drive	tank	tank

Walk Over Surface Scan

Coordinates East / North	150	151	152	153	154	155	156	157	158
169	drive	drive	drive	drive	drive	drive	drive	tank	tank
170	2800	2800	2900	2900	3000	3300	3300	3200	3200
171	2900	3000	3100	3000	3200	3200	3200	3000	3000
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3600	3400	3300	3500	3700	3800	3300	3200	3300
176	3300	3600	3400	3500	3500	3500			
177	3400	3900	3400	3700	3500	3500			
178	3700	3700	3500	3600					
179	3600								
180									
181									
182									
183									
184									
185									
186									
187									
188									
189									
190									
191									
192									
193									
194									
195									
196									
197									
198									
199	3500	3700					4500	4300	
200	3700	3800	3600	7000	3800	5500	4600	4100	4200
201	3700	4500	4000	3700	4000	4100	4900	4200	4400
202	3500	3900	4100	3700	4100	4100	3500	4000	4200
203	3800	4200	4000	4100	3600	4200	3800	3600	4200
204	3900	3900	3900	5100	3800	4000	3900	3600	3600
205	3700	3600	3700	4000	4000	3900	3600	3700	3900
206	3500	3600	4200	3600	4000	3800	3600	3400	3600
207	3200	3800	3600	3600	3900	3400	4100	3300	3900
208	3200	3400	3600	3700	4000	3500	4100	3700	
209	3400	3600	3700	3700	3900	rockpile			
210	3200	3300	3700	3900	rockpile				
211	3200	3600	4000						
212									
213									
214									
215									
216									
217									

Walk Over Surface Scan

218									
219									
220									

Walk Over Surface Scan

Coordinates East / North	159	160	161	162	163	164	165	166	167
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
135									
136									
137									
138									
139									
140									
141									
142									
143									
144									
145	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
146	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
147	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
148	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
149	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
150	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
151	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
152	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
153	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
154	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
155	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
156	tank	tank	tank	tank	tank	tank	tank	tank	
157	tank	tank	tank	tank	tank	tank	tank	tank	
158	tank	tank	tank	tank	tank	tank	tank	tank	
159	tank	tank	tank	tank	tank	tank	tank	tank	
160	tank	tank	tank	tank	tank	tank	tank	tank	tar
161	tank	tank	tank	tank	tank	tank	tank	tank	3700
162	tank	tank	tank	tank	tank	tank	tank	tank	3900
163	tank	tank	tank	tank	tank	tank	tank	tank	4400
164	tank	tank	tank	tank	tank	tank	tank	tank	5500
165	tank	tank	tank	tank	tank	tank	tank	tank	8200
166	tank	tank	tank	tank	tank	tank	tank	tank	4700
167	tank	tank	tank	tank	tank	tank	tank	tank	4000
168	tank	tank	tank	tank	tank	tank	tank	tank	4000

Walk Over Surface Scan

Coordinates East / North	159	160	161	162	163	164	165	166	167
169	tank	tank	tank	tank	tank	tank	tank	tank	4700
170	3500	3300	3300	3400	3800	3500	3500	3500	3500
171	3500	3400	3400	3200	3800	3300	3400	3600	3200
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3500	3200	3500	3400	3200	3200	3200	3600	3200
176	3600	3500	3700	3200	3000	2200	3300	3400	3200
177	3300	3500	3400	3400	3000	3300	3300	3500	3500
178	3500	3700	3300	3500	3300	3400	3400	3500	3900
179	3200	3500	3500	3800	3300	3400	3400	3500	4100
180	3200	3400	3600	3400	3300	3500	3500	4200	3800
181	3200	3500	3300	3400	3300	3500	3500	3600	3700
182	3400	3500	3500	3300	3400	3500	3500	3700	3500
183	3500	3400	3400	3800	3400	3400	3500	3500	3500
184	3500	3400	3500	3500	3500	3700	3500	3500	3500
185	3400	3400	3400	3500	3600	3500	3400	3500	3500
186	3300	3300	3700	4000	3700	3600	3500	3600	3700
187	3200	3500	3800	4000	3500	3700	3400	3700	3700
188	3200	4000	3700	4000	4000	3700	3300	3800	4000
189	3400	3900	4000	4100	3500	3800	3500	3800	3500
190	4000	3600	3500	3600	4000	3800	4100	3900	4100
191							4200	4100	4100
192							3800	4100	4100
193							3800	3800	4000
194							3400	3700	4200
195							3800	4100	4100
196							4300	3900	4200
197							4600	4000	4900
198							4100	3900	4300
199							3800	3900	4100
200	4600	4200	4100	4000	4100	3800	4100	3600	4200
201	4500	5000	3700	3200	3700	3500	3500	3000	3500
202	4300	4200	3700	3200	3600	3500	3500	3500	3700
203	3800	3400	3500	3300	3300	3500	3300	3300	
204	3600	3600	3600	[illegible]	3300	3400	3400		
205	3600	3300	3400	3300	3400	3500			
206	3500	3600	3300	3500	3400	3600			
207	3500	3800			3500	3400			
208									
209									
210									
211									
212									
213									
214									
215									
216									
217									

Walk Over Surface Scan

218
219
220

Walk Over Surface Scan

Coordinates East / North	168	169	170	171	172	173	174	175	176
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
135									
136									
137									
138									
139									
140									
141									
142									
143									
144									
145									
146									
147									
148									
149									
150									
151									
152									
153									
154									
155									
156									
157									
158									
159									
160	tar	tar	tar	tar	tar	tar	sw	sw	sw
161	3200	3200	3000	3000	3200	3000	sw	sw	sw
162	3400	3500	3200	3200	3500	3100	sw	sw	sw
163	3400	3500	3700	3400	3500	3200	sw	sw	sw
164	3300	3700	3200	3500	3500	3000	sw	sw	sw
165	3500	3600	3200	3400	3600	3500	sw	sw	sw
166	3800	3600	3500	3600	4000	3800	sw	sw	sw
167	3600	3600	3400	3800	3600	3800	sw	sw	sw
168	3600	3600	3200	3700	3900	3300	sw	sw	sw

Walk Over Surface Scan

Coordinates East / North	168	169	170	171	172	173	174	175	176
169	3500	3500	3200	3200	3500	3200	sw	sw	sw
170	3200	3400	3400	3000	3200	3200	sw	sw	sw
171	3200	3100	3500	3100	3300	3000	sw	sw	sw
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3000	3000	3000	2900	3100	3000	3200	3700	3000
176	2900	3000	3000	2900	3200	3000	3300	3200	3000
177	3000	3500	3000	3200	3200	3200	3200	3300	3400
178	3000	3700	3000	3200	3200	3800	3300	3700	4000
179	3200	3800	3200	3300	3400	3900	3700	3500	3400
180	4000	4500	3900	4000	3200	3400	3400	3500	3800
181	3500	4000	3700	3600	3200	3600	3700	4000	3900
182	3500	4000	3700	4000	3400	3600	3500	3600	4000
183	3500	4000	3500	3500	3400	3800	4000	4000	3800
184	3700	3600	3400	3400	3700	4200	3900	4100	3700
185	3900	3500	3500	3400	3900	3900	3800	4100	3900
186	4000	3600	3400	3800	5300	3800	4000	3800	3700
187	4100	3700	3300	3800	4000	3800	3800	3600	3500
188	4000	3700	4000	4000	4000	4000	3500	3700	4400
189	4200	3800	3900	3800	3900	3800	5500	3800	7500
190	3800	4400	3900	4100	3800	3900	3800	4000	3700
191	8000	4000	4000	3900	3900	3900	3800	3900	3900
192	4400	3900	3800	3700	3800	3800	3900	4100	4100
193	4000	3900	3900	3700	3800	3900	4200	4200	3800
194	4100	4000	4000	3400	3700	3800	3900	4000	3900
195	3800	3900	4000	3500	3700	3400	3700	3700	3800
196	3900	4200	3900	3400	3600	3900	3600	3600	4100
197	3900	4000	3600	3400	3400	3400	3800	3400	3800
198	3300	3500	3300	3900	3800	3600	3800	3600	rockpile
199	3400	3300	3100	rockpile	3700	3600	rockpile	rockpile	rockpile
200	3300	3200	3300	rockpile	4000	rockpile	rockpile	rockpile	
201	3700			rockpile	rockpile	rockpile			
202	3800								
203									
204									
205									
206									
207									
208									
209									
210									
211									
212									
213									
214									
215									
216									
217									

218									
219									
220									

Walk Over Surface Scan

Coordinates East / North	177	178	179	180	181	182	183	184	185
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
135									
136									
137									
138									
139									
140									
141									
142									
143									
144									
145									
146									
147									
148									
149									
150									
151									
152									
153									
154									
155									
156									
157									
158									
159									
160	3000	3200	3400	3300	3400	3500	3300	3500	3500
161	3300	3100	3200	3200	3300	3300	3400	3700	3600
162	3000	3000	pit	pit	pit	pit	pit	pit	pit
163	3200	3000	pit	pit	pit	pit	pit	pit	pit
164	3000	3000	pit	pit	pit	pit	pit	pit	pit
165	3200	3000	pit	pit	pit	pit	pit	pit	pit
166	3200	3200	pit	pit	pit	pit	pit	pit	pit
167	3400	3200	pit	pit	pit	pit	pit	pit	pit
168	3000	3000	pit	pit	pit	pit	pit	pit	pit

Walk Over Surface Scan

Coordinates East / North	177	178	179	180	181	182	183	184	185
169	3000	3000	pit	pit	pit	pit	pit	pit	pit
170	3100	3500	pit	pit	pit	pit	pit	pit	pit
171	3000	3400	pit	pit	pit	pit	pit	pit	pit
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3000	3000	3200	3000	3100	3200	3000	3200	3200
176	3000	3000	3300	3100	3100	3000	3000	3400	3100
177	3000	3300	3000	3200	3200	3200	3100	3500	3000
178	3100	3500	3500	3200	3300	3500	3100	3300	3200
179	3100	3500	3500	3400	3200	3400	3000	3500	3300
180	3800	4100	3600	3400	3400	3500	3400	3400	3700
181	4100	4200	4000	4000	3400	3300	3500	3400	3200
182	3700	4100	4400	4400	3500	3300	3500	3500	3200
183	3900	4100	4200	4200	3800	3300	3400	3400	3200
184	3900	3800	3800	4000	3700	3300	3400	3000	3300
185	4200	3800	3700	3800	3200	3500	3300	3200	3200
186	3800	3800	3800	3700	3300	3300	3300	3400	3300
187	3900	3800	3800	3900	3500	3400	3300	3600	3200
188	4200	4100	4000	4100	3500	3500	3400	3600	3200
189	4400	4400	4100	4000	3500	3600	3200	3500	3200
190	4000	4200	4400	4200	3500	3400	3400	3300	3300
191	4000	4100	3800	4000	3700	3500	3500	3300	3200
192	4000	4100	4000	4600	3700	3500	3200	3500	
193	4400	4000	3800	4100	3400	3500	3200	3500	
194	4200	3800	4200	3800	3500	3500			
195	3900	3900	4500	3500	3700				
196	3600	3700	3900	3700					
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Walk Over Surface Scan

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161	3400	3200	3100	3000	3200	3100	3300	3300	3100
162	pit	pit	pit	3000	3200	3000	3400	3400	3000
163	pit	pit	pit	3000	3300	3200	3400	3400	3000
164	pit	pit	pit	3200	3500	3200	3000	3500	3400
165	pit	pit	pit	3300	3300	3200	3100	3500	3300
166	pit	pit	pit	3200	3400	3400	3200	3100	3400
167	pit	pit	pit	3100	3400	3700	3400	3200	3400
168	pit	pit	pit	3200	3300	3400	3300	3200	3300

Walk Over Surface Scan

Coordinates East / North	186	187	188	189	190	191	192	193	194
169	pit	pit	pit	3200	3300	3400	3300	3300	3200
170	pit	pit	pit	3400	3000	3400	3200	3300	3100
171	pit	pit	pit	3200	3200	3000	3500	3400	3300
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3000	3000	3000	3000	3200	3000	3000	3300	3000
176	3000	3000	3200	3000	3000	3300	3200	3400	3000
177	3000	3000	3200	3000	3000	2900	3300	3700	3000
178	3200	3000	3000	3000	3100	2900	3400	3400	3200
179	3300	3100	3000	3000	3000	3000	3300	3300	3100
180	[illegible]	3200	3100	3000	3000	3000	3000	3500	3200
181	3000	3000	3000	3000	3100	2900	3000	3500	3200
182	3900	3100	3300	2900	3000	2800	3000	3300	3300
183	3800	3200	3200	2900	3000	3000	3000	3000	3000
184	3200	4500	3400	3000	3000	3000	3200	3000	3000
185	3300	3600	3500	3000	3000	3100	3100	3000	2800
186	3500	3500	3400	3000	3200	3200	3200	3000	2800
187	3000	3500	3100	3700	3200	3200	3400	3000	3200
188	3000	3200	3200	3200	3000	3300	3300	3100	
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Walk Over Surface Scan

Coordinates East / North	195	196	197	198	199	200	201	202	203
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161	3500	3500	3500	3500	3700	3700	3700		
162	3500	3300	3400	3500	3200	3500	4000	4000	
163	3200	3400	3500	3400	3400	4000	3900	3500	3500
164	3000	3500	3500	3300	3500	4000	3500	3500	3800
165	3000	3400	3400	3300	3400	3900	3500	3500	3800
166	3200	3300	3300	3400	3300	3500	3500	3600	3500
167	3100	3500	3800	3300	3300	3500	3600	3300	3300
168	3200	3500	3400	3100	3200	3000	3200	3400	3400

Walk Over Surface Scan

Coordinates East / North	195	196	197	198	199	200	201	202	203
169	3000	3500	3300	3000	3200	3400	3000	3400	3200
170	3100	3400	3300	3300	3100	3200	3100	3300	3200
171	3200	3200	3300	3200	3000	3200	3200	3100	3200
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	v	sw
175	3200	3000	3100	3000	3100		163000	3000	
176	3000	3000	3200	3000	3100		3000	3000	
177	3100	2800	3000	3200	3200		3100	4000	
178	3100	3000	3000	3000	3200		3100		
179	3200	3000	3000	3100	3000		3200		
180	3200	3200	3200	3000	3000	3100	3200	3200	
181	3200	3300	3100	3400	2800	3200	3100		
182	3200	3500	3300	3300	3000	3200			
183	3100	3400	3200	3200	3306				
184	3100	3400	3200	3500					
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172	sw	sw
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ORISE

December 10, 1992

Mr. Jerome Roth
Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

SUBJECT: CONFIRMATORY RADIOLOGICAL SURVEY PLAN FOR THE TEXAS INSTRUMENTS INCORPORATED BURIAL SITE, ATTLEBORO, MASSACHUSETTS

Dear Mr. Roth:

Enclosed is a copy of the subject document. As discussed in our earlier phone conversation, on-site activities have been scheduled for December 15-16, 1992.

If there are any questions, please direct them to me at (615) 576-3355 or Michele Landis at (615) 576-2908.

Sincerely,

Armin Jaberaboansari
Project Leader
Environmental Survey and
Site Assessment Program

AJ:tte

cc: J. Parrott, NRC/NMSS, 6H3
T. Mo, NRC/NMSS, 6H3
D. Tiktinsky, NRC/NMSS, 6H3
J. Swift/F. Brown, NRC/NMSS, 6H3
J. Kinneman, NRC/Region I
M. Landis, ORISE
J. Berger, ORISE
PMDA, 6E6
File/205

CONFIRMATORY SURVEY PLAN FOR THE TEXAS INSTRUMENTS INCORPORATED BURIAL SITE, ATTLEBORO, MASSACHUSETTS

SITE HISTORY AND DESCRIPTION

The Texas Instruments Incorporated site at Attleboro, Massachusetts, was owned and operated by Metals and Controls (M&C) until 1959, at which time M&C merged with Texas Instruments, Inc. The General Plate Division of M&C began processing nuclear materials in 1952, and between 1952 and 1959 fabricated uranium foils for reactor experiments and fuel components and complete reactor fuel cores for the U.S. Navy. Source material license D-549 was issued permitting acquisition and title to not more than 22.7 kg (50 pounds) of refined source material for use in the production of uranium foils; additional source material was acquired and used under contract with U.S. Government. Special nuclear materials license No. SNM-23 was issued, permitting acquisition and title to 110 kg of enriched uranium for fabrication of the fuel components and cores. After the merger in 1959, Texas Instruments continued fabricating reactor fuel cores, primarily for research and production reactors. Also, source materials, i.e., natural uranium and thorium, were still being fabricated for sale to various corporations.

A 1964 Texas Instruments health and safety manual states that uranium- and thorium contaminated noncombustible scrap material and machinery were collected in 55-gallon steel drums and were disposed of through authorized agencies, or were buried on-site in compliance with 10CFR20.304. Burials were made from 1958 to 1961, and the burial site was closed in 1967. Records indicate two known burials, one in 1958 of contaminated ductwork, and one in 1961 of 28.4 mCi of enriched uranium noncombustible scrap. Work with nuclear material was gradually reduced beginning in 1968 and was terminated in 1974. The interior of the facility was decontaminated and released for unrestricted use by the Nuclear Regulatory Commission (NRC) in 1983.

Prepared by the Environmental Survey and Site Assessment Program of Oak Ridge Institute for Science and Education, Oak Ridge, TN, under interagency agreement (NRC Fin. A-9076) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy.

The Texas Instruments Inc. Facility, Attleboro, MA is located in North Attleboro, approximately 48 kilometers south of Boston. The Radiological Site Assessment Program, predecessor to the Environmental Survey and Site Assessment Program, of the Oak Ridge Associated Universities (ORAU) conducted a radiological survey of portions of the facility's outdoor areas during April and May, 1984. The results of that survey indicated several areas with surface and/or subsurface uranium concentrations in excess of guidelines.[1]

Texas Instruments Inc. has completed the cleanup and final survey activities at the burial site located between Buildings 11 and 12. The excavated area at the burial site is approximately 1600 m^2 and the average depth of the excavated area is approximately 1.5 meters. The U.S. Nuclear Regulatory Commission, Region I Office, has requested that the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) perform an independent confirmatory survey of the excavated area at the burial site.

OBJECTIVE

The objective of a confirmatory survey is to provide independent document reviews and radiological data, for use by the NRC in evaluating the adequacy and accuracy of the licensee's radiological status report, relative to established guidelines.

RESPONSIBILITY

Work described in this survey plan will be performed under the direction of Michele Landis, Project Manager and Armin Jaberaboansari, Project Leader with ESSAP. The cognizant site supervisor has the authority to make appropriate changes to the survey procedures as deemed necessary. After consultation with the NRC site representative, the scope of the survey plan may be altered. Deviations to the survey plan or procedures will be documented in the site log book.

DOCUMENT REVIEW

ESSAP will review the licensee's radiological survey data. Procedures and methods utilized by the licensee will be reviewed for adequacy and appropriateness. The post-remedial action data will be reviewed for accuracy, completeness and compliance with guidelines.

PROCEDURES

Survey activities will be conducted in accordance with the ORISE ESSAP Survey Procedures Manual. Specific procedures applicable to this survey are listed on page 4 of this survey plan.

REFERENCE GRID

A 10 m grid was established during ESSAP's radiological survey of the area in 1984 which was subsequently used by the licensee. The same reference grid will be used in this survey.

SURFACE SCANS

Surface scans of the excavated and the surrounding area (approximately 10,000 m^2) will be performed using NaI detectors coupled to countrate meters with audible indicators. Areas of elevated direct radiation will be noted for further investigation.

SOIL SAMPLING

Surface soil samples will be obtained from ten randomly selected grid line intersections. Ten to fifteen samples will be obtained from the overburden piles. Additional soil samples will be obtained from locations of elevated direct radiation, identified by surface scans, or at specific locations based on previous ESSAP and/or licensee's survey results.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data will be returned to ORISE's ESSAP laboratory in Oak Ridge, TN for analysis and interpretation. Soil samples will be analyzed by gamma spectrometry. Approximately 10% of the soil samples will be analyzed by alpha spectroscopy for isotopic uranium.

The data generated will be compared with the licensee's documentation and NRC guidelines established for release to unrestricted use. Results will be presented in a report and provided to the NRC for review and comment. Data and samples collected as a part of this survey will be archived by ESSAP.

GUIDELINES

The soil concentration guideline, for enriched uranium, is 30 pCi/g.

TENTATIVE SCHEDULE

Measurement and Sampling	December 14-15, 1992
Sample Analysis	January, 1993
Draft Report	April, 1993

LIST OF CURRENT PROCEDURES

Applicable procedures from ORISE/ESSAP Survey Procedures Manual include:

Section 5.0 Instrument Calibration and Operational Check Out

- 5.1 General Information
- 5.2 Electronic Calibration of Ratemeters
- 5.3 Gamma Scintillation Detector Check Out and Cross Calibration
- 5.4 Alpha Scintillation Detector Calibration and Check-Out

REFERENCES

1. "Radiological Survey of the Texas Instruments Site, Attleboro, Massachusetts," Oak Ridge Associated Universities, January, 1988.

2. "Post Excavation Radiological Survey Report, Texas Instruments Incorporated Burial Site, Attleboro, Massachusetts," Creative Pollution Solutions, Inc., November 28, 1992.

3. "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source or Special Nuclear Material," U.S. Nuclear Regulatory Commission, Division of Fuel Cycle and Material Safety, Washington D.C., August 1987.

APPENDIX A
COST ESTIMATE*
CONFIRMATORY SURVEY
FOR THE TEXAS INSTRUMENTS
INCORPORATED BURIAL SITE,
ATTLEBORO, MASSACHUSETTS

Plan Preparation - $1,300

Plan preparation includes the following activities: document reviews, survey plans, trip planning and the cost and time estimates.

On Site Activities - $18,300

On site activities will include 6 man days at the site performing the following: gamma scans and soil sampling.

The on-site expenses also include trip preparation (equipment calibration and packing), travel to and from the site (airlines and rental vehicles), hotel expenses, and per diem, unpacking equipment, and logging in samples.

Sample Analysis - $6,600

Includes analysis of soil samples by gamma spectrometry and analysis of selected samples by alpha spectroscopy for isotopic uranium.

Report Preparation - $7,700

The report preparation will include the following activities: tabulation of data, illustration, and writing and reviewing the final draft, final or interim report, word processing and reproduction.

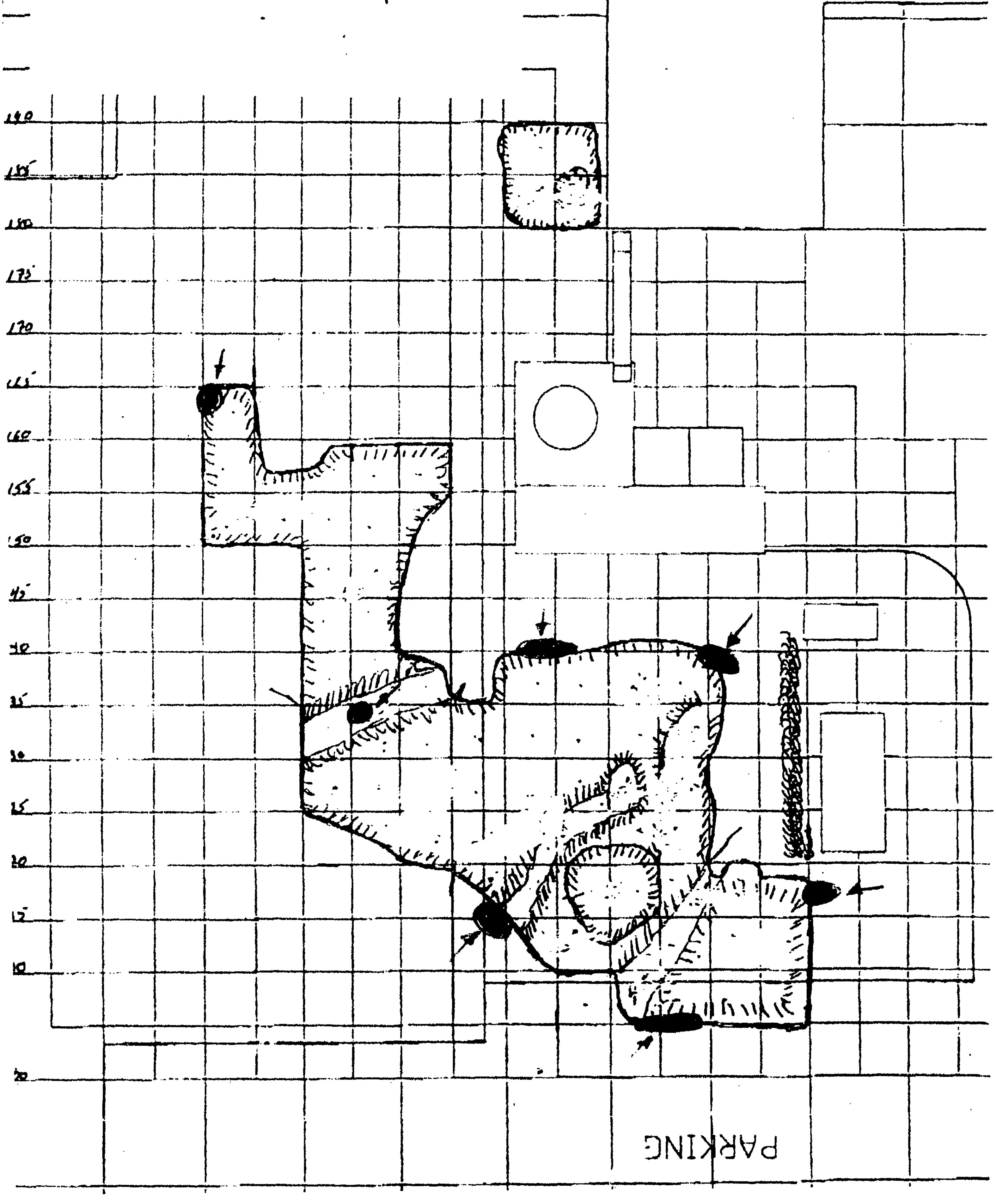
Total Cost Estimate $3[illegible],900

*Estimates are for survey of all areas listed in the NRC Request for Technical Assistance received by ESSAP. Reduction or increase in the number of areas being surveyed would result in changes to the original estimate in the "on site activities" and "sample analyses" categories. Due to the nature of the survey, this estimate is a best guess; site and weather conditions and survey findings may change the scope of the survey and increase or decrease the cost estimate. The NRC site representative will be notified if major changes in the scope of the survey need to be made.

Attachment 3

EXCAVATION AREA AS OF 11/6/92

APPROXIMATE ELEVATIONS SHOWN



NRC FORM 591 PART 1

SAFETY INSPECTION

U.S. NUCLEAR REGULATORY COMMISSION

1. LICENSEE	2. REGIONAL OFFICE
	REGION III U.S. NUCLEAR REGULATORY COMMISSION 799 ROOSEVELT ROAD GLEN ELLYN, IL 60137

3. DOCKET NUMBER(S)	4. LICENSE NUMBER(S)	5. DATE OF INSPECTION

LICENSEE:

[illegible] compliance with the Nuclear Regulatory [illegible] selective examinations of procedures [illegible] as follows:

☐ 1. [illegible]

☐ 2. [illegible] We have no further questions [illegible]

☐ 3. [illegible] This form is a **NOTICE OF VIOLATION**, [illegible]

☐ A. [illegible] was not properly posted to [illegible] 34.42

☐ B. [illegible] of sealed sources were not performed [illegible] Number [illegible]

☐ C. Records of [illegible] were not properly maintained [illegible] License Condition Number [illegible]

☐ D. [illegible]

☐ E. [illegible] were not [illegible] in accordance with [illegible] License Condition Number [illegible]

☐ F. [illegible]

[illegible] 7001 [illegible]

I hereby state that [illegible] the items of noncompliance identified above [illegible] will be submitted unless required by the NRC.

SIGNATURE - LICENSEE	DATE	[illegible]	DATE

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 70-33/92-04

Docket No. 70-33

License No. SNM-23 Priority 1 Category UHFF

Licensee: Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02702

Facility Name: HFIR Project

Inspection At: Attleboro, Massachusetts

Inspection Conducted: December 14-16, 1992

Inspector: [signature] [date]
[illegible], Project Engineer
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Branch
Division of Radiation Safety and Safeguards
Date

Approved by: [signature] [date]
W. J. Pasciak, Chief
Facilities Radiation Protection Section
Facilities Radiological Safety and Safeguards Branch
Division of Radiation Safety and Safeguards
Date

Areas Inspected: Special, announced inspection by a region based inspector to observe a survey conducted by the NRC contractor, the Oak Ridge Institute for Science and Education (ORISE), to verify survey results provided by the licensee.

Results: Preliminary results of the ORISE survey indicated that the licensee appeared to have completed cleanup of the bottom of the excavated area in an appropriate manner. However, elevated radiation levels obtained on the walls of the excavated areas indicate that not all radioactive material, above the NRC approved guidance values, had been removed. No safety concerns or violations of regulatory requirements were identified.

DETAILS

1.0 Individuals Contacted

M. Elliot, Manager, Environmental Engineering
M. Griffin, Project Manager
T. Gutman, Consultant
W. Lorenzen, Health Physicist
J. O'Donnell, Corporate Health Physicist
W. Schuele, Attleboro Site Manager
F. V. ale, Jr., Manager, Environmental Engineering/Industrial Hygiene

Other licensee representatives, employees and remediation contractor employees were also interviewed during this inspection.

2.0 Background

On August 26, 1992, NRC issued Amendment No. 16 to Facility License SNM-23. This amendment authorized the licensee to perform remediation of the on-site low level radwaste burial site in accordance with the "Remediation Plan for the Identified Building 12 Burial Area" (Remediation Plan) and the "Radiological Health and Safety Plan dated July 30, 1992." The licensee performed the remediation activities between August 27 and November 13, 1992 and provided the NRC with the "Post Excavated Radiological Survey Report" dated November 28, 1992. This report, provided as Attachment 1, was used as the basis for preparation of the "Confirmatory Radiological Survey Plan for the Texas Instruments Incorporated Burial Site, Attleboro, Massachusetts" which was submitted to the NRC Region ' office by the NRC contractor, the Oak Ridge Institute for Science and Education (ORISE) by letter dated December 10, 1992 (see Attachment 2). This plan was approved by the NRC and the confirmatory survey was conducted December 14-16, 1992.

3.0 Conduct of the Verification Survey

ORISE personnel conducted the verification survey discussed in Paragraph 2.0. Available surfaces of the excavated and adjacent areas were scanned using gamma scintillation or GM detectors. Soil samples were taken from randomly selected locations within the excavated areas. Additional soil samples also were taken within the excavated areas at locations that exhibited elevated radiation readings during the scanning, or were identified as elevated in the licensee's report. Each of these samples was split with the licensee and will be analyzed to verify the licensee's analytical ability. The results will be included in correspondence to the licensee when the analyses are completed.

4.0 Preliminary Survey Results

Preliminary results indicated that the licensee appeared to have completed cleanup of the bottom of the excavated area in an appropriate manner. However, elevated radiation levels (ranging from 2½ to 40 times background) identified on the walls of the excavation (see Attachment 3) indicated that radioactive material, above the 30 picocuries total uranium per gram of soil guidance value contained in the NRC-approved Remediation Plan, may not have been removed from the burial site. As a result, the licensee was requested by the inspector to perform additional remediation activities.

5.0 Additional Actions Required

5.1 Licensee

Upon completion of the additional remediation activities, the licensee is expected to resurvey the excavated areas and provide the NRC with a revised final survey report of the remediated area.

5.2 NRC

Upon receipt of the licensee's final survey report, the NRC contractor will visit the site, resurvey the applicable areas and will perform final confirmatory surveys on the surface of the remediated area.

6.0 Exit Interview

The inspector met with the licensee representatives denoted in Paragraph 1.0 at the conclusion of the inspection on December 16, 1992. The ORISE team leader and the inspector summarized the results of the confirmatory survey conducted by ORISE personnel. The inspector thanked the licensee for providing the survey team logistical support and backup when required.

During the exit interview, the inspector provided the licensee with guidance in regard to soil sample result averaging. It was stated that since the soil samples were taken at the grid block intersections, the average residual uranium value for each adjacent four grid blocks also had to meet the 30 picocuries total uranium per gram of soil criteria. In addition, the licensee was reminded that the results of groundwater monitoring for total uranium had to be incorporated into the final report.

TEXAS INSTRUMENTS

November [illegible], 1992

OVERNIGHT MAIL

Mr. Terry Roth
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406-1415

Dear Mr. Roth:

The attached report is being submitted to the U.S. Nuclear Regulatory Commission (NRC) by Texas Instruments Incorporated (TI), Materials & Controls Group located in Attleboro, Massachusetts. It summarizes the results of radiological surveys performed on TI property at the former burial site location near [illegible], MA.

The radiological survey report documents the effectiveness of remediation activities carried out in accordance with a plan submitted to the NRC on July [illegible], 1992 and subsequently approved by the NRC on August 26, 1992.

As we discussed during a site inspection on November 5, 1992, the excavated area will remain exposed to facilitate confirmatory sampling by Oak Ridge Institute of Science and Education.

If there are any questions or concerns regarding the enclosed report, please do not hesitate to call me at (508) [illegible]-1809.

Sincerely yours,

[illegible]

Michael J. Elliott
Environmental Engineering Manager

Attachment

cc: Mr. James D. Berger, ORISE
Mr. Daniel V. [illegible], Jr., TI Dallas
Mr. Francis J. [illegible], Jr., TI Attleboro

POST EXCAVATION RADIOLOGICAL SURVEY REPORT

TEXAS INSTRUMENTS INCORPORATED
BURIAL SITE
Attleboro, Massachusetts

Prepared by

Creative Pollution Solutions, Inc.

11/28/92

INTRODUCTION

The post excavation survey for the Texas Instruments Incorporated Building 12 Burial Site was designed in accordance with the Remediation Plan (approved 8/29/92). The remediation of the site included at least all areas outlined in the initial plan. When necessary, additional areas were excavated. The average depth of the excavated area is approximately 1.5 meters. In many areas groundwater was reached. Excavated material was either processed to remove aggregate and/or staged for disposition. A volume of approximately 90,000 ft^3 of material was excavated of which approximately 58,000 ft^3 was sent to EnviroCare of Utah via rail for final disposition. Figure 1 in Appendix A in this report shows the area of excavation. The excavated area will not be backfilled (except around an exposed fire hydrant) until after ORISE completes necessary sampling to confirm the post excavation surveys.

The post excavation survey consists of two parts: a walkover surface scan of the affected area and surface soil sampling of the excavated area.

SURFACE SOIL SAMPLING WITHIN THE EXCAVATED AREA

The soil sampling plan for the excavated area consisted of surface soil samples at each corner and in the middle of each 10 meter x 10 meter grid cell. Wherever possible surface (0-15cm) soil samples of approximately 1 kg each were collected at these points. In some cases excavation equipment had to be used to extract a sample from beneath the standing water. A map of sample locations along with sample results are shown in Appendix A. All of the samples from the excavated area were analyzed using gross alpha screening. The average of all gross alpha screening samples within the excavated area is less than 30 pCi/g (Note: 30 counts/10 min approximately equals 30 pCi/g as correlated with Babcock and Wilcox gamma spectroscopy data (see Appendix C). The gross alpha screening methodology is described in Appendix B.

SURVEY OF AFFECTED AREA

A walkover surface scan using portable NaI(Tl) gamma scintillation detectors was conducted at 1 meter intervals over the entire affected area. The affected areas consist of any areas in the defined exclusion area (see Health and Safety Plan, 8/92). The grid system established in the ORAU Radiological Survey (1985) was used. A walkover of the excavated area was not possible because of the elevated water table and accumulation of surface water run-off in this area. The walkover survey data is provided in Appendix D.

These surveys were conducted with a Ludlum model 44-2 1" by 1" NaI(Tl) probe coupled to a Ludlum model 2221 Portable Scaler/ratemeter. The purpose of these surveys was to determine and locate any radiological anomalies. The NaI type detectors are inherently highly energy

dependent, but are useful due to its general greater sensitivity. The use of such instruments are well suited for the identification of anomalies, however, care must be given when interpreting the response in terms of exposure rates (μR/h). In this regard, a linear response check was performed using a ^{60}Co Source, the results of which are included within Appendix D. The energy distribution of photons encountered in field are characterized by a much lower photon energy distribution which is further confounded by a large degradation of this spectral distribution due to the source incorporation in a soil matrix. The interpretation of exposure rate from this instrument, short of an exhaustive study, is to assume from previous studies (ORAU) that a nominal background exposure rate of 11 μR/h exists and that a the NaI(Tl) background response correlates to this value. Even under this presumption certain errors will exist such as variation of background with time. Not withstanding a response factor from 0.0039 to 0.0034 with an average of 0.0037 is established.

APPENDIX A

EXCAVATION FLOOR SAMPLING
ALPHA SCREENING RESULTS

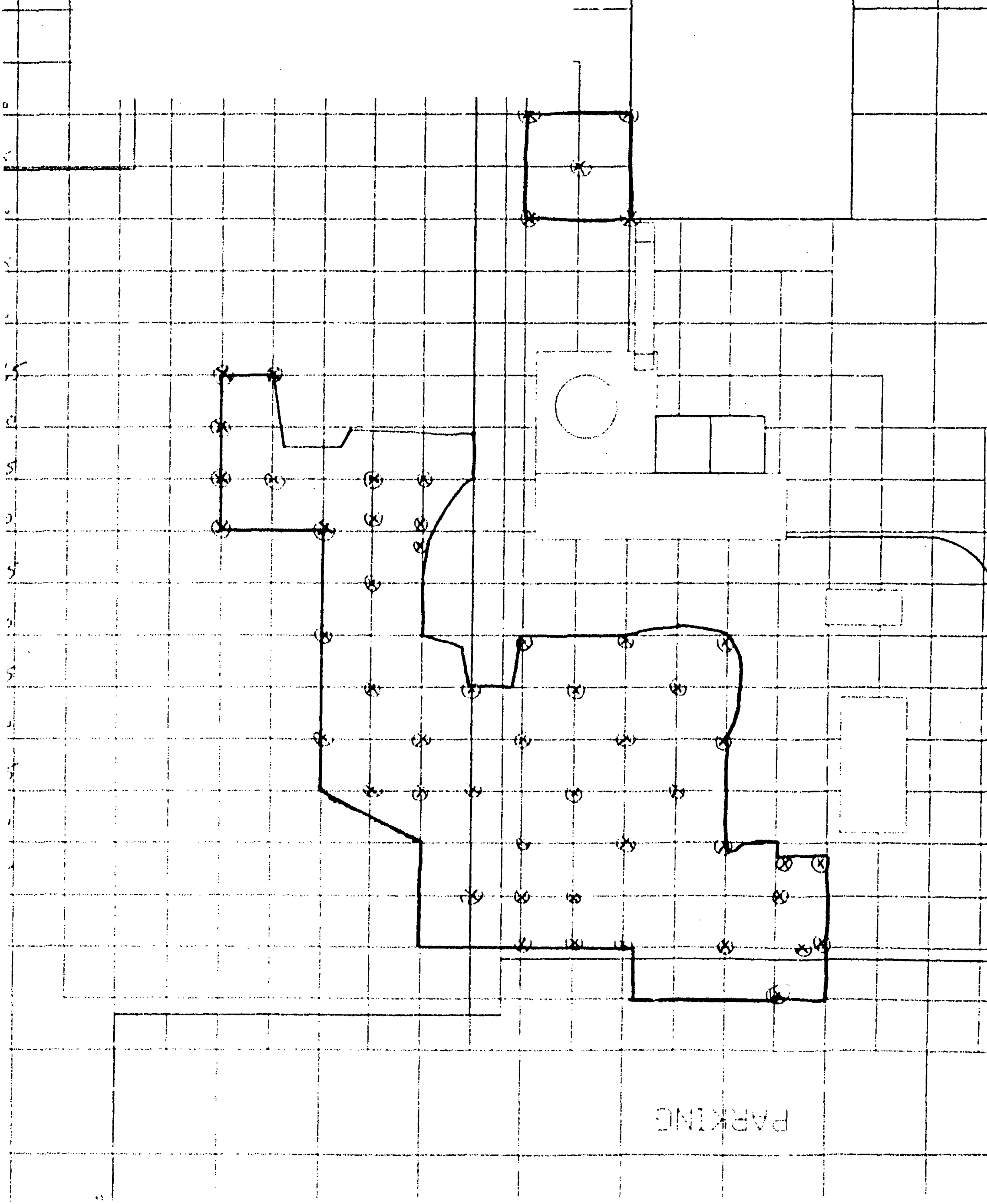
North	East	Alpha Screen (pCi/g)
200	150	29
200	155	7
200	160	16
200	165	19
195	155	11
195	165	10
190	130	17
190	140	12
190	150	28
185	125	**45**
185	135	**50**
185	145	**8**
185	152	**50**
185	155	**21**
180	125	15
180	130	14
180	150	4
180	152	48
180	155	11
175	115	14
175	125	12
175	135	14
170	110	53
170	115	22
170	120	34
170	130	7
170	140	16
170	180	22
170	190	46

North	East	Alpha Screen (pCi/g)
165	110	34
165	115	18
165	125	11
165	135	22
165	185	30
160	110	22
160	120	17
160	130	27
160	140	24
160	180	33
160	190	23
155	125	12
155	135	25
150	110	26
150	120	27
150	130	21
150	140	55
145	105	9
145	115	18
145	120	17
142	110	24
140	110	42
140	120	9

Average of values = 23.10 pCi/g
Standard deviation = 13.23

SURFACE SOIL SAMPLING LOCATIONS

⊗ - Sample Locations



APPENDIX B

ALPHA SCREENING METHODOLOGY

The alpha screening technique employed was gross alpha counting of a soil sample in intimate contact with a ZnS(Ag) detector. Using this method the ZnS(Ag) disc is disposable.

The method employed in the field was as follows:

1) Approximately 1 kg soil sample obtained

2) Sample homogenized by mixing (in larger container if necessary)

3) An aliquot of the homogenized sample is then (approximately 20-40 grams) dried in an oven at about 100° C for approximately 10 minutes. The sample is then allowed to cool.

4) The sample is then sieved and placed in direct contact with the phosphor side of the ZnS dish assembly.

5) The sample is then place in direct contact with a photomultiplier tube and counted for 10 minutes.

The counts obtained have been correlated to both alpha spectroscopy and gamma spectroscopy. The correlation to gamma spectroscopy is attached in Appendix C and the correlation to alpha spectroscopy has been demonstrated in previous reports.

APPENDIX C

COMPARISON OF ALPHA SCREENING AND GAMMA SPECTROSCOPY

Since the post excavation survey results were obtained using alpha screening 10 split samples were sent to both ORISE and an outside laboratory to establish a correlation between the gamma spectroscopy data and the alpha screening data. The comparison with one set of gamma spectroscopy results are shown below.

Notes regarding attached graph:

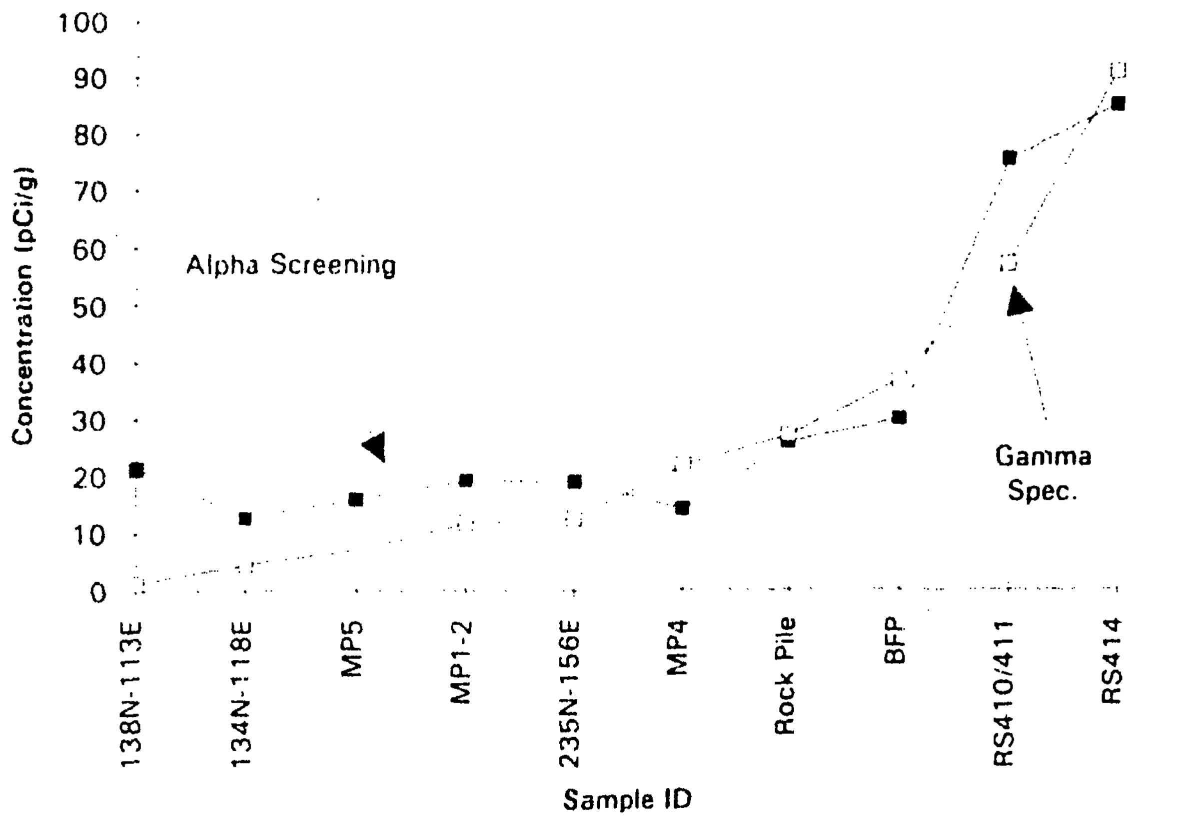
1) alpha screening result is based on an average of 5-10 samples

2) gamma spec data assumed an activity ratio (U-234/U-235) of 22.

Comparison of Alpha Screening and Gamma Spectroscopy for Uranium in Soil

SAMPLE ID	ALPHA SCREEN (TOTAL U pCi/g)	GAMMA SPEC (TOTAL U pCi/g)
138N-113E	21.4	1.25
134N-118E	12.8	4.65
MP5	15.9	7.1
MP1-2	19.2	11.65
235N-156E	19	12.49
MP4	14.2	21.82
Rock Pile	25.8	26.96
BFP	29.9	36.76
RS410/411	75.3	56.99
RS414	85	90.77

Comparison of Alpha Screening and Gamma Spectroscopy for Uranium in Soil



APPENDIX D

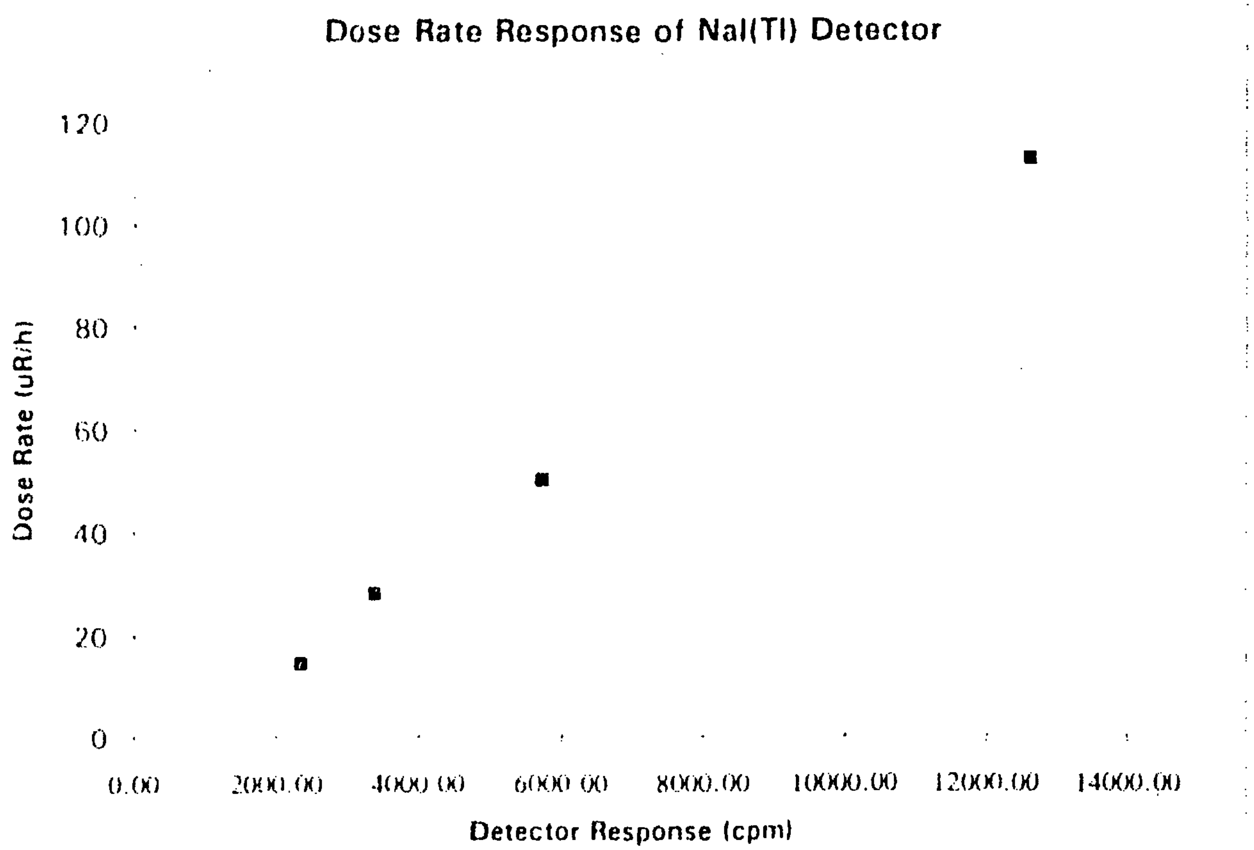
WALKOVER SURVEY RESULTS

NOTE: The attached represents the results of the walk over survey. The results presented are in the units of counts per minute (cpm)

Determination of the Response of the NaI(Tl) Detector for Radiological Field Surveys

	Bkg	2.5 meter	2.0 meter	1.5 meter	1.0 meter
1.00	5206.00	7455.00	8444.00	10938.00	17472.00
2.00	5283.00	7277.00	8564.00	10835.00	17646.00
3.00	5143.00	7441.00	8751.00	11107.00	17738.00
4.00	4959.00	7489.00	8552.00	10797.00	17744.00
5.00	5056.00	7589.00	8418.00	10864.00	17790.00
6.00	5105.00	7602.00	8334.00	10542.00	18064.00
Average	5125.33	7475.50	8510.50	10847.17	17742.33
Exp. Err	113.64	118.39	145.98	185.39	193.97
Th. Err.	71.59	86.46	92.25	104.15	133.20
Chi. Sq.	2.52	1.87	2.50	3.17	2.12

Net Response, cpm	2350.17	3385.17	5721.83	12617.00
Dose Rate, uR/h	14.58	28.13	50	112.5
Calibration Factor, uR/h/cpm	0.0062038	0.0083083	0.0087385	0.0089165



Regression Statistics

Multiple R	0.9962444
R Square	0.9925029
Adjusted R Square	-1.333333
Standard Error	3.7517943
Observations	1

Analysis of Variance

	df	Sum of Squares	Mean Square	F
Regression	4	5590.341138	1397.58528	397.16
Residual	3	42.22788077	14.0759603	
Total	7	5632.569019		

	Coefficients	Standard Error	t Statistic	P-value	Lower 95%	Upper 95%
Intercept	0					
Slope	0.0087835	0.000259572	33.8385201	5E-09	0.0079575	0.00961

Walk Over Surface Scan

Coordinates East / North	105	106	107	108	109	110	111	112	113
120									
121									
122									
123									
124									
125									
126									
127									
128							3200	3200	2500
129						2600	2800	2800	2500
130						2700	2600	2700	3500
131						3000	2800	2800	2900
132				2800	2500	2500	2500	2500	2500
133				2500	2600	3100	3100	3200	2900
134	tar	tar	tar	3000	3000	2800	3000	2800	2800
135	tar	3200	2500	3200	3100	3000	3100	3200	3000
136	tar	2900	3000	3300	3000	3000	3300	3100	3100
137	tar	3000	2900	3000	3100	3000	2900	3300	3200
138	2900	2900	3100	3100	3200	3100	3000	3000	3100
139	3500	3200	3000	3300	3000	3200	3000	3200	3200
140	3300	2800	3600	3000	3300	3300	3200	3300	3300
141	3300	3500	3500	3500	3700	3300	3800	3700	3700
142	tar	3300	3500	4000	3400	3000	3200	3100	3200
143	tar								
144	tar								
145	tar								
146	tar								
147	tar								
148	tar								
149	tar								
150	tar								
151	tar								
152	tar								
153	tar								
154	tar								
155	tar								
156	tar								
157	tar								
158	tar								
159	[illegible]	3500	4000	3700	5500	3000			
160		3600	3900	4000	3900	3500			
161		3700	3800	4000	4000				
162		4100	4500	4000	3900				
163		3500	4000	3700	3000				
164		4900	3900	4900	3800				
165		3800	4000	3900	4100				
166		4000	3900	3500	3500				
167		3500	4700	4800	4000	3800			
168		3700	4900	3700	4800	3300			

Walk Over Surface Scan

Coordinates East / North	105	106	107	108	109	110	111	112	113
169				4100	4200	4100			
170				3900	3900	3900			
171				3400	3500	3700			
172				3600	3900	3700			
173				3400	3500	3600			
174				3300	3400	3500			
175				3200	3300	3400			
176				3100	3200	3200			
177				3300	3500	3500	3200		
178				3500	3500	3300	3500	4500	
179				3400	3200	3100	3300	3300	3200
180						3000	3600	3500	3400
181						3200	3200	4100	3700
182							3300	3400	4100
183									4000
184									
185									
186									
187									
188									
189									
190									
191									
192									
193									
194									
195									
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197									
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202									
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205									
206									
207									
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212									
213									
214									
215									
216									
217									

Walk Over Surface Scan

218									
219									
220									

Walk Over Surface Scan

Coordinates East / North	114	115	116	117	118	119	120	121	122
120									
121									
122									
123									
124									
125									
126									
127									
128	2500	2400	2500	2500					
129	2500	2900	2500	2800					
130	2600	2600	2500	2500	2500	2500	2400		
131	2500	2800	2500	2500	2400	2300	3000		
132	2500	2800	2800	2600	2500	2500	2500		
133	2900	3000	3100	2900	2500	2500	2500		
134	2700	2500	2700	2500	2500	2500	2500		
135	2800	3000	3000	3000	2900	2800	2800		
136	3400	3100	rock	rock	3200	2900	2900		
137	3200	3558	rock	rock	3100	3200	3000		
138	3100	3200	3100	2900	3000	3000	2900		
139	3100	3200	3100	3300	2500	3000	3000		
140	3500	3400	3400	3100	3000	3000	3000		
141	3800	3600	3400	3200	3500	3200	3300		
142	3400	3300	3000	3200	2900	2900			
143					2800	2800			
144						2900	2900	2700	2800
145						2800	3000	3100	3000
146						2900	3200	3000	3200
147							3000	3000	3100
148									
149									
150									
151									
152									
153									
154									
155									
156									
157									
158									
159									
160									
161									
162									
163									
164									
165									
166									
167									
168									

Walk Over Surface Scan

Coordinates East / North	114	115	116	117	118	119	120	121	122
169									
170									
171									
172									
173									
174									
175									
176									
177									
178									
179	3200	3200	3300	3500	3500	3300	3400		
180	3400	3400	3000	3000	3000	3300	3500	3400	
181	3300	3200	3600	3200	3200	3000	3500	3600	3400
182	3300	3400	3400	3100	3000	3000	3200	3500	3200
183	3300	3300	3100	3200	3100	3000	3100	3300	3200
184	3100	3400	3000	3100	3200	3100	3100	3300	3200
185		3500	3200	3100	3300	3000	3200	3500	3200
186		3400	3100	3200	3300	3200	2900	3500	3500
187		3400	3200	3100	3500	3000	3000	3500	3200
188		3200	3100	3300	3500	3200	3000	3200	3400
189		3300	3200	4100	3000	3200	3200	3200	3200
190		3500	3200	3100	3000	3200	3000	3200	3700
191		3500	3200	3100	3200	3100	3500	3200	3700
192		3400	3200	3000	3500	3200	3200	3500	3700
193		3300	3400	3200	3500	3100	3200	3500	3700
194		3400	3400	3100	3200	3200	3400	3500	3400
195		3400	3400	3100	3000	3200	3500	3300	3300
196		3400	3200	3000	3100	3300	3500	3000	3500
197		3400	3400	3100	3100	3600	3500	3100	3500
198		3200	3300	3300	3400	3000	3100	3100	3300
199		3300	3300	3200	3300	3100	3100	3000	3300
200		3400	3100	3000	3000	3100	3300	3300	3400
201							3300	3400	3300
202							3200	3100	3400
203							3100	3200	3200
204							3200	3200	3100
205							3200	3100	3400
206							3100	3100	3200
207							3000	3100	3500
208							3000	3300	3500
209							3000	3200	3600
210							3500	3300	3200
211							3400	3200	3200
212		3300	3200	4400	3600	3400	3400	3500	3200
213		3200	3200	3700	3600	3300	3400	3300	3100
214		3400	3100	3600	3700	3500	3300	3200	3100
215		3300	3800	3600	4600	3400	3300	3300	3400
216		3300	3500	3800	3600	3800	3400	3400	3600
217		3600	4100	3900	3600	4000	4000	3800	3600

218		4100	4300	4100	4000	3800	3800	4000	3600
219		4000	3800	4200	4100	3800	3900	3800	3600
220		4000	4200	4600	4100	3800	3900	3600	3700

Walk Over Surface Scan

Coordinates East / North	123	124	125	126	127	128	129	130	131
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
135									
136									
137									
138									
139									
140									
141									
142									
143									
144	2900	3000	3000	3000	3000	3000	3000	2900	
145	3000	3200	3200						3000
146	3400	3400	3500						
147	3000	3100							
148									
149									
150									
151									
152									
153									
154									
155									
156									
157									
158									
159									
160									
161									
162									
163									
164									
165									
166									
167									
168									

Walk Over Surface Scan

Coordinates East / North	123	124	125	126	127	128	129	130	131
169									
170									
171									
172									
173									
174									
175									
176									
177									
178									
179									
180									
181									
182	3100								
183	3400								
184	3500	3200							
185	3700	3200							
186	3400	3600							
187	3500	3700	3400						
188	3500	3200	3400						
189	3400	3400	3700	3200					
190	3700	3400	3200	3600	3600				
191	3600	3600	3200	3700	3800	3700	3600	3700	4500
192	3500	3600	3600	3700	4300	3800	4000	5000	6500
193	3500	3900	3700	3600	4100	3800	4000	4500	3700
194	3300	3700	3600	3600	3600	3600	3500	4000	3600
195	3200	3500	3600	3300	3400	3600	3500	3700	3700
196	3500	3300	3100	3300	3400	3600	3400	3500	3700
197	3500	3700	3500	3300	3200	3700	3100	3500	3600
198	3500	3600	3400	3500	3400	3200	3100	3700	3600
199	3200	3200	3000	3300	3300	3200	3100	3600	3500
200	3300	3400	3200	3500	3300	3400	3400	3600	3400
201	3200	3400	3200	3400	3500	3400	3400	3700	3200
202	3300	3300	3800	3100	3600	3200	3200	3900	3100
203	3500	3100	3400	3200	3300	3000	3400	3300	3000
204	3300	3100	3500	3300	3400	3000	3500	3300	3400
205	3200	3200	3500	3400	3600	3200	3500	3600	3500
206	3100	3500	3400	3400	3100	3700	3400	3400	3600
207	3400	3300	3300	3400	3300	3500	3500	3600	3600
208	3400	3200	3400	3200	3700	3400	3400	3400	3200
209	3200	3300	3400	3300	3200	3500	3300	3200	3100
210	3300	3300	3400	3500	3200	3300	3200	3200	3100
211	3200	3200	3100	3200	3500	3600	3200	3300	3100
212	3200	3200	3300	3300	3300	3500	3100	3400	3200
213	3300	3300	3300	3200	3700	3500	3500	3300	3200
214	3300	3600	3300	3500	3200	3400	3500	3200	3400
215	3300	3700	3600	3700	3500	3600	3600	3600	3500
216	3800	3800	3500	3600	3500	3800	3600	3800	3500
217	4200	4000	3800	4000	3800	4000	4100	3800	3500

Walk Over Surface Scan

218	4000	3600	4000	3900	3600	3800	4000	3700	3500
219	4000	3600	3800	4200	3600	3800	3700	4600	3600
220	3600	3800	3600	3400	3600	3400	3600	3300	3100

Walk Over Surface Scan

Coordinates East / North	132	133	134	135	136	137	138	139	140
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
135									
136									
137									
138									
139									
140									
141									
142									
143									
144									
145	3000	3000	2900	2900	3000	3000	3000	2900	3000
146	3000	3000	3000	2900	2900	3000	3000	2800	3000
147	3000	3000	2800	3000	3000	3000	3000	3000	3000
148	3000	3000	3000	3000	3100	3000	3200	2900	3000
149	3200						3200	3000	3000
150							3300	3200	3200
151									
152									
153									
154									
155									
156									
157									
158									
159									
160									
161									
162									
163									
164									
165									
166									
167									
168									

Walk Over Surface Scan

Coordinates East / North	132	133	134	135	136	137	138	139	140
169									
170									4100
171									4200
172						sw	sw	sw	sw
173						sw	sw	sw	sw
174						sw	sw	sw	sw
175								3500	3400
176								3200	3400
177								3200	3500
178								3400	3500
179								3500	3600
180								3500	3700
181									
182									
183									
184									
185									
186									
187									
188									
189									
190			3800	4300	5500	3900	3700	4000	3700
191	4500	5500	3800	5500	4800	3400	3700	3900	4000
192	6100	5000	4100	3500	3800	3200	3700	3500	4000
193	5700	10000	3800	3400	3200	3400	3400	3500	3400
194	4400	4100	3700	3300	3200	3200	3200	3300	3500
195	3300	3400	3700	3200	3000	3300	3200	3400	3500
196	3200	3500	3500	3300	3000	3100	3100	3400	3400
197	3200	3100	3300	3500	3000	3200	3200	3300	3200
198	3500	3300	3400	3600	3200	3200	3300	3100	3300
199	3600	3300	3400	3500	3000	3900	3200	3200	3500
200	3500	3400	3400	3800	3700	3500	3200	3400	3200
201	3400	3400	3000	4000	3500	3300	3400	3100	3300
202	3600	3700	3400	3800	3400	3500	3400	3400	3300
203	3500	3600	3700	3900	3700	3200	3400	3400	3500
204	3500	3600	3800	4400	3500	3300	5800	3200	3400
205	3500	3600	4100	3600	3900	3500	3400	3500	3400
206	3700	3500	3800	3500	3700	3100	3100	3600	3500
207	3800	3700	3500	3400	3500	3200	3100	3400	3500
208	3400	3100	3200	3300	3200	3100	3300	3300	3300
209	3100	3200	3300	3500	3400	3300	3500	3400	3400
210	3300	3300	3400	3500	3300	3100	3300	3500	3500
211	3100	3100	3100	3200	3200	3200	3200	3200	3300
212	3100	3100	3300	3400	3300	3400	3600	3200	3400
213	3600	3200	3500	3600	3600	3400	3600	3300	3600
214	3500	3200	4000	3500	3800	3800	3800	3300	3600
215	3600	3400	4000	3600	3800	4000	3800	3500	3600
216	3700	4100	3700	4000	3900	4400	4100	3800	3800
217	3800	3800	3700	3900	3800	4200	4300	4000	

218	3500	3600	3400	3900	3200	4200	4200			
219	3600	3400	3200	3400	3000	3600				
220	3300	3100	3300	3100						

Walk Over Surface Scan

Coordinates East / North	141	142	143	144	145	146	147	148	149
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
135									
136									
137									
138									
139									
140									
141									
142									
143									
144									
145	2800	2900	3100	3100	4100	4000	3300	3200	3100
146	2700	3000	3300	3400	2900	3700	3700	3000	3200
147	2800	3000	3400	3500	2800	3400	3800	3300	3200
148	3800	3200	3300	3300	3100	3900	3700	3400	3300
149	3000	3900	3200	3300	3100	3500	3200	3500	3200
150	3700	3100	3200	3100	3000	3500	3500	3200	3000
151			3300	3200	3200	3000	2900	3200	3100
152			3000	3400	3200	3100	3000	3400	3100
153			3700	3700	3200	3100	3000	3200	3000
154			3500	3200	3300	3200	3400	3100	3900
155			3400	3300	3800	3200	3400	3100	3000
156			3300	3100	2700	3100	3200	3000	3000
157			3200	3700	2900	3100	3000	3000	3100
158			3100	3000	3000	3000	3000	3000	3200
159			3100	3000	3000	3000	3000	3100	3000
160			3200	3300	3200	3200	3100	3000	3900
161			3400	2900	3000	3100	3000	2900	3000
162			3300	3000	2900	3200	3000	3000	3000
163			3400	3000	3100	3100	3200	2900	3000
164			3300	3100	3000	3300	3400	3000	3200
165			3500	3300	3000	3300	3300	3200	3300
166			3300	3200	3000	3400	3200	3000	3300
167			3700	3300	3300	3200	3100	3000	3200
168			3300	3100	3200	3200	3200	3200	3000

Walk Over Surface Scan

Coordinates East / North	141	142	143	144	145	146	147	148	149
169			3000	3000	3100	3200	3300	3400	3300
170	3400	3300	3500	3200	3000	3100	3200	3000	2500
171	3800	3600	3500	3500	3000	3000	3200	3000	2900
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3400	3500	3400	4000	3400	3700	3500	3500	3400
176	3400	3500	3700	3500	3300	3500	3500	3400	3400
177	3500	3500	3600	3500	3300	3800	3500	4000	3900
178	3200	3700	3500	3800	9300	4000	3500	3800	3900
179	3700	3800	3500	3800	6500	4000	4200	3600	3500
180	3800	4000							
181									
182									
183									
184									
185									
186									
187									
188									
189									
190	3400	3600	3600	3600	3300	3200	3400		
191	3600	3700	3800	3400	3300	3400	3600		
192	3400	3600	3400	3600	3500	3500	3600		
193	3700	3600	3200	3800	3700	3700	3500		
194	3600	3600	3500	3600	3600	3400	3900		
195	3200	3700	3500	3500	3800	3600	4700		
196	2300	3500	3700	3500	3900	4700	3800		
197	3400	3300	3200	3600	3700	4800	3600		
198	3500	3400	3200	3400	3300	3700	3500	3600	3500
199	3500	3500	3300	3400	3400	3800	3200	3400	3400
200	3200	3200	3000	3300	3500	3200	3200	3400	3500
201	3300	3300	3300	3200	3500	3300	3500	3500	3300
202	3000	3400	3300	3300	3400	3200	3400	3300	3600
203	3300	3000	3200	3400	3300	3000	3400	3400	3500
204	3500	3300	3300	3300	3300	3700	3400	3600	3500
205	3400	3400	3400	3300	3400	3500	3700	3400	3000
206	3400	3500	3300	3400	3500	4500	3600	3500	3500
207	3300	3400	3500	3400	3500	3400	3600	3600	3500
208	3500	3400	3600	3600	3400	3200	3700	3600	3500
209	3600	3700	3700	3600	3500	3400	3700	3500	3400
210	3400	3600	3400	3700	3500	3700	3700	3500	3500
211	3300	3500	3400	3500	3500	3500	3400	3200	3300
212	3200	3300	3600	3600	3400	3400	3400		
213	3400	3300	3500	3400	3100	3500			
214	3200	3500	3600						
215	3300	3600							
216	3600								
217									

218										
219										
220										

Walk Over Surface Scan

Coordinates East / North	150	151	152	153	154	155	156	157	158
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
135									
136									
137									
138									
139									
140									
141									
142									
143									
144									
145	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
146	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
147	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
148	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
149	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
150	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
151	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
152	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
153	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
154	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
155	drive	drive	drive	drive	drive	drive	drive	bldg	bldg
156	drive	drive	drive	drive	drive	drive	drive	tank	tank
157	drive	drive	drive	drive	drive	drive	drive	tank	tank
158	drive	drive	drive	drive	drive	drive	drive	tank	tank
159	drive	drive	drive	drive	drive	drive	drive	tank	tank
160	drive	drive	drive	drive	drive	drive	drive	tank	tank
161	drive	drive	drive	drive	drive	drive	drive	tank	tank
162	drive	drive	drive	drive	drive	drive	drive	tank	tank
163	drive	drive	drive	drive	drive	drive	drive	tank	tank
164	drive	drive	drive	drive	drive	drive	drive	tank	tank
165	drive	drive	drive	drive	drive	drive	drive	tank	tank
166	drive	drive	drive	drive	drive	drive	drive	tank	tank
167	drive	drive	drive	drive	drive	drive	drive	tank	tank
168	drive	drive	drive	drive	drive	drive	drive	tank	tank

Walk Over Surface Scan

Coordinates East / North	150	151	152	153	154	155	156	157	158
169	drive	drive	drive	drive	drive	drive	drive	tank	tank
170	2800	2800	2900	2900	3000	3300	3300	3200	3200
171	2900	3000	3100	3000	3200	3200	3200	3000	3000
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3600	3400	3300	3500	3700	3800	3300	3200	3300
176	3300	3600	3400	3500	3500	3500			
177	3400	3900	3400	3700	3500	3500			
178	3700	3700	3500	3600					
179	3600								
180									
181									
182									
183									
184									
185									
186									
187									
188									
189									
190									
191									
192									
193									
194									
195									
196									
197									
198									
199	3500	3700					4500	4300	
200	3700	3800	3600	7000	3800	5500	4600	4100	4200
201	3700	4500	4000	3700	4000	4100	4900	4200	4400
202	3500	3900	4100	3700	4100	4100	3500	4000	4200
203	3800	4200	4000	4100	3600	4200	3800	3600	4200
204	3900	3900	3900	5100	3800	4000	3900	3600	3600
205	3700	3600	3700	4000	4000	3900	3600	3700	3900
206	3500	3600	4200	3600	4000	3800	3600	3400	3600
207	3200	3800	3600	3600	3900	3400	4100	3300	3900
208	3200	3400	3600	3700	4000	3500	4100	3700	
209	3400	3600	3700	3700	3900	rockpile			
210	3200	3300	3700	3900	rockpile				
211	3200	3600	4000						
212									
213									
214									
215									
216									
217									

Walk Over Surface Scan

218									
219									
220									

Walk Over Surface Scan

Coordinates East / North	159	160	161	162	163	164	165	166	167
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
135									
136									
137									
138									
139									
140									
141									
142									
143									
144									
145	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
146	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
147	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
148	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
149	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
150	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
151	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
152	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
153	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
154	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
155	bldg	bldg	bldg	bldg	bldg	bldg	bldg	bldg	
156	tank	tank	tank	tank	tank	tank	tank	tank	
157	tank	tank	tank	tank	tank	tank	tank	tank	
158	tank	tank	tank	tank	tank	tank	tank	tank	
159	tank	tank	tank	tank	tank	tank	tank	tank	
160	tank	tank	tank	tank	tank	tank	tank	tank	tar
161	tank	tank	tank	tank	tank	tank	tank	tank	3700
162	tank	tank	tank	tank	tank	tank	tank	tank	3900
163	tank	tank	tank	tank	tank	tank	tank	tank	4400
164	tank	tank	tank	tank	tank	tank	tank	tank	5500
165	tank	tank	tank	tank	tank	tank	tank	tank	8200
166	tank	tank	tank	tank	tank	tank	tank	tank	4700
167	tank	tank	tank	tank	tank	tank	tank	tank	4000
168	tank	tank	tank	tank	tank	tank	tank	tank	4000

Walk Over Surface Scan

Coordinates East / North	159	160	161	162	163	164	165	166	167
169	tank	tank	tank	tank	tank	tank	tank	tank	4700
170	3500	3300	3300	3400	3800	3500	3500	3500	3500
171	3500	3400	3400	3200	3800	3300	3400	3600	3200
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3500	3200	3500	3400	3200	3200	3200	3600	3200
176	3600	3500	3700	3200	3000	2200	3300	3400	3200
177	3300	3500	3400	3400	3000	3300	3300	3500	3500
178	3500	3700	3300	3500	3300	3400	3400	3500	3900
179	3200	3500	3500	3800	3300	3400	3400	3500	4100
180	3200	3400	3600	3400	3300	3500	3500	4200	3800
181	3200	3500	3300	3400	3300	3500	3500	3600	3700
182	3400	3500	3500	3300	3400	3500	3500	3700	3500
183	3500	3400	3400	3800	3400	3400	3500	3500	3500
184	3500	3400	3500	3500	3500	3700	3500	3500	3500
185	3400	3400	3400	3500	3600	3500	3400	3500	3500
186	3300	3300	3700	4000	3700	3600	3500	3600	3700
187	3200	3500	3800	4000	3500	3700	3400	3700	3700
188	3200	4000	3700	4000	4000	3700	3300	3800	4000
189	3400	3900	4000	4100	3500	3800	3500	3800	3500
190	4000	3600	3500	3600	4000	3800	4100	3900	4100
191							4200	4100	4100
192							3800	4100	4100
193							3800	3800	4000
194							3400	3700	4200
195							3800	4100	4100
196							4300	3900	4200
197							4600	4000	4900
198							4100	3900	4300
199							3800	3900	4100
200	4600	4200	4100	4000	4100	3800	4100	3600	4200
201	4500	5000	3700	3200	3700	3500	3500	3000	3500
202	4300	4200	3700	3200	3600	3500	3500	3500	3700
203	3800	3400	3500	3300	3300	3500	3300	3300	
204	3600	3600	3600	3300	3300	3400	3400		
205	3600	3300	3400	3300	3400	3500			
206	3500	3600	3300	3500	3400	3600			
207	3500	3800			3500	3400			
208									
209									
210									
211									
212									
213									
214									
215									
216									
217									

218										
219										
220										

Walk Over Surface Scan

Coordinates East	168	169	170	171	172	173	174	175	176
North									
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
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145									
146									
147									
148									
149									
150									
151									
152									
153									
154									
155									
156									
157									
158									
159									
160	tar	tar	tar	tar	tar	tar	sw	sw	sw
161	3200	3200	3000	3000	3200	3000	sw	sw	sw
162	3400	3500	3200	3200	3500	3100	sw	sw	sw
163	3400	3500	3700	3400	3500	3200	sw	sw	sw
164	3300	3700	3200	3500	3500	3000	sw	sw	sw
165	3500	3600	3200	3400	3600	3500	sw	sw	sw
166	3800	3600	3500	3600	4000	3800	sw	sw	sw
167	3600	3600	3400	3800	3600	3800	sw	sw	sw
168	3600	3600	3200	3700	3900	3300	sw	sw	sw

Walk Over Surface Scan

Coordinates East / North	168	169	170	171	172	173	174	175	176
169	3500	3500	3200	3200	3500	3200	sw	sw	sw
170	3200	3400	3400	3000	3200	3200	sw	sw	sw
171	3200	3100	3500	3100	3300	3000	sw	sw	sw
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3000	3000	3000	2900	3100	3000	3200	3700	3000
176	2900	3000	3000	2900	3200	3000	3300	3200	3000
177	3000	3500	3000	3200	3200	3200	3200	3300	3400
178	3000	3700	3000	3200	3200	3800	3300	3700	4000
179	3200	3800	3200	3300	3400	3900	3700	3500	3400
180	4000	4500	3900	4000	3200	3400	3400	3500	3800
181	3500	4000	3700	3600	3200	3600	3700	4000	3900
182	3500	4000	3700	4000	3400	3600	3500	3600	4000
183	3500	4000	3500	3500	3400	3800	4000	4000	3800
184	3700	3600	3400	3400	3700	4200	3900	4100	3700
185	3900	3500	3500	3400	3900	3900	3800	4100	3900
186	4000	3600	3400	3800	5300	3800	4000	3800	3700
187	4100	3700	3300	3800	4000	3800	3800	3600	3500
188	4000	3700	4000	4000	4000	4000	3500	3700	4400
189	4200	3800	3900	3800	3900	3800	5500	3800	7500
190	3800	4400	3900	4100	3800	3900	3800	4000	3700
191	8000	4000	4000	3900	3900	3900	3800	3900	3900
192	4400	3900	3800	3700	3800	3800	3900	4100	4100
193	4000	3900	3900	3700	3800	3900	4200	4200	3800
194	4100	4000	4000	3400	3700	3800	3900	4000	3900
195	3800	3900	4000	3500	3700	3400	3700	3700	3800
196	3900	4200	3900	3400	3600	3900	3600	3600	4100
197	3900	4000	3600	3400	3400	3400	3800	3400	3800
198	3300	3500	3300	3900	3800	3600	3800	3600	rockpile
199	3400	3300	3100	rockpile	3700	3600	rockpile	rockpile	rockpile
200	3300	3200	3300	rockpile	4000	rockpile	rockpile	rockpile	
201	3700			rockpile	rockpile	rockpile			
202	3800								
203									
204									
205									
206									
207									
208									
209									
210									
211									
212									
213									
214									
215									
216									
217									

218										
219										
220										

Walk Over Surface Scan

Coordinates East / North	177	178	179	180	181	182	183	184	185
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
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145									
146									
147									
148									
149									
150									
151									
152									
153									
154									
155									
156									
157									
158									
159									
160	3000	3200	3400	3300	3400	3500	3300	3500	3500
161	3300	3100	3200	3200	3300	3300	3400	3700	3600
162	3000	3000	pit	pit	pit	pit	pit	pit	pit
163	3200	3000	pit	pit	pit	pit	pit	pit	pit
164	3000	3000	pit	pit	pit	pit	pit	pit	pit
165	3200	3000	pit	pit	pit	pit	pit	pit	pit
166	3200	3200	pit	pit	pit	pit	pit	pit	pit
167	3400	3200	pit	pit	pit	pit	pit	pit	pit
168	3000	3000	pit	pit	pit	pit	pit	pit	pit

Walk Over Surface Scan

Coordinates East / North	177	178	179	180	181	182	183	184	185
169	3000	3000	pit	pit	pit	pit	pit	pit	pit
170	3100	3500	pit	pit	pit	pit	pit	pit	pit
171	3000	3400	pit	pit	pit	pit	pit	pit	pit
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3000	3000	3200	3000	3100	3200	3000	3200	3200
176	3000	3000	3300	3100	3100	3000	3000	3400	3100
177	3000	3300	3000	3200	3200	3200	3100	3500	3000
178	3100	3500	3500	3200	3300	3500	3100	3300	3200
179	3100	3500	3500	3400	3200	3400	3000	3500	3300
180	3800	4100	3600	3400	3400	3500	3400	3400	3700
181	4100	4200	4000	4000	3400	3300	3500	3400	3200
182	3700	4100	4400	4400	3500	3300	3500	3500	3200
183	3900	4100	4200	4200	3800	3300	3400	3400	3200
184	3900	3800	3800	4000	3700	3300	3400	3000	3300
185	4200	3800	3700	3800	3200	3500	3300	3200	3200
186	3800	3800	3800	3700	3300	3300	3300	3400	3300
187	3900	3800	3800	3900	3500	3400	3300	3600	3200
188	4200	4100	4000	4100	3500	3500	3400	3600	3200
189	4400	4400	4100	4000	3500	3600	3200	3500	3200
190	4000	4200	4400	4200	3500	3400	3400	3300	3300
191	4000	4100	3800	4000	3700	3500	3500	3300	3200
192	4000	4100	4000	4600	3700	3500	3200	3500	
193	4400	4000	3800	4100	3400	3500	3200	3500	
194	4200	3800	4200	3800	3500	3500			
195	3900	3900	4500	3500	3700				
196	3600	3700	3900	3700					
197	3700	3600	rockpile	rockpile					
198	rockpile	rockpile	rockpile	rockpile					
199	rockpile								
200									
201									
202									
203									
204									
205									
206									
207									
208									
209									
210									
211									
212									
213									
214									
215									
216									
217									

Walk Over Surface Scan

218									
219									
220									

Walk Over Surface Scan

Coordinates East / North	186	187	188	189	190	191	192	193	194
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
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136									
137									
138									
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142									
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158									
159									
160	3300	3200	3300	3700	4400	3200	3200	3200	3200
161	3400	3200	3100	3000	3200	3100	3300	3300	3100
162	pit	pit	pit	3000	3200	3000	3400	3400	3000
163	pit	pit	pit	3000	3300	3200	3400	3400	3000
164	pit	pit	pit	3200	3500	3200	3000	3500	3400
165	pit	pit	pit	3300	3300	3200	3100	3500	3300
166	pit	pit	pit	3200	3400	3400	3200	3100	3400
167	pit	pit	pit	3100	3400	3700	3400	3200	3400
168	pit	pit	pit	3200	3300	3400	3300	3200	3300

Walk Over Surface Scan

Coordinates East / North	186	187	188	189	190	191	192	193	194
169	pit	pit	pit	3200	3300	3400	3300	3300	3200
170	pit	pit	pit	3400	3000	3400	3200	3300	3100
171	pit	pit	pit	3200	3200	3000	3500	3400	3300
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3000	3000	3000	3000	3200	3000	3000	3300	3000
176	3000	3000	3200	3000	3000	3300	3200	3400	3000
177	3000	3000	3200	3000	3000	2900	3300	3700	3000
178	3200	3000	3000	3000	3100	2900	3400	3400	3200
179	3300	3100	3000	3000	3000	3000	3300	3300	3100
180	3500	3200	3100	3000	3000	3000	3000	3500	3200
181	3000	3000	3000	3000	3100	2900	3000	3500	3200
182	3000	3100	3300	2900	3000	2800	3000	3300	3300
183	3500	3200	3500	2900	3000	3000	3000	3000	3000
184	3500	3500	3300	3000	3000	3000	3200	3000	3000
185	3400	3000	3500	3000	3000	3100	3100	3000	2800
186	3500	3000	3400	3000	3200	3200	3200	3000	2800
187	3000	3500	3200	3500	3200	3200	3400	3000	3200
188	3000	3200	[illegible]	3200	3000	3300	3300	3100	
189	3500	3000	3500	3300					
190	3200	3500	3500						
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Walk Over Surface Scan

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Walk Over Surface Scan

Coordinates East / North	195	196	197	198	199	200	201	202	203
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160	3550	3500	3500	4200	3600	4000			
161	3500	3500	3500	3500	3700	3700	3700		
162	3500	3300	3400	3500	3200	3500	4000	4000	
163	3200	3400	3500	3400	3400	4000	3900	3500	3500
164	3000	3500	3500	3400	3500	4000	3500	3500	3800
165	3000	3400	3400	3300	3400	3900	3500	3500	3800
166	2950	3400	3300	3400	3300	3500	3500	3600	3500
167	3100	3500	3800	3300	3300	3500	3600	3300	3300
168	3300	3500	3400	3100	3200	3000	3200	3400	3400

Walk Over Surface Scan

Coordinates East / North	195	196	197	198	199	200	201	202	203
169	3000	3500	3300	3000	3200	3400	3000	3400	3200
170	3100	3400	3300	3300	3100	3200	3100	3300	3200
171	3200	3200	3300	3200	3000	3200	3200	3100	3200
172	sw	sw	sw	sw	sw	sw	sw	sw	sw
173	sw	sw	sw	sw	sw	sw	sw	sw	sw
174	sw	sw	sw	sw	sw	sw	sw	sw	sw
175	3200	3000	3100	3000	3100		163000	3000	
176	3000	3000	3200	3000	3100		3000	3000	
177	3100	2800	3000	3200	3200		3100	4000	
178	3100	3000	3000	3000	3200		3100		
179	3200	3000	3000	3100	3000		3200		
180	3200	3200	3200	3000	3000	3100	3200	3200	
181	3200	3300	3100	3400	2800	3200	3100		
182	3200	3500	3300	3300	3000	3200			
183	3100	3400	3200	3200	3300				
184	3100	3400	3200	3500					
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Walk Over Surface Scan

Coordinates East	204	205
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169	3300	3000
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171	3200	3300
172	sw	sw
173	sw	sw
174	sw	sw
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December 10, 1992

Mr. Jerome Roth
Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

SUBJECT: CONFIRMATORY RADIOLOGICAL SURVEY PLAN FOR THE TEXAS INSTRUMENTS INCORPORATED BURIAL SITE, ATTLEBORO, MASSACHUSETTS

Dear Mr. Roth:

Enclosed is a copy of the subject document. As discussed in our earlier phone conversation, on-site activities have been scheduled for December 15-16, 1992.

If there are any questions, please direct them to me at (615) 576-3355 or Michele Landis at (615) 576-2908.

Sincerely,

Armin Jaberaboansari
Project Leader
Environmental Survey and
Site Assessment Program

AJ:tlc

cc: J. Parrott, NRC/NMSS, 6H3
T. Mo, NRC/NMSS, 6H3
D. Tiktinsky, NRC/NMSS, 6H3
J. Swift/E. Brown, NRC/NMSS, 6H3
J. Kinneman, NRC/Region I
M. Landis, ORISE
J. Berger, ORISE
PMDA, 6E6
File/205

CONFIRMATORY SURVEY PLAN FOR THE TEXAS INSTRUMENTS INCORPORATED BURIAL SITE, ATTLEBORO, MASSACHUSETTS

SITE HISTORY AND DESCRIPTION

The Texas Instruments Incorporated site at Attleboro, Massachusetts, was owned and operated by Metals and Controls (M&C) until 1959, at which time M&C merged with Texas Instruments, Inc. The General Plate Division of M&C began processing nuclear materials in 1952, and between 1952 and 1959 fabricated uranium foils for reactor experiments and fuel components and complete reactor fuel cores for the U.S. Navy. Source material license D-549 was issued permitting acquisition and title to not more than 22.7 kg (50 pounds) of refined source material for use in the production of uranium foils; additional source material was acquired and used under contract with U.S. Government. Special nuclear materials license No. SNM-23 was issued, permitting acquisition and title to 110 kg of enriched uranium for fabrication of the fuel components and cores. After the merger in 1959, Texas Instruments continued fabricating reactor fuel cores, primarily for research and production reactors. Also, source materials, i.e., natural uranium and thorium, were still being fabricated for sale to various corporations.

A 1964 Texas Instruments health and safety manual states that uranium- and thorium-contaminated noncombustible scrap material and machinery were collected in 55-gallon steel drums and were disposed of through authorized agencies, or were buried on-site in compliance with 10CFR20.304. Burials were made from 1958 to 1961, and the burial site was closed in 1967. Records indicate two known burials, one in 1958 of contaminated ductwork, and one in 1961 of 28.4 mCi of enriched uranium noncombustible scrap. Work with nuclear material was gradually reduced beginning in 1968 and was terminated in 1974. The interior of the facility was decontaminated and released for unrestricted use by the Nuclear Regulatory Commission (NRC) in 1983.

Prepared by the Environmental Survey and Site Assessment Program of Oak Ridge Institute for Science and Education, Oak Ridge, TN, under interagency agreement (NRC Fin. A-9076) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy.

The Texas Instruments Inc. Facility, Attleboro, MA is located in North Attleboro, approximately 48 kilometers south of Boston. The Radiological Site Assessment Program, predecessor to the Environmental Survey and Site Assessment Program, of the Oak Ridge Associated Universities (ORAU) conducted a radiologica. survey of portions of the facility's outdoor areas during April and May, 1984. The results of that survey indicated several areas with surface and/or subsurface uranium concentrations in excess of guidelines.[1]

Texas Instruments Inc. has completed the cleanup and final survey activities at the burial site located between Buildings 11 and 12. The excavated area at the burial site is approximately *1600 m²* and the average depth of the excavated area is approximately 1.5 meters. The U.S. Nuclear Regulatory Commission, Region I Office, has requested that the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) perform an independent confirmatory survey of the excavated area at the burial site.

OBJECTIVE

The objective of a confirmatory survey is to provide independent document reviews and radiological data, for use by the NRC in evaluating the adequacy and accuracy of the licensee's radiological status report, relative to established guidelines.

RES ONSIBILITY

Work described in this survey plan will be performed under the direction of Michele Landis, Project Manager and Armin Jaberaboansari, Project Leader with ESSAP. The cognizant site supervisor has the authority to make appropriate changes to the survey procedures as deemed necessary. After consultation with the NRC site representative, the scope of the survey plan may be altered. Deviations to the survey plan or procedures will be documented in the site log book.

DOCUMENT REVIEW

ESSAP will review the licensee's radiological survey data. Procedures and methods utilized by the licensee will be reviewed for adequacy and appropriateness. The post-remedial action data will be reviewed for accuracy, completeness and compliance with guidelines.

PROCEDURES

Survey activities will be conducted in accordance with the ORISE ESSAP Survey Procedures Manual. Specific procedures applicable to this survey are listed on page 4 of this survey plan.

REFERENCE GRID

A 10 m grid was established during ESSAP's radiological survey of the area in 1984 which was subsequently used by the licensee. The same reference grid will be used in this survey.

SURFACE SCANS

Surface scans of the excavated and the surrounding area (approximately 10,000 m^2) will be performed using NaI detectors coupled to countrate meters with audible indicators. Areas of elevated direct radiation will be noted for further investigation.

SOIL SAMPLING

Surface soil samples will be obtained from ten randomly selected grid line intersections. Ten to fifteen samples will be obtained from the overburden piles. Additional soil samples will be obtained from locations of elevated direct radiation, identified by surface scans, or at specific locations based on previous ESSAP and/or licensee's survey results.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data will be returned to ORISE's ESSAP laboratory in Oak Ridge, TN for analysis and interpretation. Soil samples will be analyzed by gamma spectrometry. Approximately 10% of the soil samples will be analyzed by alpha spectroscopy for isotopic uranium.

The data generated will be compared with the licensee's documentation and NRC guidelines established for release to unrestricted use. Results will be presented in a report and provided to the NRC for review and comment. Data and samples collected as a part of this survey will be archived by ESSAP.

GUIDELINES

The soil concentration guideline, for enriched uranium, is 30 pCi/g.

TENTATIVE SCHEDULE

Measurement and Sampling	December 14-15, 1992
Sample Analyses	January, 1993
Draft Report	April, 1993

LIST OF CURRENT PROCEDURES

Applicable procedures from ORISE/ESSAP Survey Procedures Manual include:

Section 5.0 Instrument Calibration and Operational Check Out

- 5.1 General Information
- 5.2 Electronic Calibration of Ratemeters
- 5.3 Gamma Scintillation Detector Check Out and Cross Calibration
- 5.4 Alpha Scintillation Detector Calibration and Check Out

5.5 GM Detector Calibration and Check-Out

5.13 Field Measuring Tape Calibration

Section 6.0 Site Preparation

6.2 Reference Grid System

Section 7.0 Scanning and Measurement Techniques

7.1 Surface Scanning

Section 8.0 Sampling Procedures

8.1 Surface Soil Sampling

8.4 Sample Identification and Labeling

Section 9.0 Integrated Survey Procedures

9.1 Background Measurements and Baseline Sampling

9.2 General Survey Approaches and Strategies

Section 10.0 Health and Safety and Control of Cross Contamination

Section 11.0 Quality Assurance and Quality Control

REFERENCES

1. "Radiological Survey of the Texas Instruments Site, Attleboro, Massachusetts," Oak Ridge Associated Universities, January, [illegible].

2. "Post Excavation Radiological Survey Report, Texas Instruments Incorporated Burial Site, Attleboro, Massachusetts," Creative Pollution Solutions, Inc., November 28, 1992.

3. "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source or Special Nuclear Material," U.S. Nuclear Regulatory Commission, Division of Fuel Cycle and Material Safety, Washington D.C., August 1987.

APPENDIX A

COST ESTIMATE*

CONFIRMATORY SURVEY

FOR THE TEXAS INSTRUMENTS

INCORPORATED BURIAL SITE,

ATTLEBORO, MASSACHUSETTS

Plan Preparation - $4,300

Plan preparation includes the following activities: document reviews, survey plans, trip planning and the cost and time estimates.

On Site Activities - $18,300

On site activities will include 6 man days at the site performing the following: gamma scans and soil sampling.

The on site expenses also include trip preparation (equipment calibration and packing), travel to and from the site (airlines and rental vehicles), hotel expenses, and per diem, unpacking equipment, and logging in samples.

Sample Analysis - $6,600

Includes analysis of soil samples by gamma spectrometry and analysis of selected samples by alpha spectroscopy for isotopic uranium.

Report Preparation - $7,700

The report preparation will include the following activities: tabulation of data, illustration, and writing and reviewing the final draft, final or interim report, word processing and reproduction.

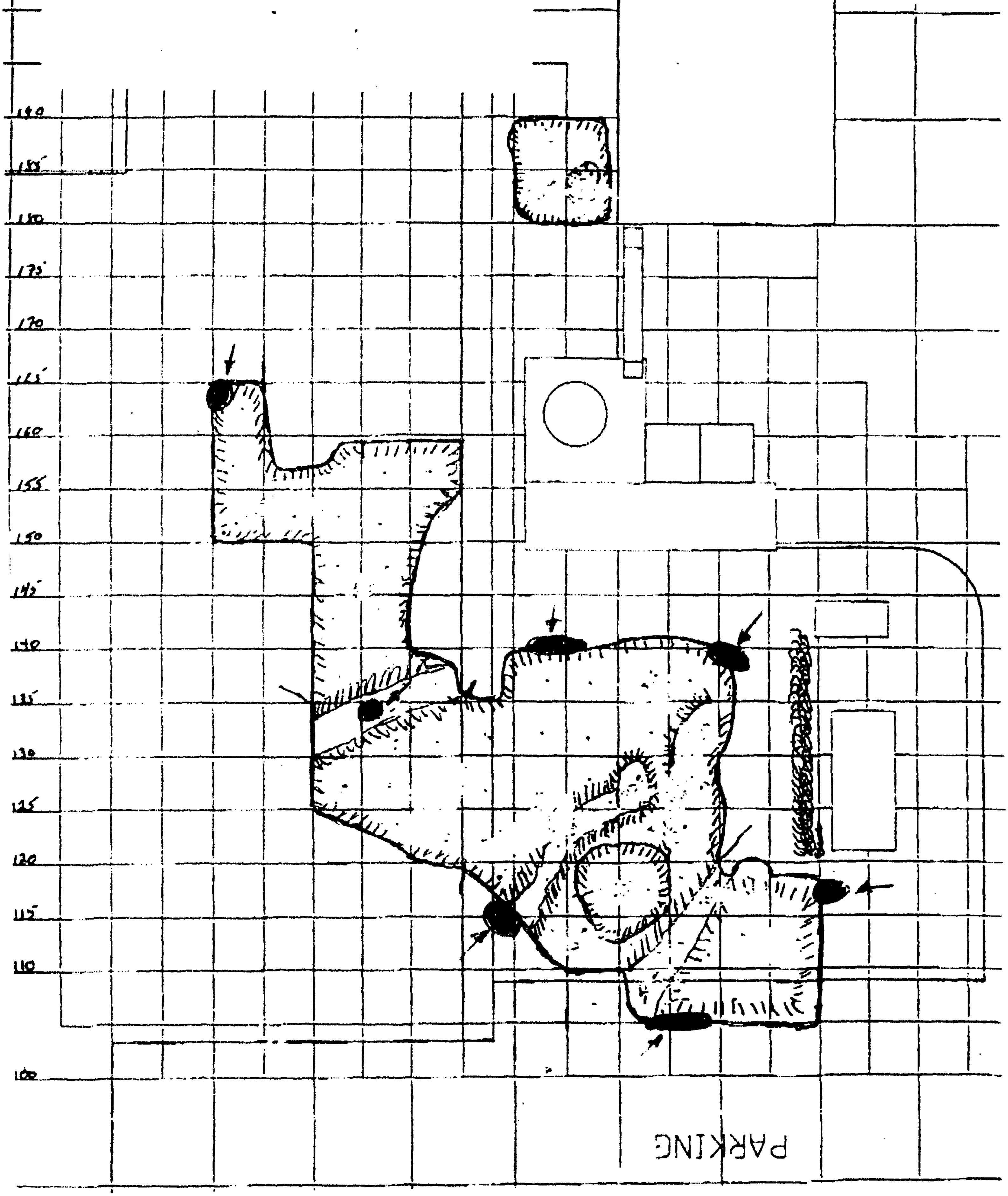
Total Cost Estimate = $46,900

**Estimates are for surveys of all areas listed in the NRC Request for Technical Assistance received by ESSAP. Reduction or increase in the number of areas being surveyed would result in changes to the original estimate in the "on site activities" and "sample analyses" categories. Due to the nature of the survey, this estimate is a best guess; site and weather conditions and survey findings may change the scope of the survey and increase or decrease the cost estimate. The NRC site representative will be notified if major changes to the scope of the survey need to be taken.*

Attachment 3

EXCAVATION AREA AS OF 11/6/92

APPROXIMATE ELEVATIONS SHOWN



Clean-up

70-33

ORISE

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

January 25, 1993

Mr. Jerry Roth
Region I
Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, Pennsylvania 19400

SUBJECT: INTERIM RADIOLOGICAL SURVEY LETTER REPORT FOR THE TEXAS INSTRUMENTS, INCORPORATED BURIAL SITE, ATTLEBORO, MASSACHUSETTS

Dear Mr. Roth:

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) performed a confirmatory radiological survey of the Texas Instruments Burial Site in Attleboro, Massachusetts, on December 15-16, 1993. Survey activities included gamma surface scans and collection of soil samples. ESSAP offers the following interim survey data for your review.

SURFACE SCANS

Gamma surface scans were performed at the boundary of the excavated area. Several locations of elevated direct radiation were identified (Figure 1). At a number of these locations, the elevated activity was associated with small pieces of metal debris. A similar piece of material was identified while scanning around the overburden piles at grid block location 220N, 145E. Remedial activities by Creative Pollution Solutions (CPS), a contractor for Texas Instruments, were not effective. Furthermore, during these remedial activities, a relatively larger piece of scrap metal with elevated activity was excavated from the west side of the burial site, adjacent to the parking area.

SOIL SAMPLING

Ten soil samples were collected from the bottom of the excavated area and six samples were collected from the overburden piles. ESSAP has analyzed all samples by gamma spectrometry. The analytical results are presented in Table 1, and sample locations are shown in Figure 2. The total uranium concentrations for samples taken from the overburden piles ranged from 1.5 to 50 pCi/g. The total uranium concentrations for samples taken from the bottom of the excavation

P.O. BOX 117, OAK RIDGE, TENNESSEE 37831-01

ranged from 3 to 400 pCi/g. The sample with a total uranium concentration of 400 pCi/g was taken at grid coordinate 185N, 125E. A second sample, taken by the licensee at approximately the same location, was analyzed by ESSAP and contained 85 pCi/g of total uranium.

The soil concentration guideline, for enriched uranium, is 30 pCi/g. The total uranium concentration at a number of locations in the excavated area exceeds this limit. Furthermore, based on the survey findings, it is ESSAP's opinion that the full extent of the burial site, particularly on the west side, adjacent to Building 11 parking area, has not been determined.

If there are any questions or you need additional information, please do not hesitate to contact me at (615) 576-3355 or Michele Landis at (615) 576-2908.

Sincerely,

Armin Jaberaboansari
Project Leader
Environmental Survey and
Site Assessment Program

AJ:mkp

cc: J. Parrott, NRC/6H3
D. Tiktinsky, NRC/6E6
T. Mo, NRC/6H3
J. Swift/F. Brown, NRC/6H3
J. Kinneman, NRC/Region I
NRC/PMDA, 6E6
J. Berger, ORISE/ESSAP
M. Landis, ORISE/ESSAP
File/205

TABLE 1
URANIUM CONCENTRATIONS IN SOIL SAMPLES
TEXAS INSTRUMENTS, INC.
ATTLEBORO, MASSACHUSETTS

Sample Location	Uranium Concentrations[a]		
	U-235	U-238	Total Uranium[b]
Excavated Area[c]			
200N, 165E	0.7 ± 0.1	10.5 ± 2.2	27
185N, 125E, Sample 1	15.1 ± 2.0	48.5 ± 7.2	400
185N, 125E, Sample 2[d]	1.7 ± 0.3	45.7 ± 6.7	85
185N, 150E	0.2 ± 0.1	5.3 ± 1.3	10
180N, 130E	1.9 ± 0.3	30.0 ± 4.5	74
170N, 190E	0.1 ± 0.1	0.5 ± 0.6	2.8
165N, 125E	0.3 ± 0.1	3.7 ± 1.2	11
160N, 135E	1.3 ± 0.1	54.3 ± 2.2	84
160N, 130E	2.1 ± 0.3	89 ± 13	140
155N, 115E	0.1 ± 0.1	1.2 ± 0.7	3.5
150N, 139E	0.6 ± 0.1	56.1 ± 2.4	70
Overburden Piles[e]			
230N, 155E	1.0 ± 0.2	27.1 ± 4.2	50
220N, 155E	0.2 ± 0.1	4.4 ± 1.1	9.0
220N, 140E	0.9 ± 0.2	15.9 ± 2.6	37
210N, 145E	0.1 ± 0.1	0.8 ± 0.7	1.5
BFP1, Sample 1[f]	1.1 ± 0.2	24.5 ± 4.0	50
BFP1, Sample 2	1.0 ± 0.2	16.8 ± 2.8	40

[a] Uncertainties represent the 95% confidence level based only on counting statistics.
[b] Total uranium concentrations are calculated based on a U-234 to U-235 activity ratio of 22:1.
[c] See Figure 2.
[d] This sample was provided to ESSAP by the licensee.
[e] Exact locations for soil samples from the overburden piles are not indicated on Figure 2. Approximate grid coordinates or a general description is provided.
[f] "Backfill Pile 1" (BFP1) is located to the west of the excavated area across from the parking area. Samples 1 and 2 were taken from the southwest and northeast corner of BFP1, respectively.

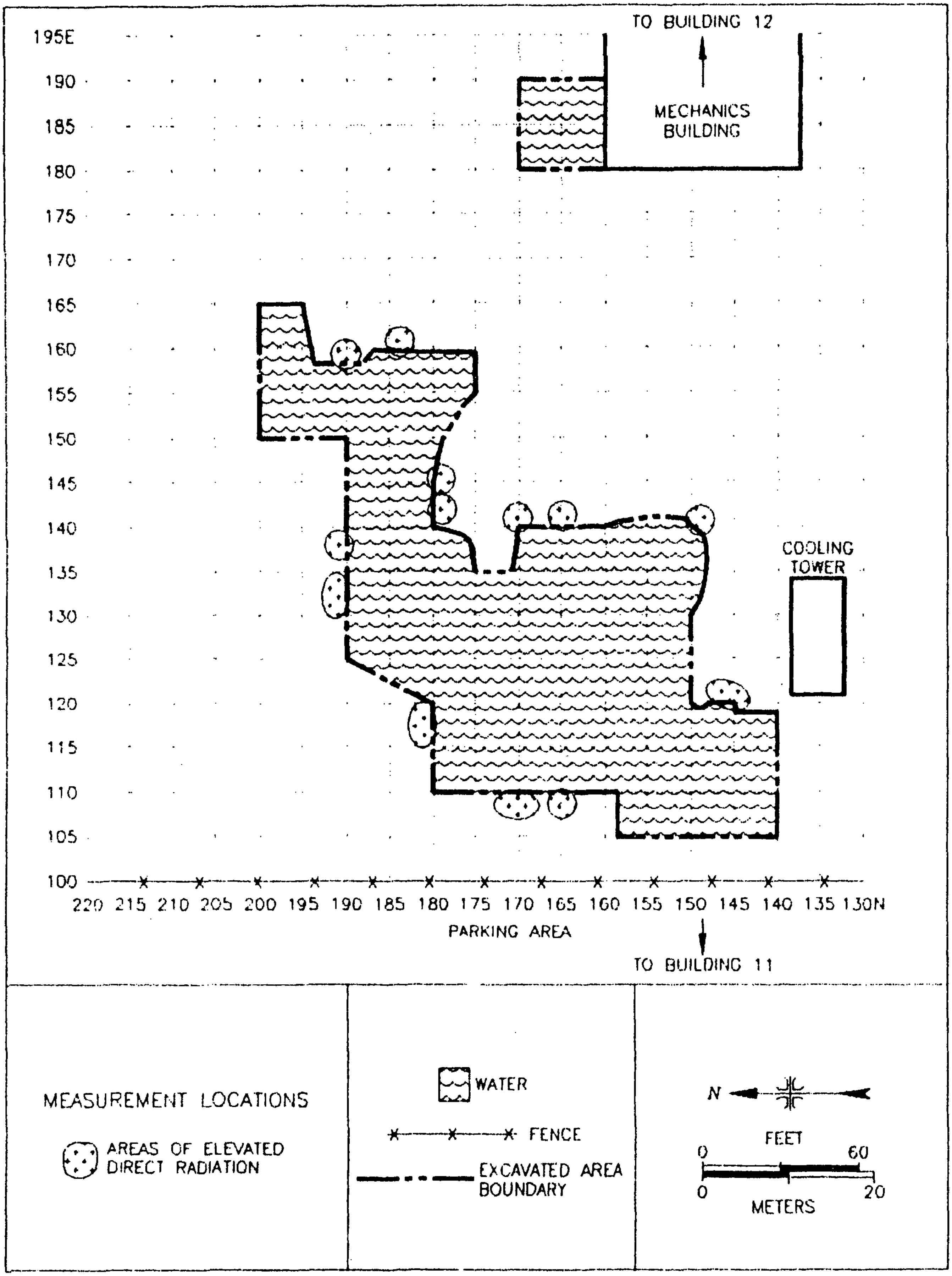


FIGURE 1: Plot Plan of the Burial Site – Areas of Elevated Direct Radiation

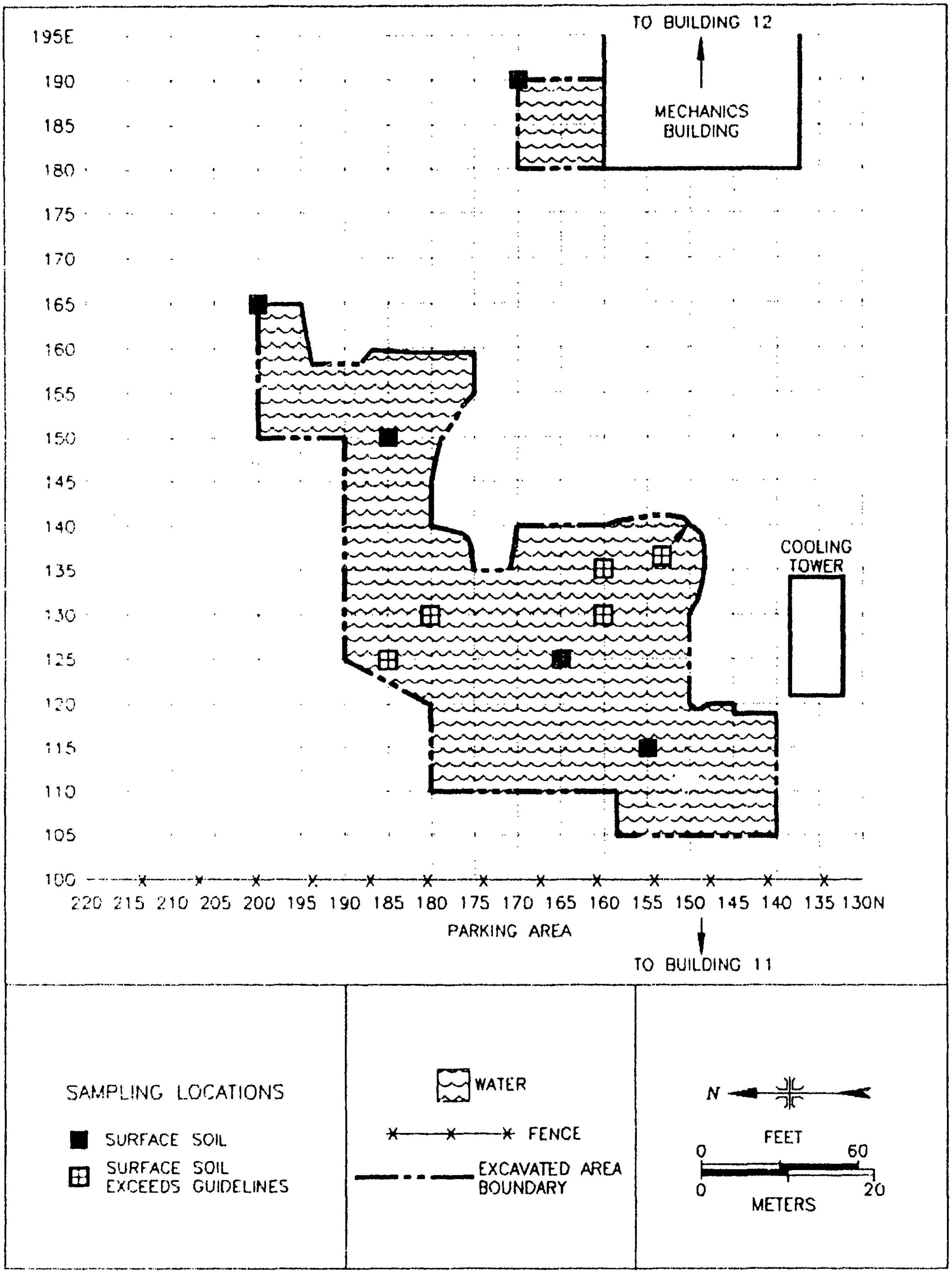


FIGURE 2: Plot Plan of the Burial Site – Surface Soil Sampling Locations

Docket No. 70-33

Mr. Frank J. Veale, Jr.
Manager, Environmental Engineering/
Industrial Hygiene
Metals and Controls Group
Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02703

Dear Mr. Veale:

Subject: NRC Inspection No. 70-33/93-01

An announced safety inspection of the site remediation activities at your facility was conducted by Mr. Roth on June 2, 1993. The inspection findings were discussed with you, Mr. Schuele, and members of your staff on June 2, 1993.

The area reviewed during the inspection was important to public health and safety and is discussed in the enclosed inspection report. This area involved site remediation activities and included the conduct of a confirmatory survey by the inspector.

All NRC-licensed operations at the facility have been terminated with the exception of decommissioning and decontamination activities. Preliminary results of the surveys conducted by the inspector during this inspection indicated that you have completed cleanup of the excavated area of the former burial site in an appropriate manner. Within the scope of this inspection, no safety concerns or violations of regulatory requirements were identified.

No response to this letter is required. Your cooperation with us is appreciated.

Sincerely,

Original Signed By;
James H. Joyner

James H. Joyner, Chief
Facilities Radiological Safety
and Safeguards Branch
Division of Radiation Safety
and Safeguards

Enclosure: NRC Region I Inspection Report No. 70-33/93-01

cc w/encl:
Public Document Room (PDR)
Local Public Document Room (LPDR)
Nuclear Safety Information Center (NSIC)
Commonwealth of Massachusetts (2)

bcc w/encl.
Region I Docket Room (with concurrences)
J. Roth, DRSS
V. McCree, OEDO, (OWFN 17 G21)
M. Landis, ORISE
A. Jaberaboansari, ORISE
J. Shepard, NMSS

RI:DRSS	RI:DRSS	RI:DRSS
Rothman	Bassani	Joyner
07/ /93	07/ /93	07/ /93

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No.: 70-33/93-01

Docket No.: 70-33

License No.: SNM-23 Priority: 1 Category: UHFF

Licensee: Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02702

Facility Name: HEIR Project

Inspection At: Attleboro, Massachusetts

Inspection Conducted: June 2, 1993

Inspector: J. Roth, Project Engineer, Date: 7/1/93
Facilities Radiation Protection Section (FRPS)
Facilities Radiological Safety and Safeguards Branch (FRSSB)
Division of Radiation Safety and Safeguards

Approved by: W. Pasciak, Chief, Date: 7-1-93
FRPS, FRSSB
Division of Radiation Safety and Safeguards

Areas Inspected: Special, announced inspection by a region-based inspector to perform a radiological survey of portions of the on-site excavated area following remediation by the licensee.

Results: Preliminary results of the survey indicated that the licensee appeared to have completed remediation of the excavated area in an appropriate manner. No safety concerns or violations of regulatory requirements were identified.

Details

1.0 Individuals Contacted

M. J. Elliott, Manager, Environmental Engineering
M. Griffin, Project Manager
W. A. Lorenzen, Health Physicist
E. E. McWilliams, Health Physicist
W. Schmele, Attleboro Site Manager
J. J. Veale, Jr., Manager, Environmental Engineering/Industrial Hygiene

Other licensee representatives, employees and remediation contractor employees were also interviewed during this inspection.

2.0 Background

On December 14-16, 1992, the NRC contractor, the Oak Ridge Institute for Science and Education (ORISE), performed a verification survey of the remediated area of the Attleboro site. During that survey, it was determined from radiation levels (ranging from 2½ to 40 times background) on the walls of the excavation that radioactive material remained that was above the 30 picocuries total uranium per gram of soil guidance value contained in the NRC approved Remediation Plan. In addition, analysis of soil samples taken by ORISE indicated that there were two locations on the bottom of the excavation that exceeded the NRC guidance value. Results of the ORISE survey are provided in Attachment 1. As a result, the licensee was requested by the inspector to perform additional remediation activities.

Since the December, 1992 NRC survey the licensee has performed additional onsite remediation, drained the groundwater out of the excavated area, and verified that the excavated area met the NRC guidance value of 30 picocuries total uranium per gram of soil.

Since, according to a May 28, 1993 letter to the NRC (Attachment 2), the licensee intended to backfill the excavation as soon as the final survey was completed, a special inspection was conducted on June 2, 1993 in order to verify that the bottom of the excavation met the NRC guidance value indicated above.

3.0 Conduct of the Verification Survey

The inspector performed the verification survey discussed in Paragraph 2.0. Surfaces adjacent to, in and on the walls of the excavation were scanned using a gamma scintillation detector. Micro R readings were taken at one meter above the surface at random locations, soil samples were taken from the two remediated areas on the bottom of the excavation and from two locations that exhibited elevated radiation readings during the scanning. The two elevated areas were remediated by the licensee prior to sampling by the inspector.

4.0 Preliminary Survey Results

4.1 Walkover Survey

A walkover survey was conducted in the excavated area by the inspector using a Ludlum Model 19 Analyzer equipped with a 2 inch sodium iodide scintillation detector. Prior to the survey, the instrument background was determined to be about 2500 counts per minute. Radiation levels in the excavated area were found to be between one and one and one half times background except in two elevated areas (grid location 188N X 152J, three times background; grid location 1[illegible]5N X 122J, two times background). Both elevated areas were immediately remediated by the licensee. Subsequent to remediation, the radiation levels in these two areas was reduced to one to one and one half times background.

4.2 One Meter Gamma Survey

The inspector performed [illegible] radiation measurements at one meter above the surface using a Ludlum Micro R Meter. The measurements were made in the following locations:

Grid Location	Results (Micro R/h)	Grid Location	Results (Micro R/h)
[illegible]	14	[illegible]N 130E	13.5
[illegible]	[illegible]	170N 130E	14
[illegible]	14	175N 140E	13
[illegible]	14	187N 140E	12
[illegible]	12.5	180N 1[illegible]0E	11.5
[illegible]	[illegible]	190N 140E	11

4.3 Soil Samples

Soil samples were collected by the inspector for the two elevated grid locations [illegible] in paragraph 4.1 and from the two grid locations [illegible] in the [illegible] survey report discussed in paragraph 2.0.

Sample Designation	Preliminary Sample Result (picocuries total uranium/gram soil)
188N 152J	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The preliminary sample analysis results were obtained by alpha counting in the licensee's laboratory. This technique has been shown to be conservative (higher) when compared to the analytical results obtained in the ORISE laboratories as indicated in Attachment 3. The samples will be sent to the ORISE laboratories for verification analyses and the results will be provided in a subsequent inspection report.

5.0 Additional Actions Required

5.1 Licensee

Upon completion of the additional remediation activities, the licensee is expected to resurvey the remediated areas and provide the NRC with a revised final survey report. The expected schedule for completion of these activities is provided in [illegible].

5.2 NRC

Following receipt of the licensee's revised final survey report, the NRC contractor will [illegible] the applicable areas and will perform final confirmatory [illegible] the status of the remediated areas.

6.0 Exit Interview

The inspection team met with the licensee representatives identified in Paragraph 1.0 at the [illegible] of the inspection on [illegible]. The scope of the inspection and the [illegible] were discussed and [illegible].

ORISE

[illegible]

[illegible]

SUBJECT: INTERIM RADIOLOGICAL SURVEY LETTER REPORT FOR THE TEXAS INSTRUMENTS, INCORPORATED BURIAL SITE, ATTLEBORO, MASSACHUSETTS

[illegible]

[illegible] Assessment Program (ESSAP) of the Oak Ridge Institute [illegible] (ORISE) [illegible] radiological survey of the Texas [illegible] on December 15-16, [illegible] soil samples. ESSAP [illegible]

[illegible]

[illegible] of the excavated area. Several [illegible] A number of these [illegible] metal debris. A similar piece of material [illegible] Texas Instruments [illegible] of the burial site [illegible]

[illegible]

[illegible] of the excavated area and six samples were [illegible] ESSAP [illegible] analyzed all samples by gamma spectrometry [illegible] Table 1 and sample locations are shown in Figure 1. The [illegible] from the bottom of the excavation [illegible]

[illegible] sample with a total uranium concentration of 400 pCi/g was [illegible]. A second sample taken by the licensee at approximately [illegible] and contained 88 pCi/g of total uranium.

[illegible] 80 pCi/g. The total uranium [illegible] [illegible] the full extent of the burial site [illegible] has not been determined.

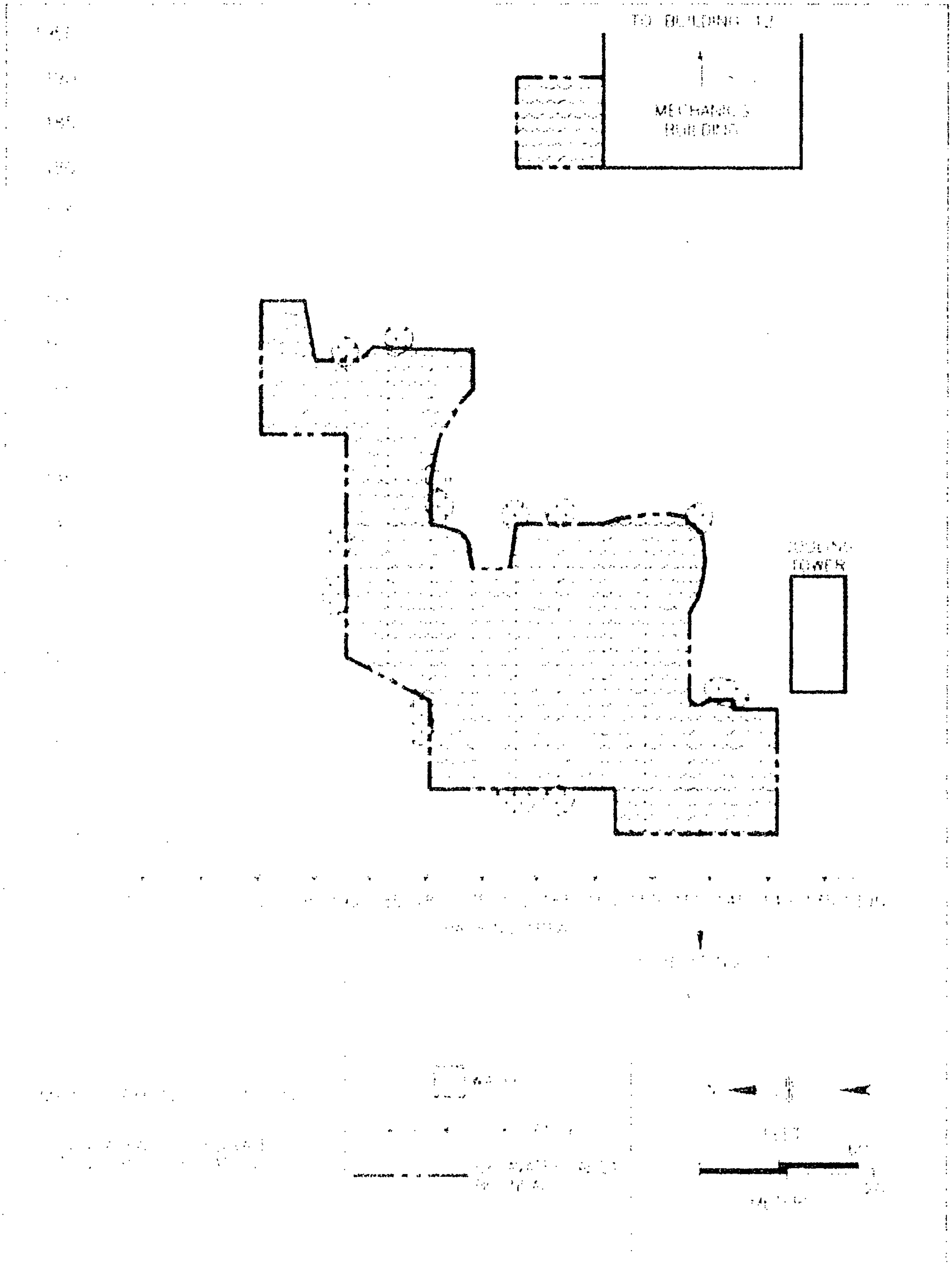
[illegible]

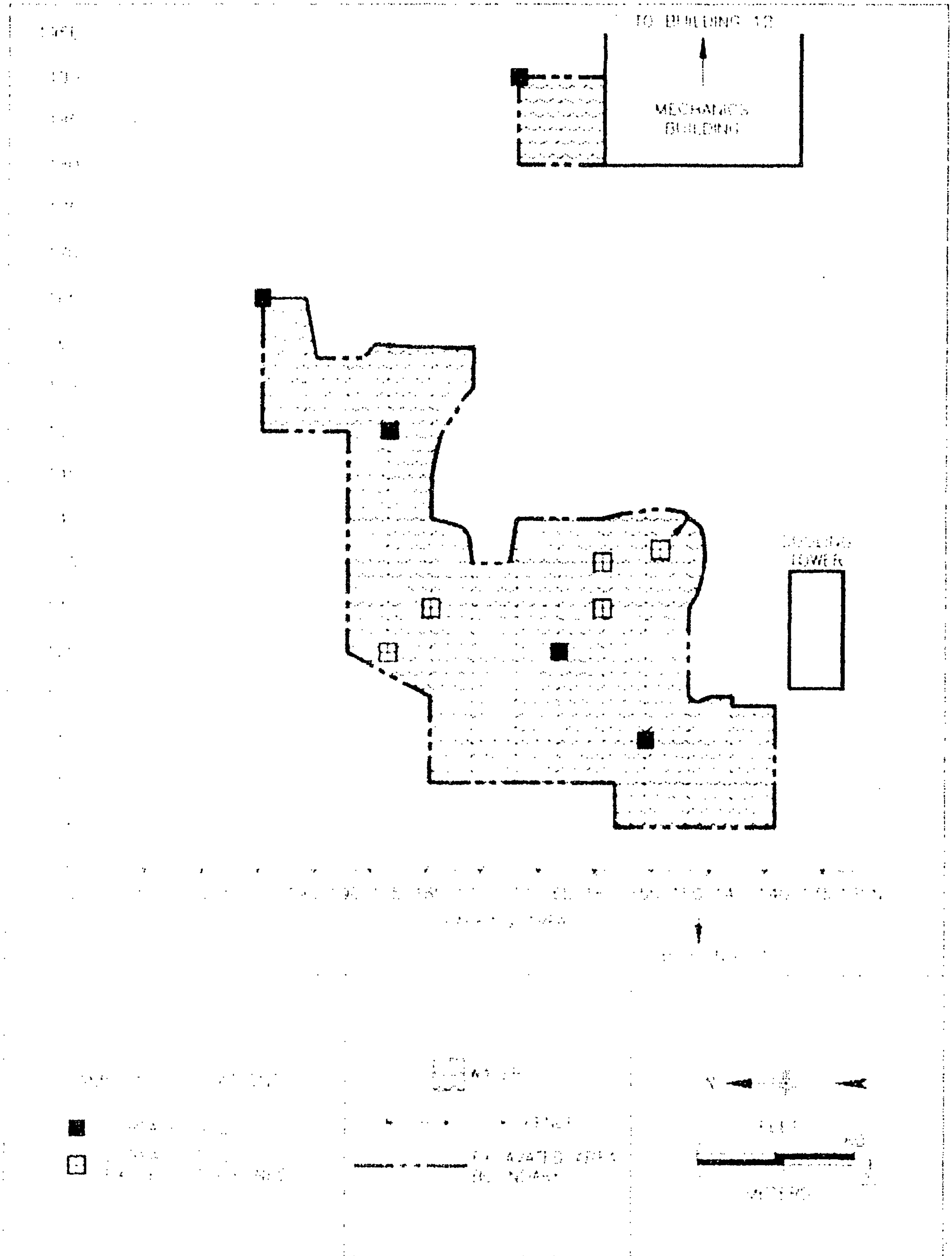
TABLE 1
URANIUM CONCENTRATIONS IN SOIL SAMPLES
TEXAS INSTRUMENTS, INC.
ATTLEBORO, MASSACHUSETTS

Sample Location	Uranium Concentrations[a]		
	U-235	U-238	Total Uranium[b]
[illegible]			
[illegible]	[illegible]	[illegible] ± 2.2	[illegible]
[illegible]	[illegible]	[illegible]	200
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	84
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]


TO BUILDING
MECHANICS BUILDING
TOWER


TO BUILDING 12
MECHANICS BUILDING
TOWER

TEXAS INSTRUMENTS

May 25, 1993

Mr. Jerome Roth
Project Engineer - Fuel Facilities
UNITED STATES NUCLEAR
REGULATORY COMMISSION REGION I
475 Allendale Road
King of Prussia, PA 19406

Re: Texas Instruments Incorporated, S.N.M. License No. 23
Docket No. 70-33

Dear Mr. Roth:

This letter will serve to document certain information that was conveyed to you orally during telephone conversations on May 5 and May 20, 1993. As requested, Texas Instruments Incorporated (TI) is submitting information concerning the status and schedule of the remaining activities to remediate the former Low Level Radioactive Waste (LLRW) burial site located on its Attleboro property.

Beginning August 31, 1992, and continuing through January 25, 1993, TI completed the excavation, processing, packaging, transportation, and disposal of approximately 62000 cu.ft. of LLRW contaminated soil and debris in accordance with its Remediation Plan (dated July 30, 1992). Remaining activities involve "Backfill and Restoration" activities. These include dewatering groundwater that infiltrated the excavation, removing a very small quantity of LLRW contaminated sediment, backfilling the excavation, restoring the site to original conditions, and submitting a final report to the NRC.

As of this writing, "Backfill and Restoration" activities are underway. After receipt of an approved "NPDES Permit Requirements Exclusion" from the EPA, dewatering operations commenced on May 14. Since then, contractors and resources have been scheduled to complete the remaining phases in a timely and efficient manner. Likewise, the site population has been notified of scheduled times and durations of parking lot closures and other inconveniences to their normal activities.

This past weekend, May 19 and 20, TI's Health Physics contractor performed radiological surveys in the excavation to more accurately define the sediments requiring removal. Subsequent activities will adhere as closely as possible to the following schedule:

All dates are for 1993

- Sediment Removal — May 26 to May 29
- Soil Sampling and Analysis — May 28 to June 2

  Gross Alpha Counting will occur simultaneously with "Sediment Removal."
  Samples will be collected according to the sampling grid pattern described in the Remediation Plan.
  Gamma Spec Analysis will be performed to verify the Gross Alpha results on a few selected samples.

- Backfill Operation — June 2 to June 9
- Final Walkover Survey — June 10 to June 16
- Restoration and Landscaping — June 17 to July 1
- Submit Final Report — August 20

Please feel free to contact me if you have any questions concerning the above information or any other related matter.

Sincerely,

MATERIALS AND CONTROLS GROUP
ENVIRONMENTAL, SAFETY, AND HEALTH DEPARTMENT

Michael J. Elliott
Engineering Manager

MJE:bvs

cc: Mr. Daniel V. Bartosh Jr., TI - Dallas
Mr. John O'Donnell, TI - Dallas
Mr. Richard L. Joosten Jr., TI - Dallas
Mr. Francis J. Veale Jr., TI - Dallas

ORISE

February 4, 1993

Mr. Jerry Roth
Region I
Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19400

SUBJECT: CONFIRMATORY ANALYSIS, GAMMA SPECTROMETRY AND ALPHA SCREENING, TEXAS INSTRUMENTS INCORPORATED, ATTLEBORO, MASSACHUSETTS

Dear Mr. Roth:

[illegible] Nuclear Regulatory Commission (NRC), the Texas Instruments [illegible] provided the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) with several soil samples for the purpose of evaluating the analytical results reported by the licensee. ESSAP has completed the gamma spectrometry analysis of these samples and offers the following data for your review.

The results of the ESSAP gamma spectrometry analysis are presented in Table 1. The results of the licensee's gamma spectrometry and alpha screening analyses are presented in Table 2, and are plotted in Figures 1 and 2. Based on a pair-wise comparison t-test, there are no statistically significant differences ($P > 0.6$) between the licensee's and the ESSAP gamma spectrometry data. In addition, for samples with a total uranium concentration of > 20 pCi/g, the licensee's alpha screening data are statistically identical ($p > 0.8$) to ESSAP's gamma spectrometry data. However, for samples with a total uranium concentration of < 20 pCi/g, the alpha screening data are statistically different ($p < 0.001$) from ESSAP's gamma spectrometry analysis. This fact should not be a concern because the alpha screening analysis appears to provide a more conservative estimate.

However, it should be noted that according to the licensee, the alpha screening data presented here are based on an average of 5 to 10 samples which tends to mask any significant variation [illegible] samples. Therefore, because only single measurements are taken at the [illegible] may still be a concern unless data to the contrary are presented. The uncertainties associated with these measurements, including those of gamma

spectrometry, may be rather high and cannot be accurately estimated. The method of statistical analysis utilized here does not take into account the level of uncertainty associated with individual measurements.

If there are any questions or you need additional information, please do not hesitate to contact me at (615) 576-[illegible] or Michele Landis at (615) 576-2908.

Sincerely,

[illegible]
Health Physics Project Leader
Environmental Survey
and Site Assessment Program

cc: E. Parrott, NRC/NMSS
T. Mo, NRC/NMSS
D. Tiktinsky, NRC/NMSS
J. Swift/[illegible] Brown, NRC/NMSS
J. Kinneman, NRC/Region I
M. Landis, ORISE
[illegible]
[illegible]
[illegible]

TABLE 1

ESSAP GAMMA SPECTROMETRY ANALYSIS OF SOIL SAMPLES TEXAS INSTRUMENTS, INC., ATTLEBORO, MASSACHUSETTS

Sample Identification[a]	Uranium Concentrations (pCi/g)[b]		
	U-235	U-238	Total Uranium[c]
[illegible]	0.1 ± 0.1	3.0 ± 0.9	5.3
MP-4	0.2 ± 0.1	5.0 ± 1.0	9.6
MP-5	0.2 ± 0.1	6.0 ± 1.0	11
[illegible]	0.2 ± 0.1	4.0 ± 1.0	13
MP-12	0.3 ± 0.1	8.0 ± 1.0	15
[illegible]	0.3 ± 0.1	8.0 ± 1.0	18
Rec. Pile	0.7 ± 0.1	12.0 ± 2.0	28
[illegible]	[illegible]	18.0 ± 3.0	36
[illegible]	[illegible]	36.0 ± 5.0	75
PS-114	1.3 ± 0.2	47.0 ± 7.0	77

[a]Sample identifications were provided by the Texas Instruments, Inc.
[b]Uncertainties represent the 95% confidence level based only on counting statistics.
[c]Total uranium concentrations are calculated based on a U-234 to U-238 activity ratio of 2.2:1.

TABLE 2

COMPARISON OF URANIUM CONCENTRATIONS IN SOIL SAMPLES AS DETERMINED BY ESSAP AND THE TEXAS INSTRUMENTS, INC.

Sample Identification	Total Uranium Concentration (pCi/g)[a]		
	Gamma Spectrometry		Alpha Screening
	ESSAP	TIA[b]	TIA
[illegible]	[illegible]	4.7	12.8
MP 4	[illegible]	21.8	[illegible]
MP 8	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	12.5	[illegible]
MP [illegible]	[illegible]	11.7	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
LLP 1	[illegible]	36.8	[illegible]
RS [illegible]	[illegible]	57.6	[illegible]
RS [illegible]	[illegible]	90.8	[illegible]

[illegible] activity ratio of [illegible] Attleboro, Massachusetts.

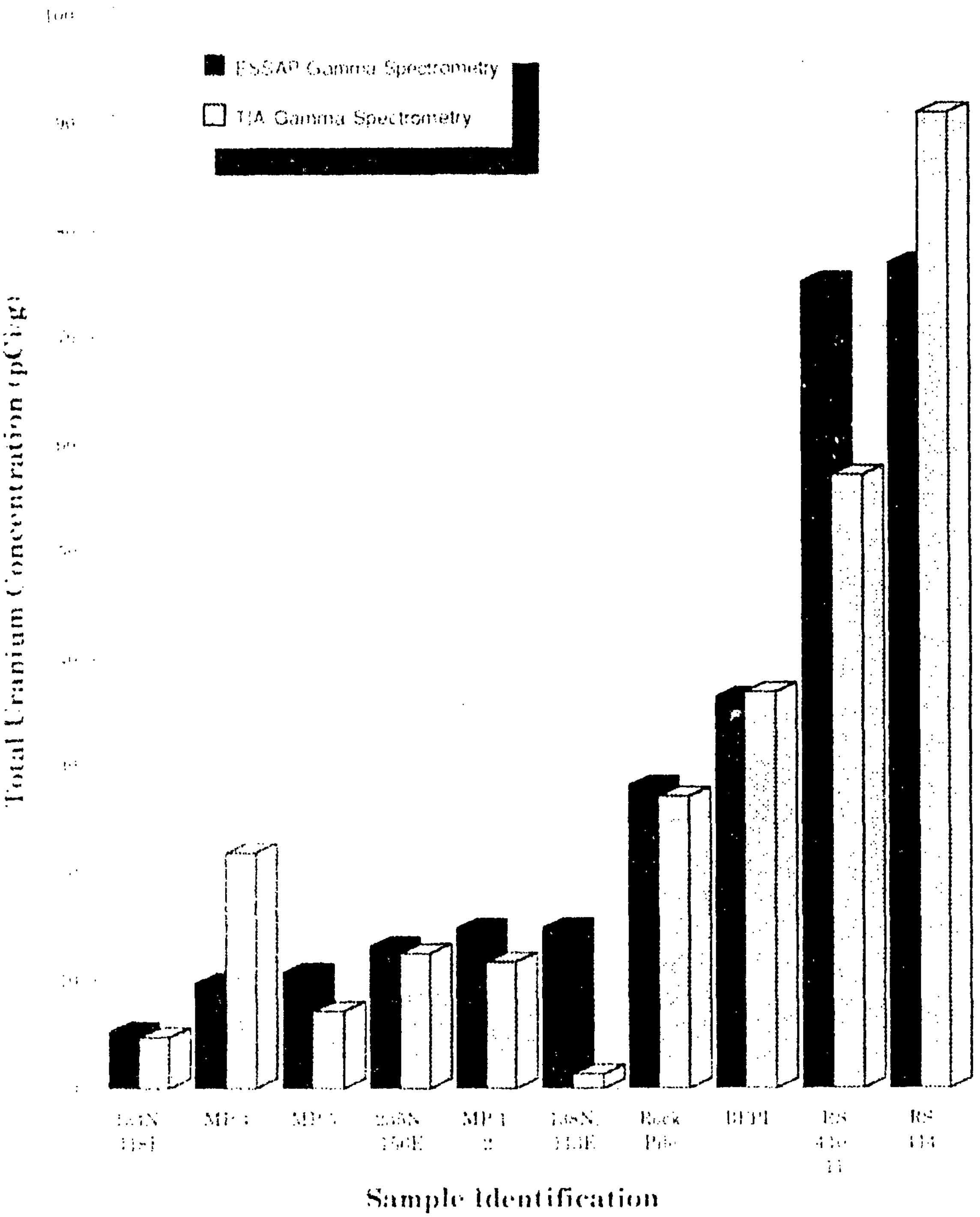


Figure 1. Comparison of ESSAP and [illegible] instrumental gamma spectrometry analysis.

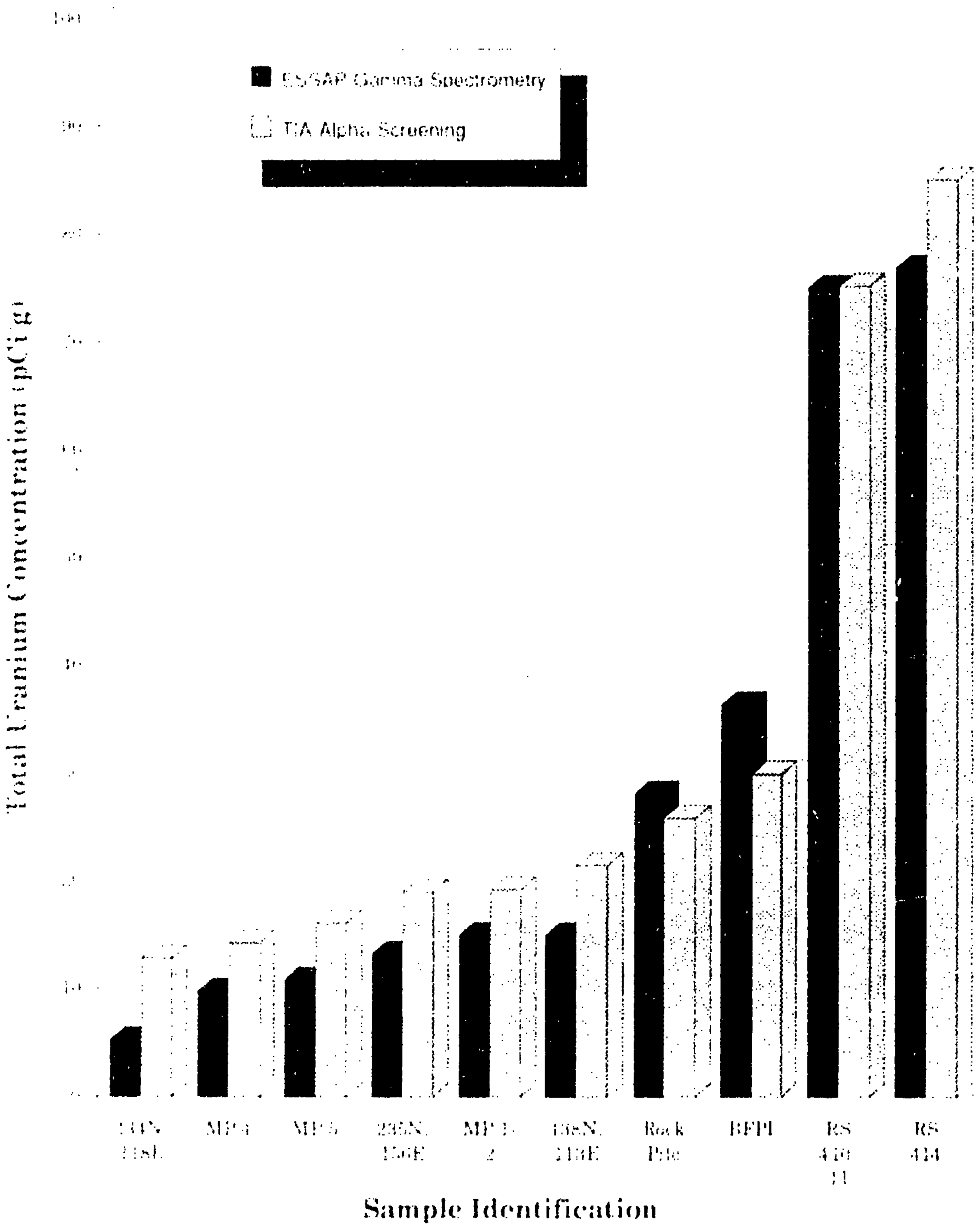


Figure [illegible]. Comparison of ESSAP gamma spectrometry and Isaacs Instruments alpha screening analysis.

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No.: 70-33/93-01

Docket No.: 70-33

License No.: SNM-23 Priority: 1 Category: UHFF

Licensee: Texas Instruments, Incorporated
34 Forest Street
Attleboro, Massachusetts 02702

Facility Name: HHIR Project

Inspection At: Attleboro, Massachusetts

Inspection Conducted: June 2, 1993

Inspector: 7/1/93 Date
I. Roth, Project Engineer
Facilities Radiation Protection Section (FRPS)
Facilities Radiological Safety and Safeguards
Branch (FRSSB)
Division of Radiation Safety and Safeguards

Approved by: 7-1-93 Date
W. Pasciak, Chief
FRPS, FRSSB
Division of Radiation Safety and Safeguards

Areas Inspected: Special, announced inspection by a region-based inspector to perform a radiological survey of portions of the onsite excavated area following remediation by the licensee.

Results: Preliminary results of the survey indicated that the licensee appeared to have completed remediation of the excavated area in an appropriate manner. No safety concerns or violations of regulatory requirements were identified.

9307200060 930707
PDR ADOCK 07000033
C PDR

Details

1.0 Individuals Contacted

M. J. Elliott, Manager, Environmental Engineering
M. Griffin, Project Manager
W. A. Lorenzen, Health Physicist
J. C. McWilliams, Health Physicist
W. Schuele, Attleboro Site Manager
E. J. Veale, Jr., Manager, Environmental Engineering/Industrial Hygiene

Other licensee representatives, employees and remediation contractor employees were also interviewed during this inspection.

2.0 Background

On December 14-16, 1992, the NRC contractor, the Oak Ridge Institute for Science and Education (ORISE), performed a verification survey of the remediated area of the Attleboro site. During that survey, it was determined from radiation levels (ranging from 20 to 40 times background) on the walls of the excavation that radioactive material remained that was above the 30 picocuries total uranium per gram of soil guidance value contained in the NRC approved Remediation Plan. In addition, analysis of soil samples taken by ORISE indicated that there were two locations on the bottom of the excavation that exceeded the NRC guidance value. Results of the ORISE survey are provided in Attachment 1. As a result, the licensee was requested by the inspector to perform additional remediation activities.

Since the December, 1992 NRC survey the licensee has performed additional onsite remediation, drained the groundwater out of the excavated area, and verified that the excavated area met the NRC guidance value of 30 picocuries total uranium per gram of soil.

Since, according to a May 25, 1993 letter to the NRC (Attachment 2), the licensee intended to backfill the excavation as soon as the final survey was completed, a special inspection was conducted on June 2, 1993 in order to verify that the bottom of the excavation met the NRC guidance value indicated above.

3.0 Conduct of the Verification Survey

The inspector performed the verification survey discussed in Paragraph 2.0. Surfaces adjacent to, in and on the walls of the excavation were scanned using a gamma scintillation detector. Micro R readings were taken at one meter above the surface at random locations, soil samples were taken from the two remediated areas on the bottom of the excavation and from two locations that exhibited elevated radiation readings during the scanning. The two elevated areas were remediated by the licensee prior to sampling by the inspector.

4.0 Preliminary Survey Results

4.1 Walkover Survey

A walkover survey was conducted in the excavated area by the inspector using a Ludlum Model 19 Analyzer equipped with a 1 inch sodium iodide scintillation detector. Prior to the survey, the instrument background was determined to be about 2500 counts per minute. Radiation levels in the excavated area were found to be between one and one and one half times background except in two elevated areas (grid location 188N X 153E, three times background; grid location [illegible]N X 12[illegible]E, two times background). Both elevated areas were immediately [illegible] by the licensee. Subsequent to remediation, the radiation levels in [illegible]

4.2 One Meter Gamma Survey

[illegible]

Grid Location	Results (Micro R/hr)	Grid Location	Results (Micro R/hr)
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	14
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	12
[illegible]	[illegible]	180N 150E	[illegible]
[illegible]	[illegible]	[illegible]	11

4.3 Soil Samples

[illegible]

Sample Identification	Preliminary Sample Result (picocuries total uranium/gram soil)
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The preliminary sample analysis results were obtained by alpha counting in the licensee's laboratory. This technique has been shown to be conservative (higher) when compared to the analytical results obtained in the ORISE laboratories as indicated in Attachment 3. The samples will be sent to the ORISE laboratories for verification analyses and the results will be provided in a subsequent inspection report.

5.0 Additional Actions Required

5.1 Licensee

Upon completion of the additional remediation activities, the licensee is expected to resurvey the [illegible] areas and provide the NRC with a revised final survey report. The expected schedule for completion of these activities is provided in Attachment [illegible].

5.2 NRC

Following receipt of the licensee's final survey report, the NRC contractor will [illegible] the licensee's survey [illegible] the applicable areas and will perform final confirmatory [illegible] of the surface of the remediated area.

6.0 Exit Interview

The inspector met with the licensee representatives identified in Paragraph 1.0 at the conclusion of the inspection on [illegible]. The scope of the inspection and the [illegible] were [illegible] and the [illegible].

ORISE

SUBJECT: INTERIM RADIOLOGICAL SURVEY LETTER REPORT FOR THE TEXAS INSTRUMENTS, INCORPORATED BURIAL SITE, ATTLEBORO, MASSACHUSETTS

[illegible] Assessment Program (ESSAP) of the Oak Ridge Institute [illegible] (ORISE) [illegible] radiological survey of the Texas [illegible] Attleboro, Massachusetts on December 15-16, 1998. [illegible] soil samples. ESSAP [illegible]

[illegible]

[illegible]

[illegible]

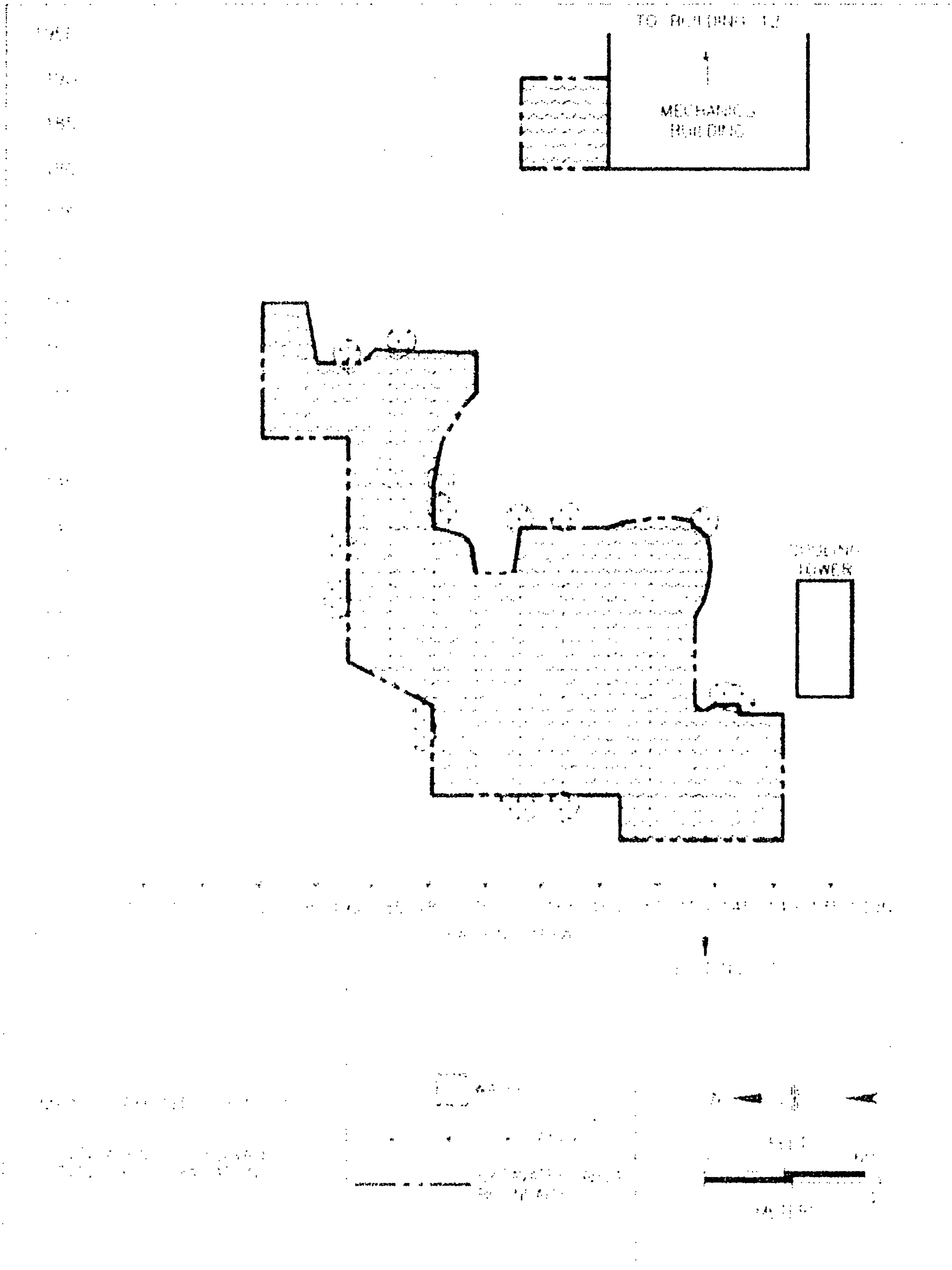
[illegible] with a total uranium concentration of 300 pCi/g was [illegible]. A second sample taken by the licensee at approximately [illegible] ESSAP [illegible] contained 88 pCi/g of total uranium.

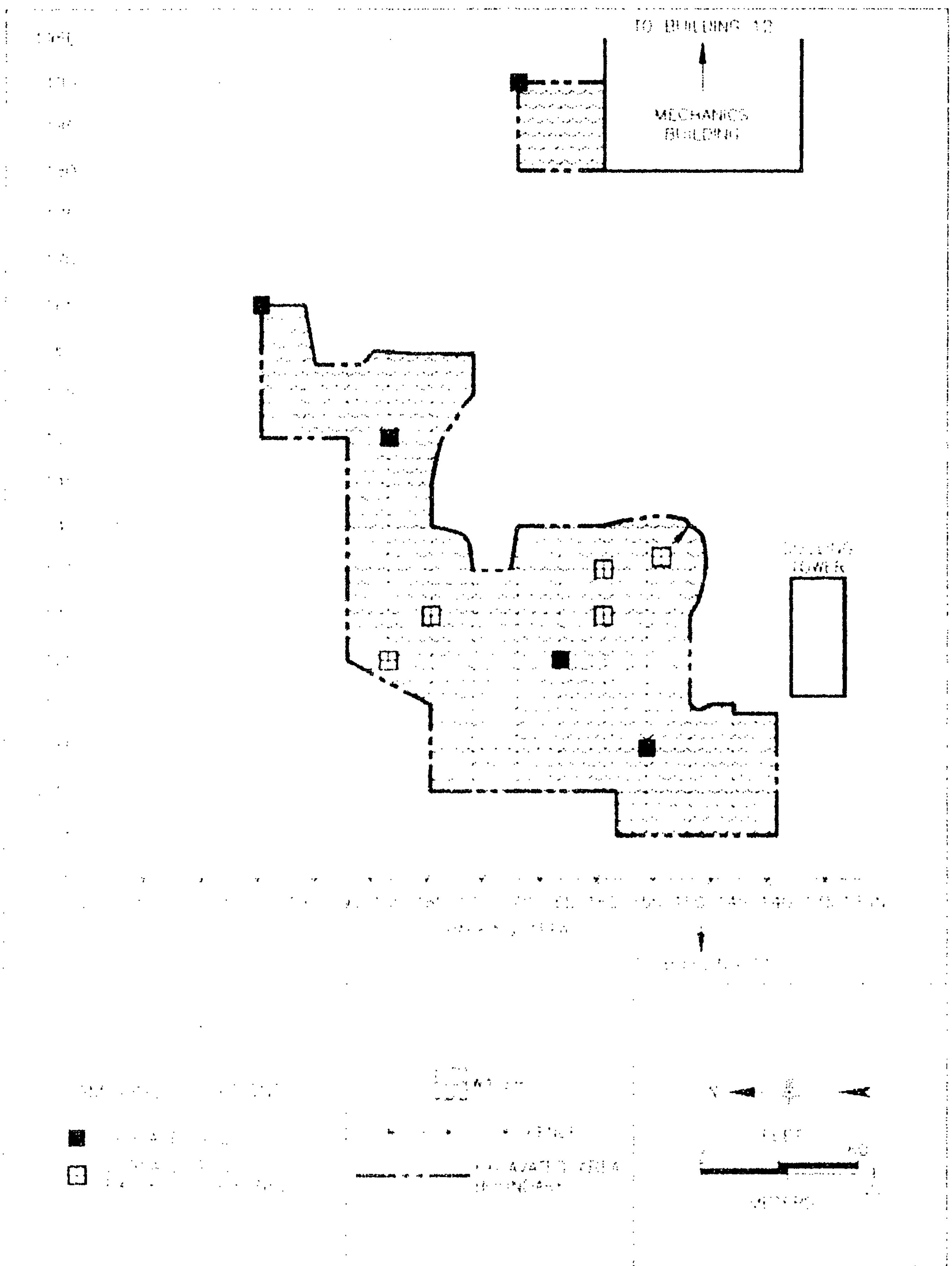
[illegible] 30 pCi/g. The total uranium [illegible] area exceeds this value. Furthermore, [illegible] ESSAP [illegible] that the full extent of the burial site [illegible] has not been determined.

[illegible] please [illegible]

TABLE 1
URANIUM CONCENTRATIONS IN SOIL SAMPLES
TEXAS INSTRUMENTS, INC.
ATTLEBORO, MASSACHUSETTS

Sample Location	Uranium Concentrations[a]		
	U-235	U-238	Total Uranium[b]
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]





TO BUILDING 12
MECHANICS BUILDING
TOWER
FEET

TEXAS INSTRUMENTS

May 25, 1993

Mr. Jerome Roth
Project Engineer - Fuel Facilities
UNITED STATES NUCLEAR
REGULATORY COMMISSION REGION I
475 Allendale Road
King of Prussia, PA 19406

Re: Texas Instruments Incorporated, S.N.M. License No. 23
Docket No. 70-33

Dear Mr. Roth:

This letter will serve to document certain information that was conveyed to you orally during telephone conversations on May 5 and May 20, 1993. As requested, Texas Instruments Incorporated (TI) is submitting information concerning the status and schedule of the remaining activities to remediate the former Low Level Radioactive Waste (LLRW) burial site located on its Attleboro property.

Beginning August 31, 1992, and continuing through January 25, 1993, TI completed the excavation, processing, packaging, transportation, and disposal of approximately 62000 cu.ft. of LLRW contaminated soil and debris in accordance with its Remediation Plan (dated July 30, 1992). Remaining activities involve "Backfill and Restoration" activities. These include dewatering groundwater that infiltrated the excavation, removing a very small quantity of LLRW contaminated sediment, backfilling the excavation, restoring the site to original conditions, and submitting a final report to the NRC.

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All dates are for 1993

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- Soil Sampling and Analysis — May 28 to June 2

  - Gross Alpha Counting will occur simultaneously with "Sediment Removal."
  - Samples will be collected according to the sampling grid pattern described in the Remediation Plan.
  - Gamma Spec Analysis will be performed to verify the Gross Alpha results on a few selected samples.

- Backfill Operation — June 2 to June 9
- Final Walkover Survey — June 10 to June 16
- Restoration and Landscaping — June 17 to July 1
- Submit Final Report — August 20

Please feel free to contact me if you have any questions concerning the above information or any other related matter.

Sincerely

MATERIALS AND CONTROLS GROUP
ENVIRONMENTAL, SAFETY, AND HEALTH DEPARTMENT

Michael J. Elliott
Engineering Manager

MJE:bvs

cc: Mr. Daniel V. Bartosh Jr., TI - Dallas
Mr. John O'Donnell, TI - Dallas
Mr. Richard L. Joosten Jr., TI - Dallas
Mr. Francis J. Veale Jr., TI - Dallas

ORISE

February 4, 1993

Mr. Jerry Roth
Region I
Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

SUBJECT: CONFIRMATORY ANALYSIS, GAMMA SPECTROMETRY AND ALPHA SCREENING, TEXAS INSTRUMENTS INCORPORATED, ATTLEBORO, MASSACHUSETTS

Dear Mr. Roth:

[illegible] of the Nuclear Regulatory Commission (NRC), the Texas Instruments Incorporated provided the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) with several soil samples for the purpose of evaluating the analytical results reported by the licensee. ESSAP has completed the gamma spectrometry analysis of these samples and offers the following data for your review.

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However, it should be noted that according to the licensee, the alpha screening data presented here are based on an average of 5 to 10 samples which tends to mask any significant variation [illegible] the individual samples. Therefore, because only single measurements are taken at the [illegible] may still be a concern unless data to the contrary are presented. The uncertainties associated with these measurements, including those of gamma

spectrometry, may be rather high and cannot be accurately estimated. The method of statistical analysis utilized here does not take into account the level of uncertainty associated with individual measurements.

If you have any questions or you need additional information, please do not hesitate to contact me at (615) 576-5255 or Michele Landis at (615) 576-2908.

Sincerely,

[illegible]
Health Physics Project Leader
Environmental Survey
and Site Assessment Program

cc: [illegible] Parrott, NRC/NMSS
T. Mo, NRC/NMSS
D. Tiktinsky, NRC/NMSS
J. Swift/F. Brown, NRC/NMSS
J. Kinneman, NRC Region I
M. Landis, ORISE
[illegible] OPSM
[illegible]
File [illegible]

TABLE 1

ESSAP GAMMA SPECTROMETRY ANALYSIS OF SOIL SAMPLES TEXAS INSTRUMENTS, INC., ATTLEBORO, MASSACHUSETTS

Sample Identification[a]	Uranium Concentrations (pCi/g)[b]		
	U-235	U-238	Total Uranium[c]
[illegible]	0.1 ± 0.1	3.0 ± 0.9	5.3
MP 4	0.2 ± 0.1	5.0 ± 1.0	9.6
MP 5	0.2 ± 0.1	6.0 ± 1.0	11
[illegible]	0.1 ± 0.1	4.0 ± 1.0	13
MP 12	0.3 ± 0.1	8.0 ± 1.0	15
[illegible]	0.3 ± 0.1	8.0 ± 1.0	15
[illegible]	0.7 ± 0.1	12.0 ± 2.0	28
[illegible]	[illegible]	18.0 ± 3.0	36
[illegible]	[illegible] ± 0.2	36.0 ± 5.0	75
[illegible]	1.3 ± 0.2	47.0 ± 7.0	77

[a] Sample identifications were provided by the Texas Instruments, Inc.
[b] Uncertainties represent the 95% confidence level based only on counting statistics.
[c] Total uranium concentrations are calculated based on a U-234 to U-238 activity ratio of 2.2:1.

TABLE 2

COMPARISON OF URANIUM CONCENTRATIONS IN SOIL SAMPLES AS DETERMINED BY ESSAP AND THE TEXAS INSTRUMENTS, INC.

Sample Identification	Total Uranium Concentration (pCi/g)[a]		
	Gamma Spectrometry		Alpha Screening
	ESSAP	TIA[b]	TIA
[illegible]	[illegible]	4.7	12.8
MP 4	[illegible]	[illegible]	[illegible]
MP 8	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
MP [illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
LEP 1	[illegible]	36.8	[illegible]
RS [illegible]	[illegible]	87.6	78.3
RS [illegible]	[illegible]	90.8	[illegible]

[illegible] activity ratio of [illegible]
[illegible] Massachusetts

[illegible]

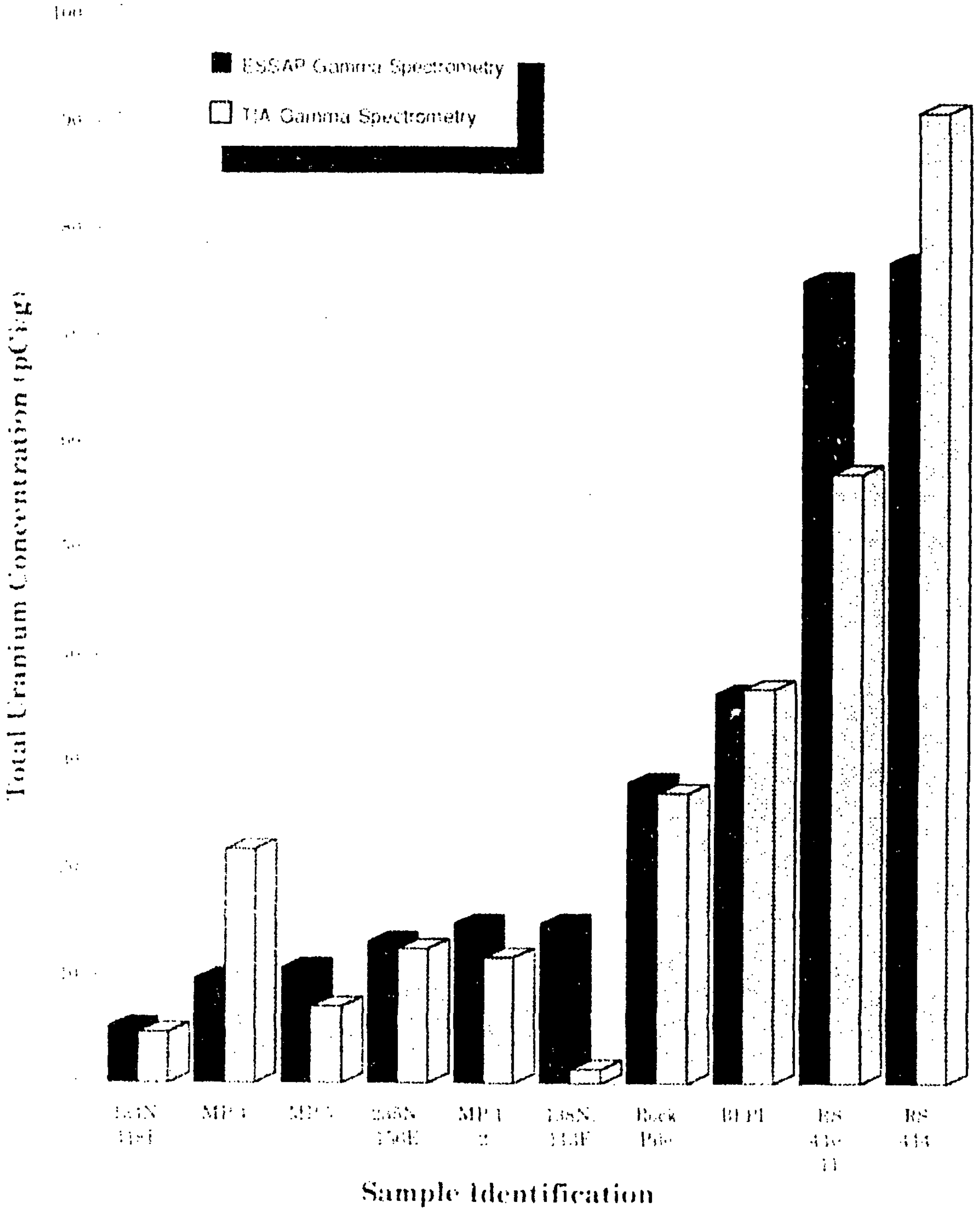

Figure 1. Comparison of ESSAP and [illegible] instrumental gamma spectrometry analysis.

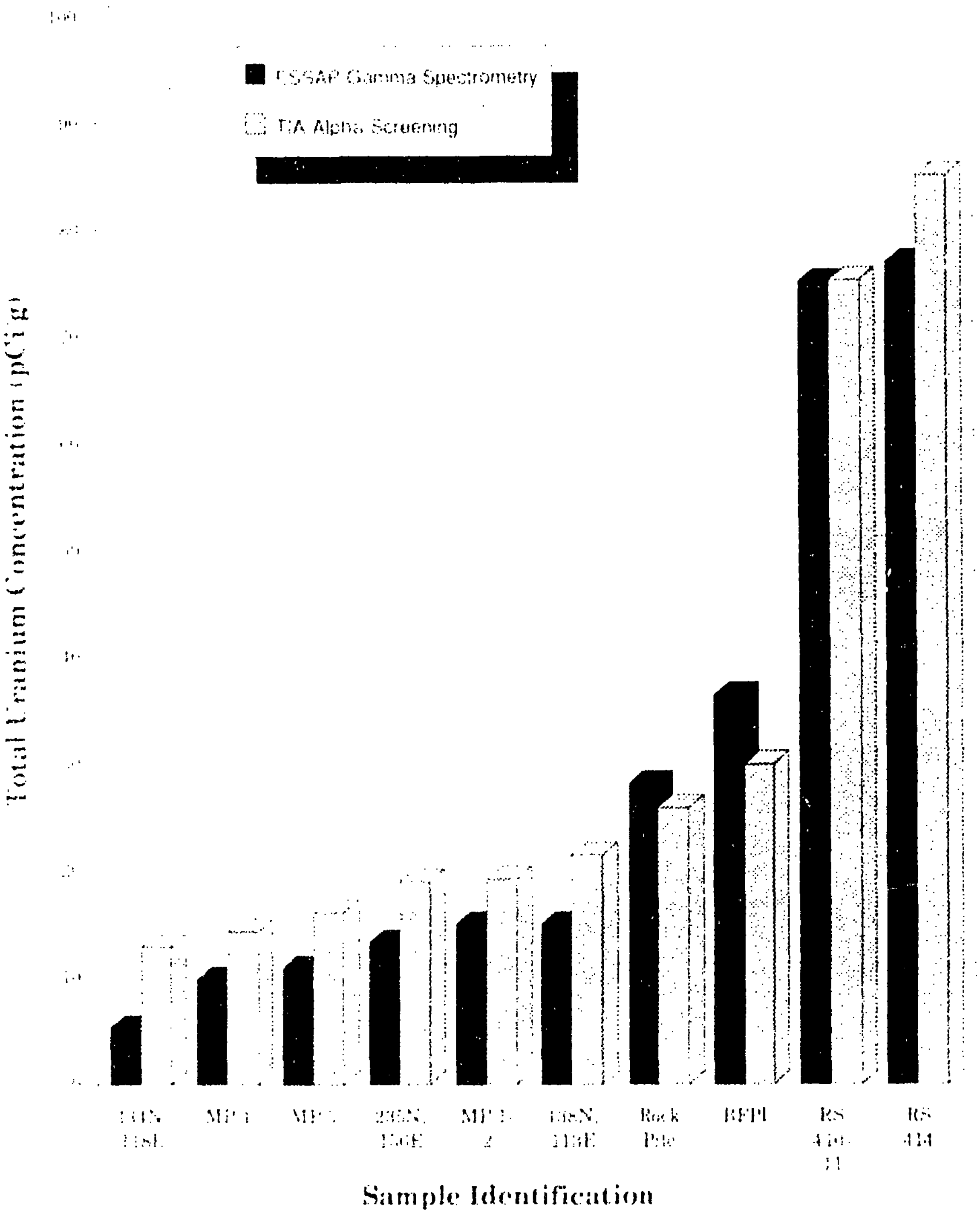

Figure [illegible]. Comparison of ESSAP gamma spectrometry and [illegible] Instruments alpha screening analysis.

ORISE

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

August 17, 1993

Mr. Jerome Roth
Region I
U. S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

DOCKET # 70-33

Subject: RESULTS OF SOIL SAMPLE ANALYSIS, TEXAS INSTRUMENTS, INC. ATTLEBORO, MASSACHUSETTS

Dear Mr. Roth:

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) has completed the analysis of four soil samples which you recently provided to us. The samples were analyzed by gamma spectrometry. The total uranium concentrations ranged from 5.8 to 38 pCi/g. The only sample exceeding the 30 pCi/g guideline was the sample taken at grid coordinates 177.5 N, 122 E.

If there are any questions or you need additional information, please do not hesitate to contact me at (615) 576-3355 or Michele Landis (615) 576-2908.

Sincerely,

Armin J. Ansari, PhD
Project Leader
Environmental Survey and
Site Assessment Program

AJA: mp

cc: J. Parrott, NRC/6H3
~~T. Mo, NRC/6H3~~
D. Tiktinsky, NRC/6E6
J. Kinneman, NRC/Region I
NRC/PMDA, 6E6
J. Berger, ORISE/ESSAP
M. Landis, ORISE/ESSAP
File/205

Central File

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CF ADOCK 07000033
CF

DFX2

TABLE 1

URANIUM CONCENTRATIONS IN SOIL SAMPLES [a]
TEXAS INSTRUMENTS, INC.
ATTLEBORO, MASSACHUSETTS

	Uranium Concentrations [b]		
Sample Location	U-235	U-238	Total Uranium [c]
185 N. 157 E	0.4 ± 0.1	5.1 ± 1.2	14
182 N. 132 E	0.6 ± 0.1	11.1 ± 1.2	25
162 N. 130 E	0.2 ± 0.1	1.2 ± 1.0	5.8
177.5 N. 122 E	0.8 ± 0.1	19.2 ± 2.3	38

[a] Samples were provided to ESSAP by the NRC

[b] Uncertainties represent the 95% confidence level based only on counting statistics

[c] Total uranium concentrations are calculated based on a U-234 to U-235 activity ratio of 22:1

NOV 02 1993

License No. SNM-23 Docket No. 070-00033

Oak Ridge Institute For Science and Education
ATTN: James Berger
Director, Environmental Survey and
Site Assessment Program
P. O. Box 117
Oak Ridge, Tennessee 37831-0117

Dear Mr. Berger:

Subject: CONFIRMATORY SURVEY - TEXAS INSTRUMENTS, ATTLEBORO, MASSACHUSETTS

As recently discussed with Armin Ansari of your staff, Region I requests that the Oak Ridge Institute for Science and Education (ORISE) conduct a confirmatory survey at the Texas Instruments, Inc. facility in Attleboro, Massachusetts. The licensee reports that they have completed the remediation of the contaminated areas of the site identified in a previous ORISE survey. Dr. Ansari confirmed that your office has received a copy of the latest confirmatory survey provided by the licensee.

From preliminary discussions with Dr. Ansari and based on our own staff assessment, we believe that you will need the assistance of a drilling contractor to obtain subsurface soil samples for the evaluation of buried licensed material. We have forwarded a completed Request for Technical Assistance (RFTA, Exhibit 1 from NRC Manual Chapter 312) to our headquarters to initiate the confirmatory survey. We would like to receive a cost estimate and survey schedule for review and approval as soon as reasonably possible.

If you have any technical questions regarding this letter please contact Mark Roberts of my staff at (215) 337-5094 or me at (215) 337-5252. Thank you in advance for your assistance and continued cooperation.

Sincerely,

Original Signed By:

John D. Kinneman, Chief
Site Decommissioning Section
Division of Radiation Safety
and Safeguards

9311180[illegible]5 931102
PDR ADOCK 07000033
C PDR

160011

OFFICIAL RECORD COPY

NOV 0 2 1998

cc:
Michelle Landis, ORISE
Armin Ansari, ORISE

Oak Ridge Institute for Science and Education 3 NOV 07 1993

Dist:
Region I Docket Room (w/concurrences)
J. Kinneman, RI
D. Tiktinsky, NMSS
T. Mo, NMSS

RI:DRSS

RI:DRSS

OFFICIAL RECORD COPY

ORISE

December 1, 1993

Mark C. Roberts
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19400

SUBJECT: COMMENTS ON THE FINAL REPORT: "REMEDIATION OF THE FORMER RADIOACTIVE WASTE BURIAL SITE" AT TEXAS INSTRUMENT INCORPORATED, ATTLEBORO, MASSACHUSETTS. [Docket 070-00033]

Dear Mr. Roberts:

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) has reviewed the subject document. The attached comments are offered for your consideration.

If there are any questions regarding these comments, please direct them to me at (615) 576-3355 or Michele Landis at (615) 576-2908.

Sincerely,

Armin J. Ansari
Project Leader
Environmental Survey and
Site Assessment Program

AJA:tlc

Attachment

cc: J. Parrott, NRC/NMSS, 6H3
T. ~~Mo, NRC/NMSS, 6H3~~ → CENTRAL FILES
D. Tiktinsky, NRC/NMSS
J. Kinneman, NRC/Region I
M. Landis, ORISE
J. Berger, ORISE
PMDA, 6E6
File #205

General Comments

1. Primarily, the licensee has used the Alpha Screening method for analysis of soil samples. In ESSAP's opinion, this appears to be an appropriate method of analysis as compared with gamma spectrometry (letter from A. Jaberaboansari to J. Roth, 2/4/93).

2. Although the total uranium concentration in several soil samples exceeds the 30 pCi/g criterion, the licensee demonstrates that the average concentration within a 10 m x 10 m grid block is less than 30 pCi/g of total uranium. This provision for averaging within a grid block was included in the licensee's Remediation Plan (Appendix J) and approved by the NRC.

   On page 5 of Appendix J, 10 m^2 should be 100 m^2.

3. The exposure rate guideline applicable to this site was not included in the licensee's Remediation Plan. However, the exposure rate guideline of 10 μR/h above background was used by the licensee in the final survey. This is consistent with the Branch Technical Position, but does not agree with the August 1991 Policy and Guideline FC 91-2, Standard Review Plan, which indicates an average exposure rate guideline of 5 μR/h above background.

Specific Comments

1. Figure 5.1. The two different symbols (closed and open circles) are not defined.

2. Appendix C, page C-2. Minor error in calculations: 0.243 cm equals 0.096 inches.

3. Appendix C, Attachment , Gross Alpha Screening Data. Column headings "NC1", "NC2", "EC1", and "EC2" are not defined. Also, it is not clear what pages are referred to in the "page" column.

   Also, this attachment is to include diagrams indicating sample locations (as stated on page 1 of Appendix D). These diagrams are not included.

4. Appendix D. Bore hole sampling locations and drilling logs are provided in Attachments 1 and 2. However, it appears that the information presented here can not be cross referenced to the alpha screening data in Appendix C, by either the sample ID number or the sampling location. Such information should be provided.

5. Appendix E, Table 1. The four locations with the highest gamma scan results were adjacent to each other and covered an approximately 75 m^2 area. Was any soil sample analysis performed in this area?

6. Appendix E, Table 5. "REF" is not defined.

7. Appendix E. The use of a NaI gamma scintillation probe to measure exposure rates is acceptable only when the probe is properly cross calibrated. In addition, Co-60 is not an appropriate calibration source for determining exposure rates when the contaminant is uranium. A similar comment was provided earlier (letter from A. Jaberaboansari to J. Roth, 12/4/92). In spite of this, the survey results do not indicate a potential problem in meeting the 10 μR/h limit.

8. Appendix F, Section 3.0. Please indicate the name of the laboratory at which the groundwater samples were analyzed.

O R I S E

December 3, 1993

Mark C. Roberts
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406

SUBJECT: PROPOSED CONFIRMATORY SURVEY PLAN FOR THE TEXAS INSTRUMENTS INCORPORATED BURIAL SITE, ATTLEBORO, MASSACHUSETTS. [Docket 070-00033]

Dear Mr. Roberts:

Enclosed is a copy of the subject document for your review and comment. The survey is tentatively scheduled to begin on December [illegible]. Please direct any questions or comments to me at (615) 576-[illegible] or Michele Landis at (615) 576-[illegible].

Sincerely,

Armin J. Ansari, Ph.D.
Project Leader
Environmental Survey and
Site Assessment Program

AJA:nk

Enclosure

c: E. Parrott, NRC/NMSS/OHS
~~T. Mo, NRC/NMSS, 4E4~~
D. Tiktinsky, NRC/NMSS
J. Kinneman, NRC/Region I
M. Landis, ORISE
J. Berger, ORISE
PMDA File
File #268

9312170159 931203
PDR ADOCK 07000033
C PDR

PROPOSED CONFIRMATORY SURVEY PLAN FOR THE TEXAS INSTRUMENTS INCORPORATED BURIAL SITE, ATTLEBORO, MASSACHUSETTS

SITE HISTORY AND DESCRIPTION

The Texas Instruments Incorporated site at Attleboro, Massachusetts, was owned and operated by M[illegible] (M&C) [illegible] 1959, at which time M&C merged with Texas Instruments. [illegible] of M&C began processing nuclear materials in 1952, and [illegible] uranium foils for [illegible] experiments and fuel components [illegible] U.S. Navy. [illegible] material license D-549 was issued [illegible] 50 pounds of refined source material [illegible] was acquired and used [illegible] special nuclear material license No. SNM-23 was [illegible] for fabrication of the fuel [illegible] 1959, Texas Instruments continued fabricating [illegible]. Also, source materials, i.e., [illegible] for sale to various corporations.

[illegible] that uranium and [illegible] were collected in 55-gallon [illegible] were buried on site [illegible] made from 1958 to 196[illegible], and the burial site was [illegible] of contaminated ductwork, [illegible]. Work with nuclear [illegible] was terminated in 1974. The [illegible] by the Nuclear Regulatory Commission (NRC) [illegible].

Prepared by the Environmental Survey and Site Assessment Program of Oak Ridge Institute for Science and Education, Oak Ridge, TN, under interagency agreement (NRC Fin. A-9076) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy.

RESPONSIBILITY

DOCUMENT REVIEW

PROCEDURES

[illegible] will be noted for further [illegible]

Exposure Rate Measurements

[illegible] USNAP [illegible] of this facility, will be [illegible]

[illegible] above the surface at a minimum of [illegible] Pressurized Ionization Chamber [illegible]

SOIL SAMPLING

[illegible] grid blocks in the area [illegible] of five surface soil samples will be collected [illegible] grid coordinates USN [illegible] gamma activity.

[illegible] around the former [illegible] approximately 2 meters [illegible] meters from the edge of the [illegible] For the remaining perimeter area [illegible] Additional boreholes may be [illegible] with the NRC site [illegible] scanned for gamma activity using a collimated NaI [illegible] Systematic soil samples will be [illegible] the middle [illegible] and the bottom (200-215 cm) of [illegible] of elevated gamma activity.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data will be returned to ORISE's ESSAP laboratory in Oak Ridge, TN for analysis and interpretation. Soil samples will be analyzed by gamma spectrometry and the results reported in pCi/g. Exposure rates will be reported in μR/h. The data generated will be compared with the licensee's documentation and NRC guidelines established for release to unrestricted use. Results will be presented in a report and provided to the NRC for review and [illegible].

GUIDELINES

[illegible] pCi/g [illegible] The exposure rate limit [illegible]

TENTATIVE SCHEDULE

[illegible]	December 14-16, 1993
[illegible]	January 1994
[illegible]	Ma[illegible] 1994

LIST OF CURRENT PROCEDURES

Applicable procedures from ORISE/ESSAP Survey Procedures Manual include:

[illegible] Check Out

[illegible] General Information

[illegible] Electronic Calibration of Ratemeters

[illegible] Gamma Scintillation Detector Check Out and Cross Calibration

[illegible] Alpha Scintillation Detector Calibration and Check Out

[illegible] GM Detector Calibration and Check Out

[illegible] Field Measuring Tape Calibration

REFERENCES

[illegible] Massachusetts," Oak [illegible]

[illegible] Incorporated Burial [illegible] November 28, 1992

[illegible] "Interim [illegible] Incorporated Burial Site", January [illegible]

[illegible]

[illegible] Release for [illegible] Special Nuclear [illegible] Fuel Cycle and Material [illegible]

[illegible] Under 10 CFR Parts [illegible] D.C., 1991

APPENDIX A

COST ESTIMATE*
CONFIRMATORY SURVEY
FOR THE TEXAS INSTRUMENTS
INCORPORATED BURIAL SITE,
ATTLEBORO, MASSACHUSETTS

[illegible]

[illegible] document reviews, survey plan, the [illegible] equipment calibration and [illegible]

[illegible]

[illegible] performing the following: gamma [illegible] The on-site expenses also include [illegible] Oak Ridge.

[illegible]

[illegible] the city facilities, rental vehicle, [illegible]

[illegible]

[illegible] by gamma spectrometry.

Report Preparation [illegible]

[illegible] tabulation of data, [illegible] word processing and [illegible]

Total Cost Estimate* $48,400

*Estimates are for survey activities described in this survey plan. Reduction or increase in the scope of the survey would result in changes in the original estimate in the "on-site activities" and "sample analysis" categories. Due to the nature of the survey, this estimate is a best guess. Site and weather conditions and survey findings may change the scope of the survey and increase or decrease the cost estimate. Major changes to the scope of the survey, if necessary, will be made only after consultation with the NRC site coordinator.

PROPOSED CONFIRMATORY SURVEY PLAN FOR THE TEXAS INSTRUMENTS INCORPORATED BURIAL SITE, ATTLEBORO, MASSACHUSETTS

SITE HISTORY AND DESCRIPTION

[illegible] Texas Instruments Incorporated site at Attleboro, Massachusetts, was owned and operated by M[illegible] MAC merged with Texas Instruments [illegible] of MAC [illegible] processing nuclear materials in 1952, and [illegible] for [illegible] experiments and fuel components [illegible] material License D-549 was issued [illegible] refined source material [illegible] was acquired and used [illegible] License No. SNM-23 was [illegible] for fabrication of the fuel [illegible] Texas Instruments continued fabricating [illegible] Also, source materials, i.e., [illegible] corporations.

[illegible] that uranium and [illegible] were collected in 55 gallon [illegible] or were buried on-site in [illegible] from 1958 to [illegible], and the burial site was [illegible] of contaminated ductwork. [illegible] Work with nuclear [illegible] was terminated in 1974. The interior [illegible] by the Nuclear Regulatory Commission (NRC) [illegible].

Prepared by the Environmental Survey and Site Assessment Program of Oak Ridge Institute for Science and Education, Oak Ridge, TN, under interagency agreement (NRC Fin. A-9076) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy.

[illegible] Oak Ridge National Laboratory (ORNL) [illegible] during April and May [illegible] Oak Ridge Institute for [illegible] December of [illegible]

[illegible] (ORISE) [illegible]

OBJECTIVE

[illegible]

RESPONSIBILITY

DOCUMENT REVIEW

PROCEDURES

[illegible] will be noted for further [illegible]

Exposure Rate Measurements

[illegible] ESSAP surveys of this facility, will be [illegible]

[illegible] a minimum of 10 [illegible] Pressurized Ionization [illegible]

SOIL SAMPLING

[illegible] grid blocks in the area [illegible] surface soil samples will be collected [illegible] the area between grid coordinates 185N 170E [illegible] gamma activity.

[illegible] drilled [illegible] around the former [illegible] approximately 2 meters [illegible] meters from the edge of the [illegible] For the remaining perimeter area, [illegible] Additional boreholes may be [illegible] with consultation with the NRC site [illegible] scanned for gamma activity using a collimated NaI [illegible] Systematic soil samples will be [illegible] middle (100-115 cm) and the bottom (200-215 cm) of [illegible] collected at locations of elevated gamma activity.

SAMPLE ANALYSIS AND DATA INTERPRETATION

[illegible] data will be returned to ORISE's ESSAP laboratory in Oak Ridge, TN for analysis and [illegible]. Soil samples will be analyzed by gamma spectrometry and the results reported in pCi/g. Exposure rates will be reported in μR/h. The data generated will be compared with the licensee's documentation and NRC guidelines established for release to [illegible] use. Results will be presented in a report and provided to the NRC for review and [illegible].

GUIDELINES

[illegible] pCi/g. [illegible] exposure rate limit [illegible]

TENTATIVE SCHEDULE

[illegible]	December [illegible], 1993
[illegible]	[illegible], 1994
[illegible]	May [illegible], 1994

LIST OF CURRENT PROCEDURES

[illegible] ORISE/ESSAP Survey Procedures Manual [illegible]

- [illegible] Check-Out
- [illegible]
- [illegible] Calibration of Ratemeters
- [illegible] Scintillation Detector Check-Out and Cross Calibration
- [illegible] Detector Calibration and Check-Out
- [illegible] Detector Calibration and Check-Out
- [illegible] Measuring Tape Calibration

REFERENCES

[illegible] Massachusetts," Oak [illegible]

[illegible] Incorporated Burial [illegible] November 28, 1992

[illegible] "Interim [illegible] Burial Site", January [illegible]

[illegible] Report [illegible]

[illegible] Special Nuclear [illegible] and Material [illegible]

[illegible] CFR Parts [illegible] D.C. 1991

APPENDIX A

COST ESTIMATE*
CONFIRMATORY SURVEY
FOR THE TEXAS INSTRUMENTS
INCORPORATED BURIAL SITE,
ATTLEBORO, MASSACHUSETTS

[illegible]

[illegible] document reviews, survey plan, the [illegible] equipment calibration and [illegible]

[illegible]

[illegible] performing the following: gamma [illegible] The on site expenses also include [illegible] to Oak Ridge.

[illegible]

[illegible] the site vicinity, rental vehicle, [illegible]

[illegible]

[illegible] samples by gamma spectrometry.

Report Preparation ([illegible])

[illegible] tabulation of data, [illegible] draft and final reports, word processing and [illegible]

Total Cost Estimate = $48,400

These costs are for survey activities described in this survey plan. Reduction or increase in the scope of the survey would result in changes in the original estimate in the "on-site activities" and "sample analysis" categories. Due to the nature of the survey, this estimate is a best guess. Site and weather conditions and survey findings may change the scope of the survey and increase or decrease the cost estimate. Major changes to the scope of the survey, if necessary, will be made only after consultation with the NRC site representative.

ORISE

January 14, 1994

Mark C. Roberts
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19400

SUBJECT: DRAFT REPORT--CONFIRMATORY SURVEY OF THE TEXAS INSTRUMENTS, INC. FORMER BURIAL SITE, ATTLEBORO, MASSACHUSETTS [DOCKECT 070-00033]

Dear Mr. Roberts:

Enclsoed are three copies of the subject document for your review and comment. Please direct your comments or questions to me at (615) 576-3355 or Michele Landis at (615) 576-2908.

Sincerely,

Armin J. Ansari, Ph.D.
Project Leader
Environmental Survey and
Site Assessment Program

AJA:rde

Enclosure

cc: J. Parrott, NRC/NMSS, 6H3
~~T. Mo, NRC/NMSS, 4E4~~ Central Files
D. Tiktinsky, NRC/NMSS
J. Kinneman, NRC/Region I
M. Landis, ORISE
J. Berger, ORISE
PMDA, 6E6
File #205

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PDR ADOCK 07000033
C PDR

160151

CONFIRMATORY SURVEY OF THE TEXAS INSTRUMENTS, INC. FORMER BURIAL SITE ATTLEBORO, MASSACHUSETTS

[DOCKET 070-00033]

A. J. ANSARI

Prepared for the
U.S. Nuclear Regulatory Commission
Region I Office

ORISE

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

Environmental Survey and Site Assessment Program
Energy/Environment Systems Division

CONFIRMATORY SURVEY
OF THE TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Prepared by

A. J. Ansari

Environmental Survey and Site Assessment Program
Energy/Environment System Division
Oak Ridge Institute for Science and Education
Oak Ridge, Tennessee 37831-0117

Prepared for the

U.S. Nuclear Regulatory Commission
Region I Office

January 1994

DRAFT REPORT

This report is based on work performed under an Interagency Agreement (NRC Fin. No. A-9076) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. Oak Ridge Institute for Science and Education performs complementary work under contract number DE-AC05-76OR00033 with the U.S. Department of Energy.

CONFIRMATORY SURVEY OF THE TEXAS INSTRUMENTS, INC. FORMER BURIAL SITE ATTLEBORO, MASSACHUSETTS

Prepared by: ______________________________ Date: __________
A. J. Ansari, Project Leader
Environmental Survey and Site Assessment Program

Reviewed by: ______________________________ Date: __________
W. L. Beck, Acting Laboratory Manager
Environmental Survey and Site Assessment Program

Reviewed by: ______________________________ Date: __________
M. R. Landis, Project Manager
Environmental Survey and Site Assessment Program

Reviewed by: ______________________________ Date: __________
A. T. Payne, Quality Assurance Officer
Environmental Survey and Site Assessment Program

Reviewed by: ______________________________ Date: __________
J. D. Berger, Program Director
Environmental Survey and Site Assessment Program

ACKNOWLEDGEMENTS

The author would like to acknowledge the significant contributions of the following staff members:

FIELD STAFF

D. M. Nugent
J. L. Payne
S. E. Potter

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R. L. Epperson
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S. T. Shipley

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D. A. Cox
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K. E. Waters

ILLUSTRATOR

M. A. Henke
T. D. Herrera

TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

ASME	American Society of Mechanical Engineers
cm	centimeter
cm^2	square centimeter
cpm	counts per minute
CPS	Creative Pollution Solutions
EML	Environmental Measurement Laboratory
EPA	Environmental Protection Agency
ESSAP	Environmental Survey and Site Assessment Program
m	meter
m^2	square meter
M&C	Metals and Controls, Incorporated
MDA	minimum detectable activity
NaI	sodium iodide
NIST	National Institute for Standards Technology
NRC	Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocurie's per gram
PIC	Pressurized Ionization Chamber
RSAP	Radiological Site Assessment Program
TI	Texas Instruments, Incorporated
μR/h	microroentgen per hour

CONFIRMATORY SURVEY OF THE TEXAS INSTRUMENTS, INC. FORMER BURIAL SITE ATTLEBORO, MASSACHUSETTS

INTRODUCTION AND SITE HISTORY

The Texas Instruments Incorporated site at Attleboro, Massachusetts, was owned and operated by Metals and Controls, Inc. (M&C) until 1959, at which time M&C merged with Texas Instruments, Incorporated (TI). The General Plate Division of M&C began processing nuclear materials in 1952, and between 1952 and 1959 fabricated uranium foils for reactor experiments and fuel components and complete reactor fuel cores for the U.S. Navy. Source material license D-549 was issued permitting acquisition and title to not more than 22.7 kg (50 pounds) of refined source material for use in the production of uranium foils; additional source material was acquired and used under contract with the U.S. Government. Special nuclear materials license No. SNM-23 was issued, permitting acquisition and title to 110 kg of enriched uranium for fabrication of the fuel components and cores. After the merger in 1959, Texas Instruments continued fabricating reactor fuel cores, primarily for research and production reactors. Also, source materials, i.e., natural uranium and thorium, were still being fabricated for sale to various corporations.

A 1964 Texas Instruments health and safety manual states that uranium- and thorium-contaminated noncombustible scrap material and machinery were collected in 55-gallon steel drums and were disposed of through authorized agencies, or were buried on-site in compliance with 10CFR20.304. Burials were made from 1958 to 1961, and the burial site was closed in 1967. Records indicate two known burials, one in 1958 of contaminated ductwork, and one in 1961 of 28.4 mCi of enriched uranium noncombustible scrap. Work with nuclear materials was gradually reduced beginning in 1968 and was terminated in 1974. The interior of the facility was decontaminated and released for unrestricted use by the Nuclear Regulatory Commission (NRC) in 1983.

The Radiological Site Assessment Program (RSAP) of the Oak Ridge Associated Universities (ORAU) conducted a radiological survey of portions of the facility's outdoor areas during April and May, 1984. The results of that survey indicated several areas with surface and/or subsurface uranium concentrations in excess of guidelines.[1] In the summer of 1992, Creative Pollution Solutions, Inc. was contracted by Texas Instruments Inc. to initiate remediation activities. The licensee submitted a post-excavation radiological survey report to the NRC in November of 1992.[2]

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) performed a confirmatory survey of the excavated area in December of 1992. The results of that survey indicated that the full extent of the burial site, particularly on the west side, adjacent to Building 11 parking lot, had not been determined.[3] Subsequently, further remediation of the former burial site was performed by Creative Pollution Solutions, Inc. Following those remediations, the licensee completed final survey activities and backfilling operations.[4]

The U.S. Nuclear Regulatory Commission, Region I Office, requested that the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) perform an independent confirmatory survey of the former burial site. This report summarizes the procedures and results of that survey.

SITE DESCRIPTION

The Texas Instruments Inc. Facility, Attleboro, MA is located in North Attleboro, approximately 48 kilometers south of Boston on Route 123 (Figure 1). The former burial site is located between Buildings 11 and 12 (Figure 2). The area of concern for remediation activities was approximately 10,000 m^2. The excavated area at the burial site was approximately 2,500 m^2 and the average depth of the excavated area was approximately 1.5 meters. The west end of the excavation extended into the parking lot, adjacent to Building 11. The excavated area has been backfilled and landscaped. The area which extended into the parking lot has been repaved.

OBJECTIVES

The objectives of the confirmatory process are to provide independent document reviews and radiological data, for use by the NRC in evaluating the adequacy and accuracy of the licensee's radiological survey data, relative to established guidelines.

DOCUMENT REVIEW

The final radiological status report, provided by the Texas Instruments Incorporated, were reviewed by ESSAP as part of the confirmatory activities.[4] Analytical procedures and methods utilized by the licensee were reviewed for adequacy and appropriateness. The data were reviewed for accuracy, completeness, and compliance with applicable NRC guidelines.

PROCEDURES

On December 14 and 15, 1993, ESSAP performed a confirmatory survey of the former burial site. The survey was conducted in accordance with a survey plan which was submitted to and approved by the NRC, Region I Office.[5]

REFERENCE GRID

A 10 m x 10 m grid was established during ESSAP's radiological survey of this site in 1984 which was subsequently used by the licensee.[2,4] The same reference grid was used in this survey.

SURFACE SCANS

Surface scans of the former burial site (approximately 10,000 m^2) were performed using NaI detectors coupled to countrate meters with audible indicators. Surface scans for gamma radiation were performed on 100% of the former excavation and the two meter perimeter immediately surrounding that area. Approximately 50% of the remaining surface area was also scanned.

EXPOSURE RATE MEASUREMENTS

Background exposure rates, determined during a previous ESSAP survey of this facility, were used for comparison.[1]

Exposure rate measurements were performed at 1 m above the surface at 12 locations, using a pressurized ionization chamber (PIC). Measurement locations are illustrated in Figure 3.

SOIL SAMPLING

The analysis results of background soil samples, collected during a previous ESSAP survey of this facility, were used for comparison.[1]

Five surface soil samples were obtained at the center of randomly selected grid blocks. In addition, two surface soil samples were collected from the area between grid coordinates 185N, 170E and 195N, 180E where the licensee had reported slightly elevated gamma radiation.[4] Sampling locations are illustrated in Figure 4.

Thirty-seven soil samples were collected from 14 boreholes. The boreholes were drilled on and around the former excavated area to a depth of approximately 2 meters, except for a number of locations where relatively large pieces of rock were encountered at a depth of approximately 1-1.5 meters. On the west side of the excavation, boreholes were drilled 3 meters from the edge of the former excavation at approximately 20 meter intervals. For the remaining perimeter area, boreholes were drilled at approximately 40 meter intervals. The location of a number of boreholes had to be moved because of their proximity to water, gas, and compressed air lines.

The boreholes were scanned for gamma activity, using a collimated NaI detector coupled to a countrate meter with an audible indicator. Systematic soil samples were collected from the surface (0-15 cm), the middle (85-100 cm), and the bottom (185-200 cm) of each borehole. In the parking lot area, the "surface" soil sample was approximately 30 cm below the surface of the pavement. Furthermore, when the depth of a borehole was 1.5 m, the bottom soil sample

was collected at 135-150 cm. When the depth of a borehole was 1 m, only two samples were collected from that borehole (0-15, and 85-100 cm).

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data were returned to ORISE's ESSAP laboratory in Oak Ridge, TN for analysis and interpretation. Exposure rates were reported in μR/h. Soil samples were analyzed by gamma spectrometry. Spectra were reviewed for U-235, U-238, Th-232, Th-228, and any other identifiable photopeaks. Soil sample results were reported in units of picocuries per gram (pCi/g). Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B. Results were compared to NRC guidelines which are provided in Appendix C.

FINDINGS AND RESULTS

DOCUMENT REVIEW

ESSAP reviewed the licensee's radiological survey data and comments were provided to the NRC.[6] In ESSAP's opinion, the licensee documents provide an adequate description of the radiological condition of the facility relative to the NRC guidelines for release to unrestricted use.

SURFACE SCANS

Surface scans for gamma activity did not identify any locations of elevated direct radiation.

EXPOSURE RATE MEASUREMENTS

The background exposure rates, previously measured at this site, ranged from 10 to 11 μR/h and averaged 10 μR/h.[1]

Exposure rates, measured at 12 locations on the former burial site ranged from 9 to 11 $\mu R/h$. (Table 1).

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES

Total uranium concentrations in background soil samples, previously determined for this site, ranged from 1.0 to 2.4 pCi/g.[1]

Concentrations of U-235, U-238, and total uranium in surface soil samples ranged from <0.1 to 0.4 pCi/g, 0.7 to 10 pCi/g, and 3.0 to 20 pCi/g, respectively. Concentrations of U-235, U-238, and total uranium in subsurface soil samples ranged from <0.1 to 0.6 pCi/g, 0.6 to 13 pCi/g, and 2.9 to 27 pCi/g, respectively (Table 2).

COMPARISON OF RESULTS WITH GUIDELINES

The NRC guidelines for residual concentrations of radionuclides in soil, established for license termination or release of a facility for unrestricted use are presented in Appendix C. The primary contaminant of concern at this site is enriched uranium.

The soil concentration guideline for enriched uranium is 30 pCi/g.[7] The total uranium concentrations in all surface and subsurface soil samples were within this limit.

At this site, the applicable NRC guideline for exposure rate at 1 m above the surface is 10 $\mu R/h$ above background, consistent with the Branch Technical Position.[7] All exposure rates were within this limit.

SUMMARY

During the period December 14 and 15, 1993, at the request of the NRC Region I Office, the Environmental Survey and Site Assessment Program of ORISE performed a confirmatory survey of the former burial site at Texas Instruments Incorporated. The survey activities consisted of surface scans for gamma activity, exposure rate measurements, and soil sampling.

Exposure rates were all within the 10 μR/h above background criterion. The radionuclide concentrations in surface and subsurface soil samples were less than the applicable guidelines for release for unrestricted use. In ESSAP's opinion, the licensee documents provide an adequate description of the radiological condition of the facility.

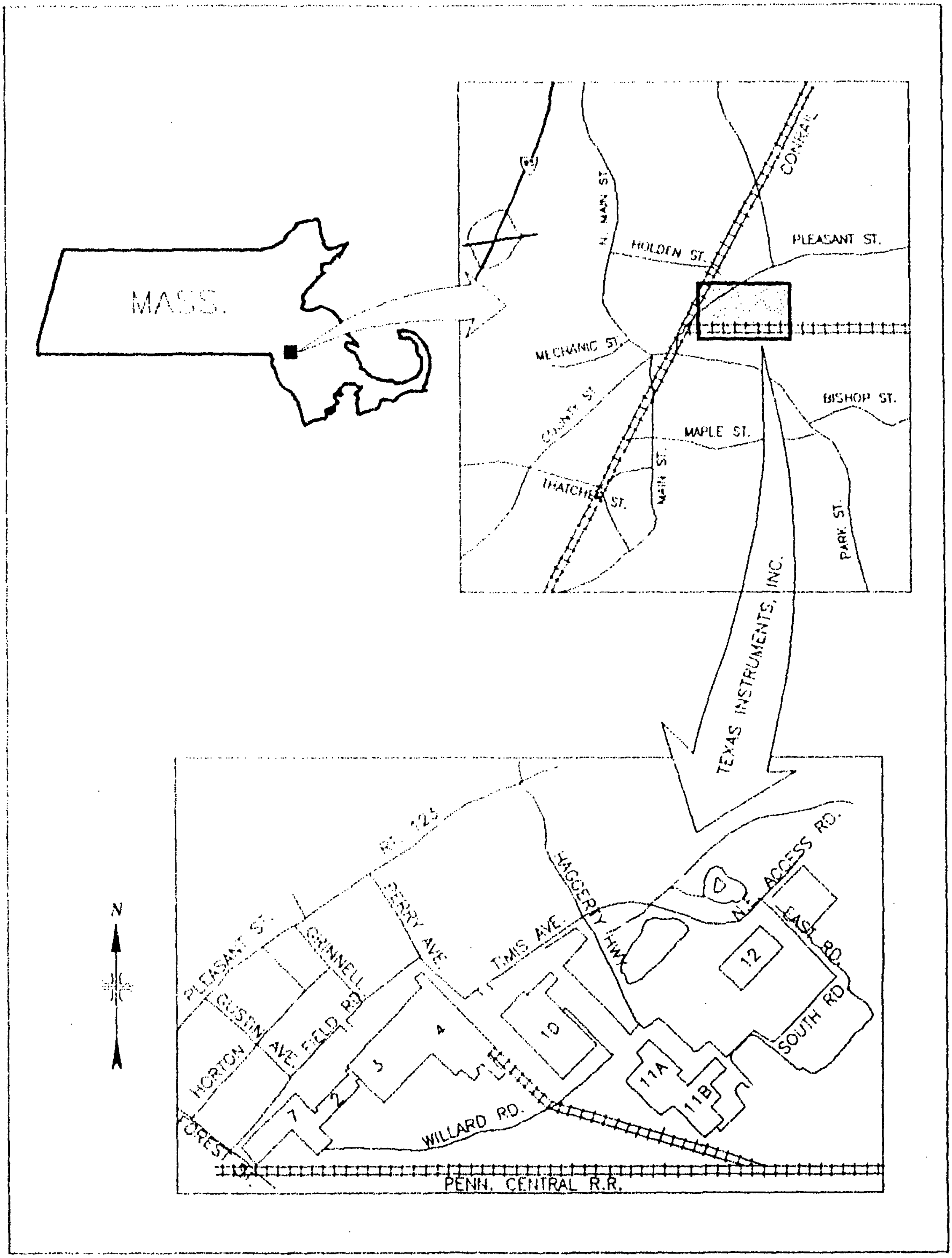

FIGURE 1: Map of Attleboro, Massachusetts – Location and Plan View of the Texas Instruments Site

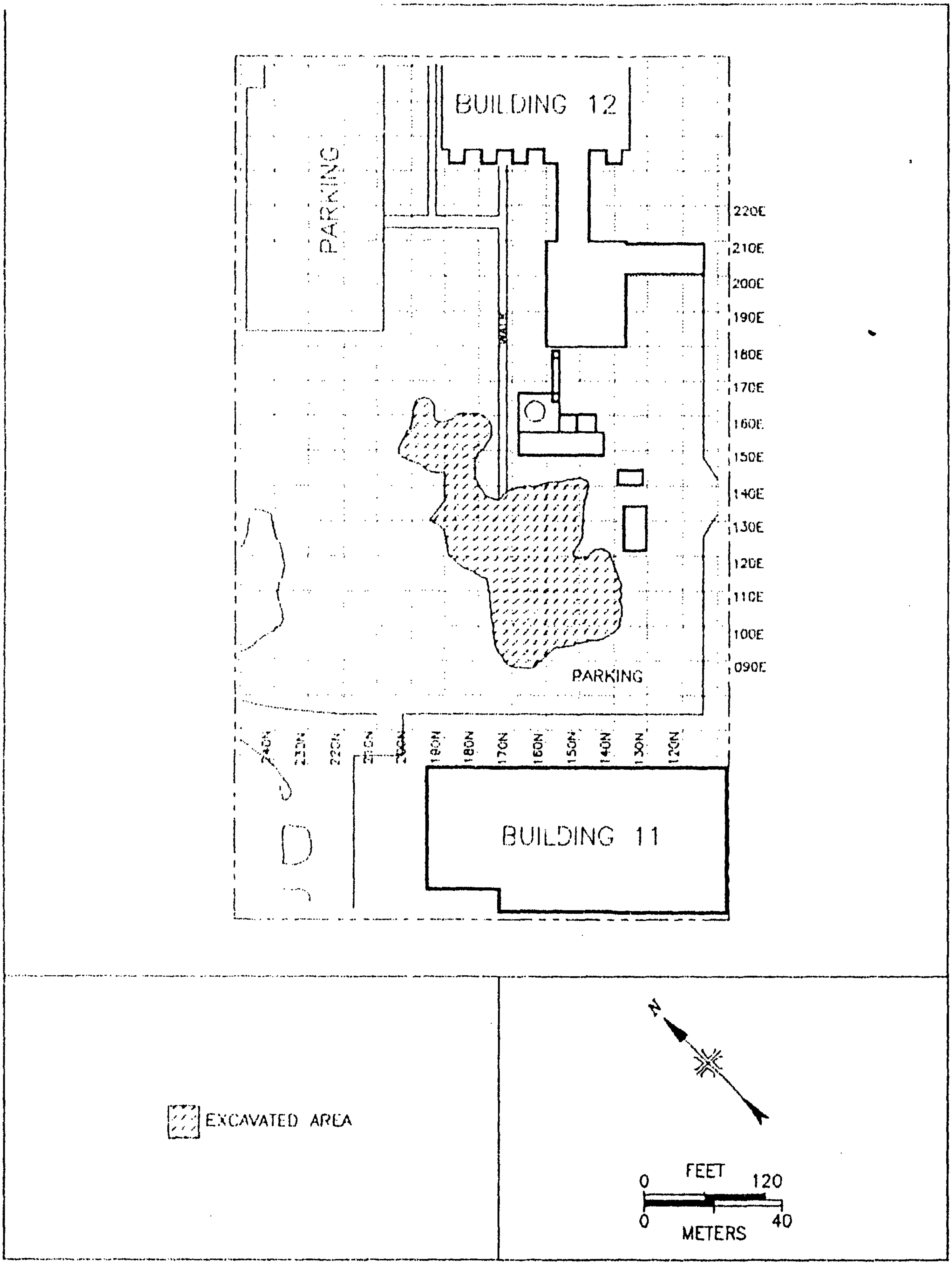

FIGURE 2: The Former Burial Site – Extent of Excavation

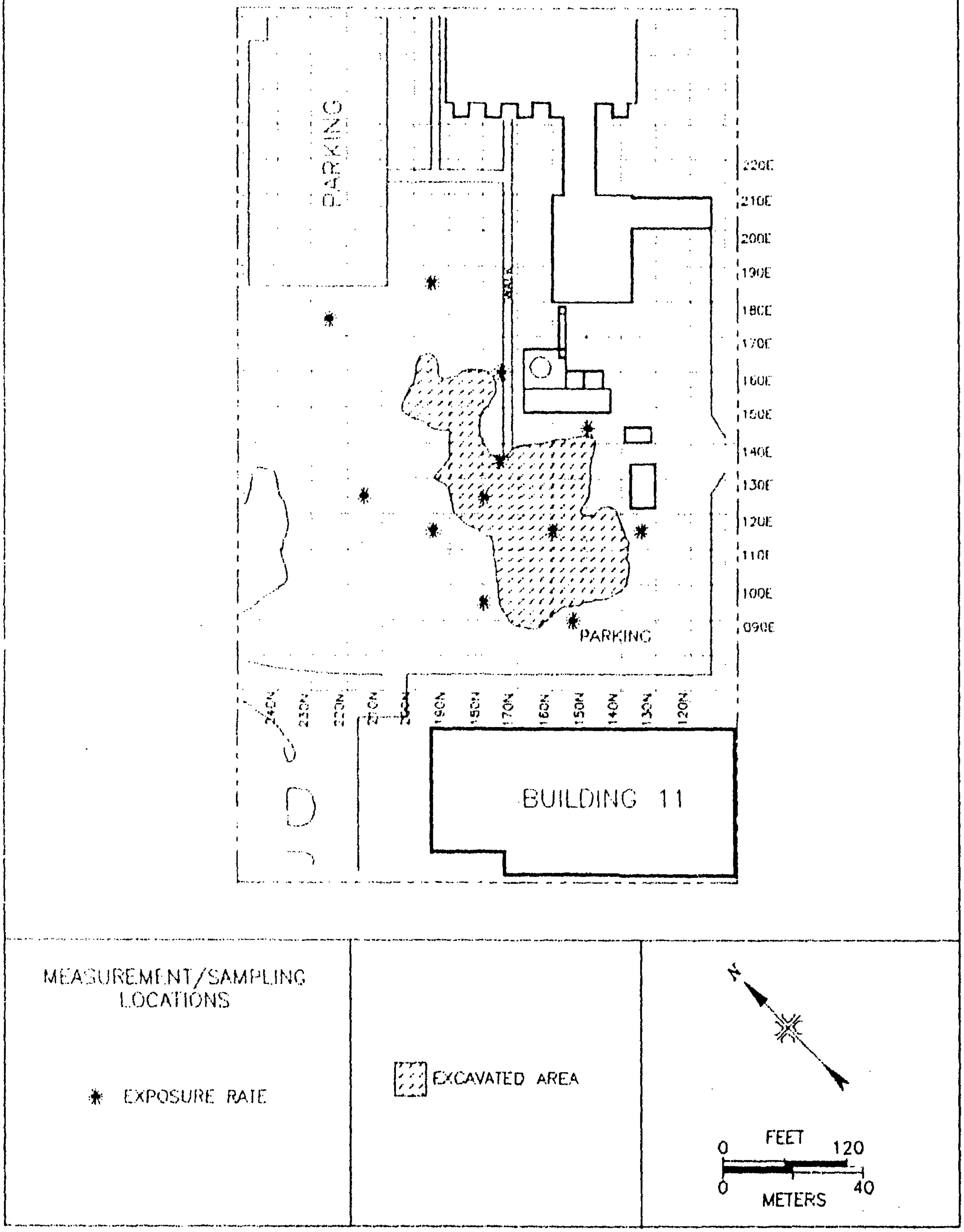

FIGURE 3: The Former Burial Site — Exposure Rate Measurement Locations

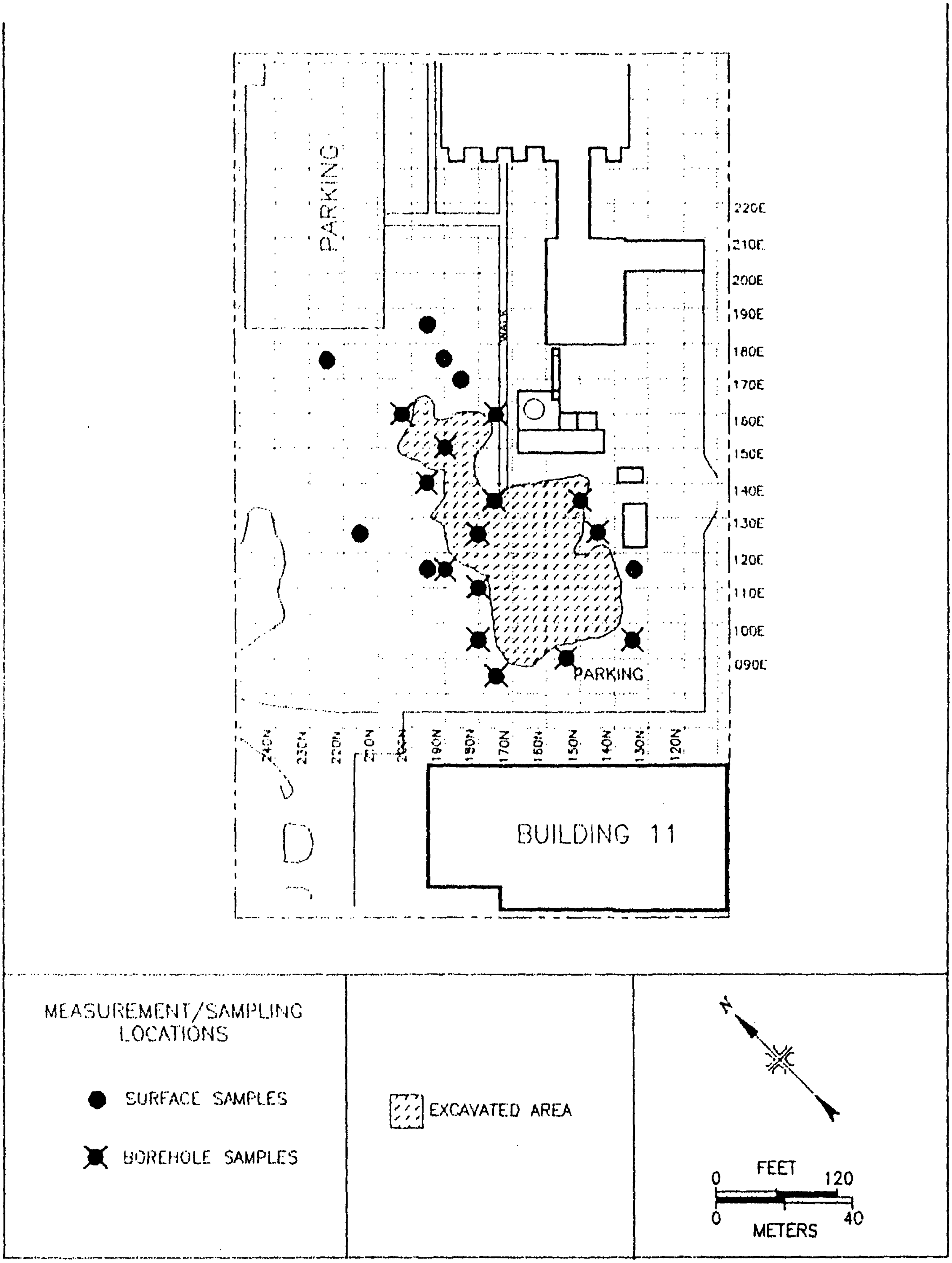

FIGURE 4: The Former Burial Site – Soil Sampling Locations

TABLE 1

EXPOSURE RATE MEASUREMENTS
TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Location[a]	Exposure Rate at 1 m above the surface (μR/h)
135N, 115E	9
150N, 145E	9
155N, 90E	11
160N, 115E	9
175N, 135E	9
175N, 160E	10
180N, 95E	11
180N, 125E	9
195N, 115E	10
195N, 185E	9
215N, 125E	9
225N, 175E	9

[a]Refer to Figure 3.

TABLE 2

URANIUM CONCENTRATIONS IN SOIL SAMPLES
TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Location[a]	Depth (cm)	Uranium Concentrations (pCi/g)[b]		
		U-235	U-238	Total U[c]
135N, 95E	0-15	0.3 ± 0.1	3.2 ± 1.2	10
	85-100	<0.1	0.6 ± 1.4	2.9
	185-200	0.2 ± 0.1	2.3 ± 1.2	6.9
135N, 115E	0-15	0.2 ± 0.1	0.9 ± 1.0	5.5
145N, 125E	0-15	<0.1	6.0 ± 1.7	8.3
	85-100	0.2 ± 0.1	4.4 ± 1.3	9.0
150N, 135E	0-15	<0.1	2.6 ± 1.1	4.9
	85-100	0.3 ± 0.1	4.1 ± 0.9	11
155N, 90E	0-15	<0.1	1.1 ± 1.0	3.4
	85-100	<0.1	2.2 ± 0.8	4.5
	185-200	0.2 ± 0.1	3.2 ± 1.4	7.8
175N, 85E	0-15	0.1 ± 0.1	1.5 ± 1.0	3.8
	85-100	<0.1	1.8 ± 1.4	4.1
	135-105	<0.1	1.6 ± 1.3	3.9
175N, 135E	0-15	<0.1	2.0 ± 1.5	4.3
	85-100	0.3 ± 0.1	7.2 ± 1.5	14
175N, 160E	0-15	0.2 ± 0.1	1.6 ± 1.1	5.6
	85-100	0.2 ± 0.1	1.6 ± 1.4	6.2
	185-200	0.2 ± 0.1	1.8 ± 0.9	6.4
180N, 95E	0-15	<0.2	3.7 ± 1.3	8.3
	85-100	<0.1	1.7 ± 1.2	4.0
	185-200	0.1 ± 0.1	3.4 ± 1.2	5.7
180N, 110E	0-15	0.4 ± 0.1	10.4 ± 2.1	20
	85-100	0.4 ± 0.1	12.7 ± 1.7	22
	135-150	<0.1	2.4 ± 1.8	4.7

TABLE 2 (Continued)

URANIUM CONCENTRATIONS IN SOIL SAMPLES
TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Location[a]	Depth (cm)	Uranium Concentrations (pCi/g)[b]		
		U-235	U-238	Total U[c]
185N, 125E	0-15	<0.1	1.7 ± 1.2	4.0
	85-100	0.3 ± 0.1	4.5 ± 1.3	11
185N, 170E	0-15	<0.1	0.7 ± 0.9	3.0
190N, 115E	0-15	<0.1	2.4 ± 1.5	4.7
	85-100	0.5 ± 0.1	2.1 ± 1.5	14
190N, 150E	0-15	<0.1	0.8 ± 1.0	3.1
	85-100	0.4 ± 0.1	6.5 ± 1.6	16
	185-200	0.6 ± 0.1	10.3 ± 1.8	24
190N, 175E	0-15	0.1 ± 0.1	1.5 ± 1.0	3.8
195N, 115E	0-15	0.4 ± 0.1	3.4 ± 1.6	13
195N, 140E	0-15	<0.1	1.2 ± 0.9	3.5
	85-100	0.3 ± 0.1	2.1 ± 1.1	9.0
	185-200	<0.1	1.7 ± 1.1	4.0
195N, 185E	0-15	<0.1	1.1 ± 0.8	3.4
200N, 160E	0-15	<0.1	1.2 ± 1.2	3.5
	85-100	0.6 ± 0.1	13 ± 2.0	27
	185-200	0.5 ± 0.1	2.8 ± 1.0	14
215N, 125E	0-15	<0.1	1.4 ± 0.9	3.7
225N, 175E	0-15	<0.1	1.6 ± 1.2	3.9

[a]Refer to Figure 4.
[b]Uncertainties represent the 95% confidence level based only on counting statistics.
[c]Total uranium concentrations are calculated based on a U-234 to U-235 activity ratio of 22:1.

REFERENCES

1. "Radiological Survey of the Texas Instruments Site, Attleboro, Massachusetts," Oak Ridge Associated Universities, January, 1985.

2. "Post Excavation Radiological Survey Report, Texas Instruments Incorporated Burial Site, Attleboro, Massachusetts," Creative Pollution Solutions, Inc., November 28, 1992.

3. Letter from A. Jaberaboansari (ORISE) to J. Roth (NRC), reference: "Interim Radiological Survey Report for the Texas Instruments Incorporated Burial Site", January 25, 1993.

4. "Remediation of the Former Radioactive Waste Burial Site", Final Report, Creative Pollution Solutions, Inc., September 1993.

5. "Confirmatory Survey Plan for the Texas Instruments Incorporated Burial Site, Attleboro, Massachusetts", Oak Ridge Institute for Science and Education, December 6, 1993.

6. Letter from A. J. Ansari (ORISE) to M. C. Roberts (NRC), reference: "Comments on the Final Report: Remediation of the Former Radioactive Waste Burial Site at Texas Instruments Incorporated", December 1, 1993.

7. U.S. Nuclear Regulatory Commission, "Disposal of Onsite Storage of Thorium and Uranium Wastes from Past Operations", 46 FR 52061, Washington, D.C., October 23, 1981.

APPENDIX A

MAJOR INSTRUMENTATION

APPENDIX A

MAJOR INSTRUMENTATION

The display of a specific product is not to be construed as an endorsement of the product or its manufacturer by the authors or their employers.

DIRECT RADIATION MEASUREMENT

Instruments

Eberline Pulse Ratemeter
Model PRM-6
(Eberline, Santa Fe, NM)

Ludlum Ratemeter-Scaler
Model 2200
(Ludlum Measurements, Inc.,
Sweetwater, TX)

Detectors

Reuter-Stokes Pressurized Ion Chamber
Model RSS-111
(Reuter-Stokes, Cleveland, OH)

Victoreen NaI Scintillation Detector
Model 489-55
3.2 cm x 3.8 cm Crystal
(Victoreen, Cleveland, OH)

LABORATORY ANALYTICAL INSTRUMENTATION

High Purity Extended Range Intrinsic Detectors
Model No: ERVDS30-25195
(Tennelec, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, TN) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

High-Purity Germanium Detector
Model GMX-23195-S, 23% Eff.
(EG&G ORTEC, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-16
(Gamma Products, Palos Hills, IL) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

SURVEY PROCEDURES

Surface Scans

Surface scans for gamma activity were performed by passing the probes slowly over the surface; the distance between the probe and the surface was maintained at a minimum. The scans were performed using NaI detectors coupled to countrate meters with audible indicators. Identification of elevated levels was based on increases in the audible signal from the recording and/or indicating instrument.

Exposure Rate Measurements

Measurements of gamma exposure rates were performed at 1 m above the surface, using a pressurized ionization chamber (PIC).

Soil Sampling

Approximately 1 kg of soil was collected at each sample location. Surface soil samples were collected at 0-15 cm depth. Samples from boreholes were collected from the surface (0-15 cm), the center (85-100 cm), and the bottom (185-200 cm) of each borehole. Collected samples were placed in a plastic bag, sealed, and labeled in accordance with ESSAP survey procedures.

ANALYTICAL PROCEDURES

Gamma Spectrometry

Samples of soil were dried, mixed, crushed, and/or homogenized as necessary, and a portion sealed in 0.5-liter Marinelli beaker or other appropriate container. The quantity placed in the

beaker was chosen to reproduce the calibrated counting geometry. Net material weights were determined and the samples counted using intrinsic germanium detectors coupled to a pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. Energy peaks used for determination of radionuclides of concern were:

U - 235	0.186 MeV
U - 238	0.063 MeV from Th-234*
Th-228	0.583 MeV from Tl-208
Th-232	0.911 MeV from Ac-228*

*Secular equilibrium assumed.

Spectra were also reviewed for other identifiable photopeaks.

UNCERTAINTIES AND DETECTION LIMITS

The uncertainties associated with the analytical data presented in the tables of this report represent the 95% confidence level for that data based only on counting statistics. Additional uncertainties associated with sampling and measurement procedures, have not been propagated into the data presented in this report.

Detection limits, referred to as minimum detectable activity (MDA), were based on 2.71 plus 4.66 times the standard deviation of the background count. When the activity was determined to be less than the MDA of the measurement procedure, the result was reported as less than MDA. Because of variations in background levels, measurement efficiencies, and contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument.

CALIBRATION AND QUALITY ASSURANCE

Calibration of all field and laboratory instrumentation was based on standards/sources, traceable to NIST, when such standards/sources were available. In cases where they were not available,

standards of an industry recognized organization were used. Calibration of pressurized ionization chambers was performed by the manufacturer.

Analytical and field survey activities were conducted in accordance with procedures from the following ESSAP documents:

- Survey Procedures Manual, Revision 7
- Laboratory Procedures Manual, Revision 7
- Quality Assurance Manual, Revision 6

The procedures contained in these manuals were developed to meet the requirements of DOE Order 5700.6C and ASME NQA-1 for Quality Assurance and contain measures to assess processes during their performance.

Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment operation is within acceptable statistical fluctuations.
- Participation in EPA and EML laboratory Quality Assurance Programs.
- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.

APPENDIX C

GUIDELINES FOR RESIDUAL CONCENTRATIONS OF THORIUM AND URANIUM WASTES IN SOIL

Guidelines for Residual Concentrations of Thorium and Uranium Wastes in Soil

On October 23, 1981, the Nuclear Regulatory Commission published in the Federal register a notice of Branch Technical Position on "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations." This document established guidelines for concentrations of uranium and thorium in soil, that will limit maximum radiation received by the public under various conditions of future land usage. These concentrations are as follows:

Material	Maximum Concentrations (pCi/g) for various options			
	1[a]	2[b]	3[c]	4[d]
Natural Thorium (Th-232 + Th-228) with daughters present and in equilibrium	10	50	--	500
Natural Uranium (U-238 + U-234) with daughters present and in equilibrium	10	--	40	200
Depleted Uranium:				
Soluble	35	100	--	1,000
Insoluble	35	300	--	3,000
Enriched Uranium:				
Soluble	30	100	--	1,000
Insoluble	30	250	--	2,500

[a]Based on EPA cleanup standards which limit radiation to 1 mrad/yr to lung and 3 mrad/yr to bone from ingestion and inhalation and 10 μR/h above background from direct external exposure.
[b]Based on limiting individual dose to 170 mrem/yr.
[c]Based on limiting equivalent exposure to 0.02 working level or less.
[d]Based on limiting individual dose to 500 mrem/yr and in case of natural uranium, limiting exposure to 0.02 working level or less.

CONFIRMATORY SURVEY OF THE TEXAS INSTRUMENTS, INC. FORMER BURIAL SITE ATTLEBORO, MASSACHUSETTS

[DOCKET 070-00033]

A. J. ANSARI

Prepared for the
U.S. Nuclear Regulatory Commission
Region I Office

ORISE
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Environmental Survey and Site Assessment Program
Energy/Environment Systems Division

CONFIRMATORY SURVEY OF THE TEXAS INSTRUMENTS, INC. FORMER BURIAL SITE ATTLEBORO, MASSACHUSETTS

Prepared by

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Prepared for the

U.S. Nuclear Regulatory Commission
Region I Office

January 1994

DRAFT REPORT

This report is based on work performed under an Interagency Agreement (NRC Fin. No. A-9076) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. Oak Ridge Institute for Science and Education performs complementary work under contract number DE-AC05-76OR00033 with the U.S. Department of Energy.

CONFIRMATORY SURVEY OF THE TEXAS INSTRUMENTS, INC. FORMER BURIAL SITE ATTLEBORO, MASSACHUSETTS

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ACKNOWLEDGEMENTS

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ABBREVIATIONS AND ACRONYMS

ASME	American Society of Mechanical Engineers
cm	centimeter
cm^2	square centimeter
cpm	counts per minute
CPS	Creative Pollution Solutions
EML	Environmental Measurement Laboratory
EPA	Environmental Protection Agency
ESSAP	Environmental Survey and Site Assessment Program
m	meter
m^2	square meter
M&C	Metals and Controls, Incorporated
MDA	minimum detectable activity
NaI	sodium iodide
NIST	National Institute for Standards Technology
NRC	Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocurie's per gram
PIC	Pressurized Ionization Chamber
RSAP	Radiological Site Assessment Program
TI	Texas Instruments, Incorporated
$\mu R/h$	microroentgen per hour

CONFIRMATORY SURVEY
OF THE TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

INTRODUCTION AND SITE HISTORY

The Texas Instruments Incorporated site at Attleboro, Massachusetts, was owned and operated by Metals and Controls, Inc. (M&C) until 1959, at which time M&C merged with Texas Instruments, Incorporated (TI). The General Plate Division of M&C began processing nuclear materials in 1952, and between 1952 and 1959 fabricated uranium foils for reactor experiments and fuel components and complete reactor fuel cores for the U.S. Navy. Source material license D-549 was issued permitting acquisition and title to not more than 22.7 kg (50 pounds) of refined source material for use in the production of uranium foils; additional source material was acquired and used under contract with the U.S. Government. Special nuclear materials license No. SNM-23 was issued, permitting acquisition and title to 110 kg of enriched uranium for fabrication of the fuel components and cores. After the merger in 1959, Texas Instruments continued fabricating reactor fuel cores, primarily for research and production reactors. Also, source materials, i.e., natural uranium and thorium, were still being fabricated for sale to various corporations.

A 1964 Texas Instruments health and safety manual states that uranium- and thorium-contaminated noncombustible scrap material and machinery were collected in 55-gallon steel drums and were disposed of through authorized agencies, or were buried on-site in compliance with 10CFR20.304. Burials were made from 1958 to 1961, and the burial site was closed in 1967. Records indicate two known burials, one in 1958 of contaminated ductwork, and one in 1961 of 28.4 mCi of enriched uranium noncombustible scrap. Work with nuclear materials was gradually reduced beginning in 1968 and was terminated in 1974. The interior of the facility was decontaminated and released for unrestricted use by the Nuclear Regulatory Commission (NRC) in 1983.

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OBJECTIVES

The objectives of the confirmatory process are to provide independent document reviews and radiological data, for use by the NRC in evaluating the adequacy and accuracy of the licensee's radiological survey data, relative to established guidelines.

DOCUMENT REVIEW

The final radiological status report, provided by the Texas Instruments Incorporated, were reviewed by ESSAP as part of the confirmatory activities.[4] Analytical procedures and methods utilized by the licensee were reviewed for adequacy and appropriateness. The data were reviewed for accuracy, completeness, and compliance with applicable NRC guidelines.

PROCEDURES

On December 14 and 15, 1993, ESSAP performed a confirmatory survey of the former burial site. The survey was conducted in accordance with a survey plan which was submitted to and approved by the NRC, Region I Office.[5]

REFERENCE GRID

A 10 m x 10 m grid was established during ESSAP's radiological survey of this site in 1984 which was subsequently used by the licensee.[2,4] The same reference grid was used in this survey.

SURFACE SCANS

Surface scans of the former burial site (approximately 10,000 m^2) were performed using NaI detectors coupled to countrate meters with audible indicators. Surface scans for gamma radiation were performed on 100% of the former excavation and the two meter perimeter immediately surrounding that area. Approximately 50% of the remaining surface area was also scanned.

EXPOSURE RATE MEASUREMENTS

Background exposure rates, determined during a previous ESSAP survey of this facility, were used for comparison.[1]

Exposure rate measurements were performed at 1 m above the surface at 12 locations, using a pressurized ionization chamber (PIC). Measurement locations are illustrated in Figure 3.

SOIL SAMPLING

The analysis results of background soil samples, collected during a previous ESSAP survey of this facility, were used for comparison.[1]

Five surface soil samples were obtained at the center of randomly selected grid blocks. In addition, two surface soil samples were collected from the area between grid coordinates 185N, 170E and 195N, 180E where the licensee had reported slightly elevated gamma radiation.[4] Sampling locations are illustrated in Figure 4.

Thirty-seven soil samples were collected from 14 boreholes. The boreholes were drilled on and around the former excavated area to a depth of approximately 2 meters, except for a number of locations where relatively large pieces of rock were encountered at a depth of approximately 1-1.5 meters. On the west side of the excavation, boreholes were drilled 3 meters from the edge of the former excavation at approximately 20 meter intervals. For the remaining perimeter area, boreholes were drilled at approximately 40 meter intervals. The location of a number of boreholes had to be moved because of their proximity to water, gas, and compressed air lines.

The boreholes were scanned for gamma activity, using a collimated NaI detector coupled to a countrate meter with an audible indicator. Systematic soil samples were collected from the surface (0-15 cm), the middle (85-100 cm), and the bottom (185-200 cm) of each borehole. In the parking lot area, the "surface" soil sample was approximately 30 cm below the surface of the pavement. Furthermore, when the depth of a borehole was 1.5 m, the bottom soil sample

was collected at 135-150 cm. When the depth of a borehole was 1 m, only two samples were collected from that borehole (0-15, and 85-100 cm).

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data were returned to ORISE's ESSAP laboratory in Oak Ridge, TN for analysis and interpretation. Exposure rates were reported in μR/h. Soil samples were analyzed by gamma spectrometry. Spectra were reviewed for U-235, U-238, Th-232, Th-228, and any other identifiable photopeaks. Soil sample results were reported in units of picocuries per gram (pCi/g). Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B. Results were compared to NRC guidelines which are provided in Appendix C.

FINDINGS AND RESULTS

DOCUMENT REVIEW

ESSAP reviewed the licensee's radiological survey data and comments were provided to the NRC.[6] In ESSAP's opinion, the licensee documents provide an adequate description of the radiological condition of the facility relative to the NRC guidelines for release to unrestricted use.

SURFACE SCANS

Surface scans for gamma activity did not identify any locations of elevated direct radiation.

EXPOSURE RATE MEASUREMENTS

The background exposure rates, previously measured at this site, ranged from 10 to 11 μR/h and averaged 10 μR/h.[1]

Exposure rates, measured at 12 locations on the former burial site ranged from 9 to 11 μR/h. (Table 1).

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES

Total uranium concentrations in background soil samples, previously determined for this site, ranged from 1.0 to 2.4 pCi/g.[1]

Concentrations of U-235, U-238, and total uranium in surface soil samples ranged from <0.1 to 0.4 pCi/g, 0.7 to 10 pCi/g, and 3.0 to 20 pCi/g, respectively. Concentrations of U-235, U-238, and total uranium in subsurface soil samples ranged from <0.1 to 0.6 pCi/g, 0.6 to 13 pCi/g, and 2.9 to 27 pCi/g, respectively (Table 2).

COMPARISON OF RESULTS WITH GUIDELINES

The NRC guidelines for residual concentrations of radionuclides in soil, established for license termination or release of a facility for unrestricted use are presented in Appendix C. The primary contaminant of concern at this site is enriched uranium.

The soil concentration guideline for enriched uranium is 30 pCi/g.[7] The total uranium concentrations in all surface and subsurface soil samples were within this limit.

At this site, the applicable NRC guideline for exposure rate at 1 m above the surface is 10 μR/h above background, consistent with the Branch Technical Position.[7] All exposure rates were within this limit.

SUMMARY

During the period December 14 and 15, 1993, at the request of the NRC Region I Office, the Environmental Survey and Site Assessment Program of ORISE performed a confirmatory survey of the former burial site at Texas Instruments Incorporated. The survey activities consisted of surface scans for gamma activity, exposure rate measurements, and soil sampling.

Exposure rates were all within the 10 μR/h above background criterion. The radionuclide concentrations in surface and subsurface soil samples were less than the applicable guidelines for release for unrestricted use. In ESSAP's opinion, the licensee documents provide an adequate description of the radiological condition of the facility.

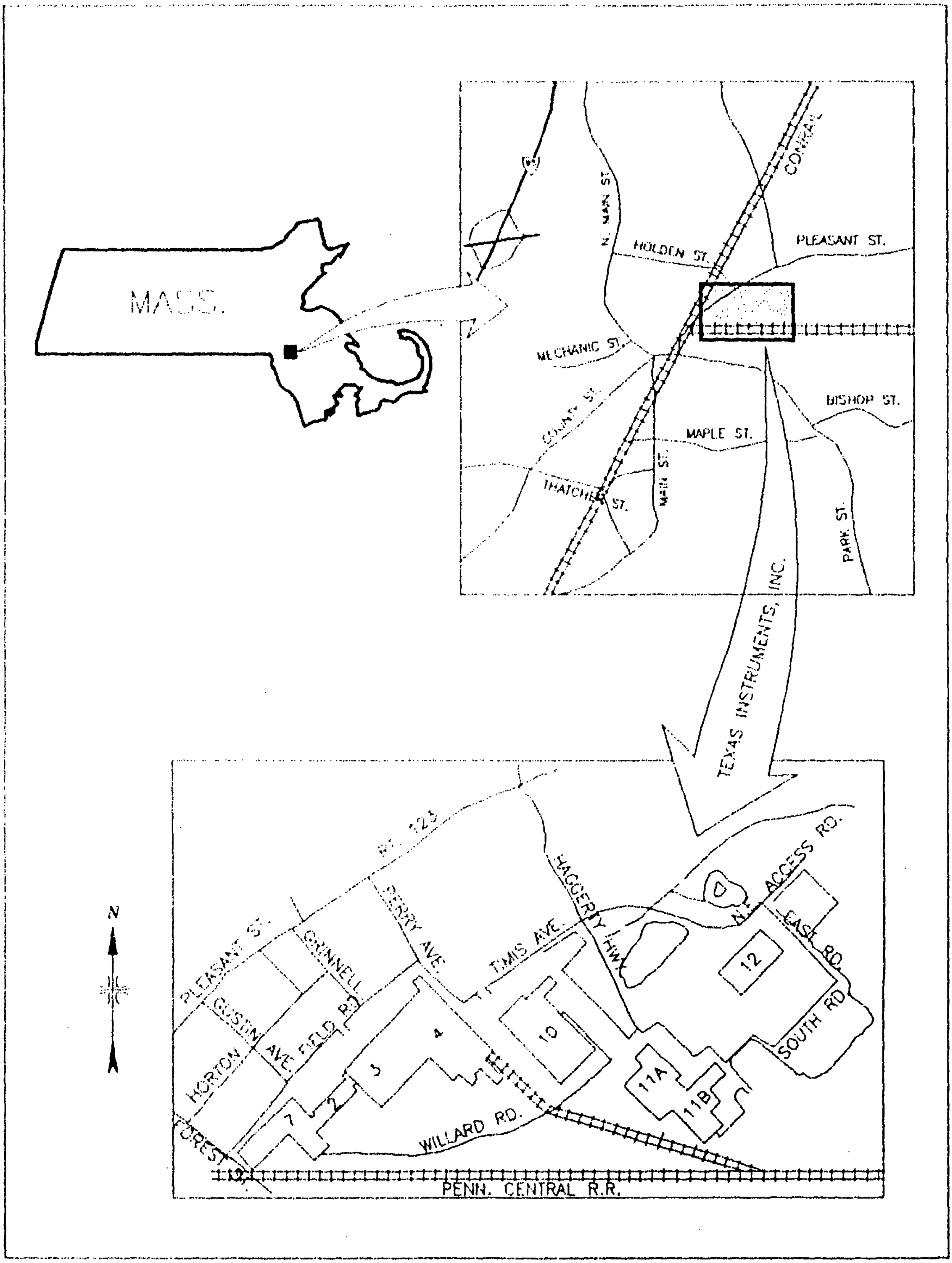

FIGURE 1: Map of Attleboro, Massachusetts – Location and Plan View of the Texas Instruments Site

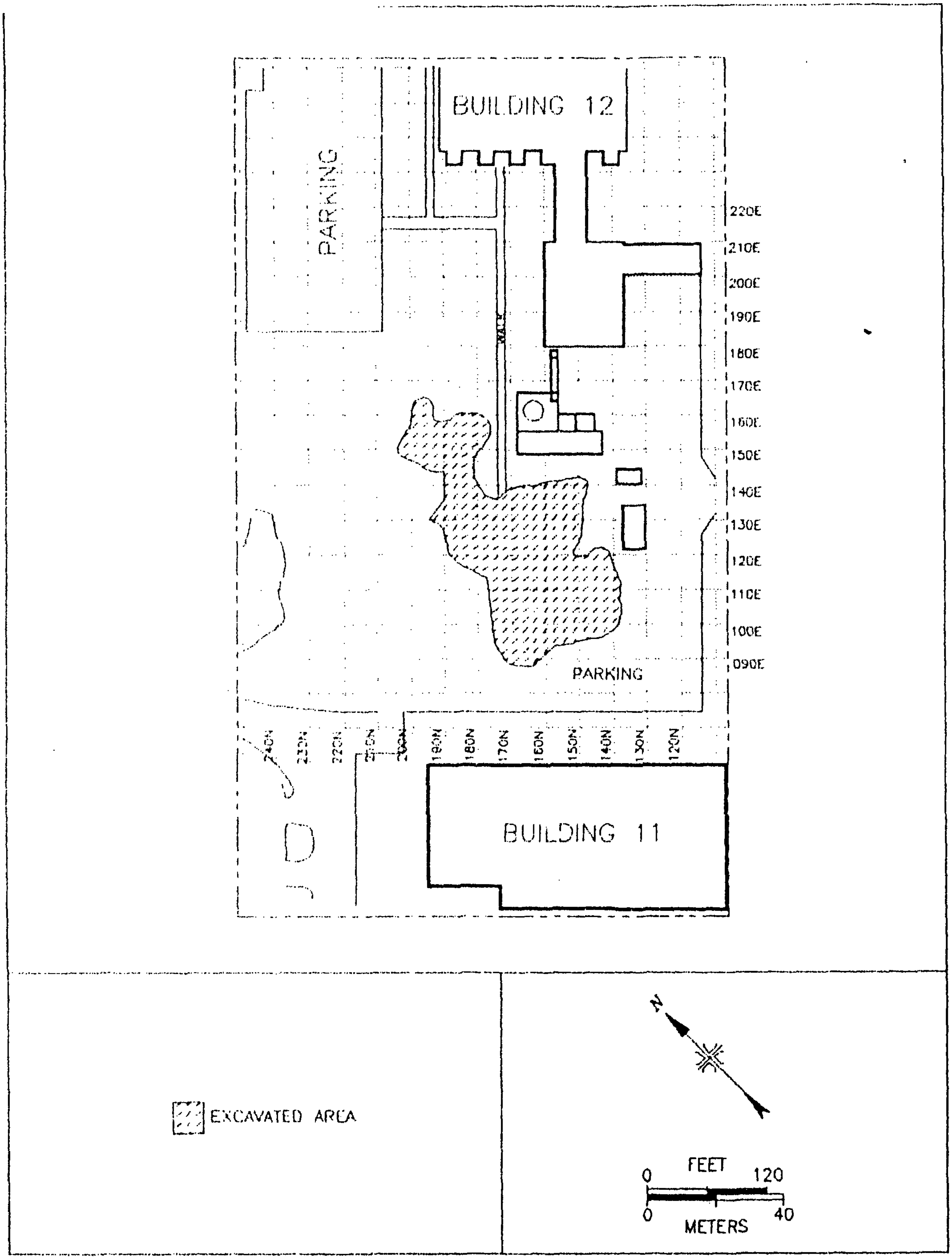

FIGURE 2: The Former Burial Site – Extent of Excavation

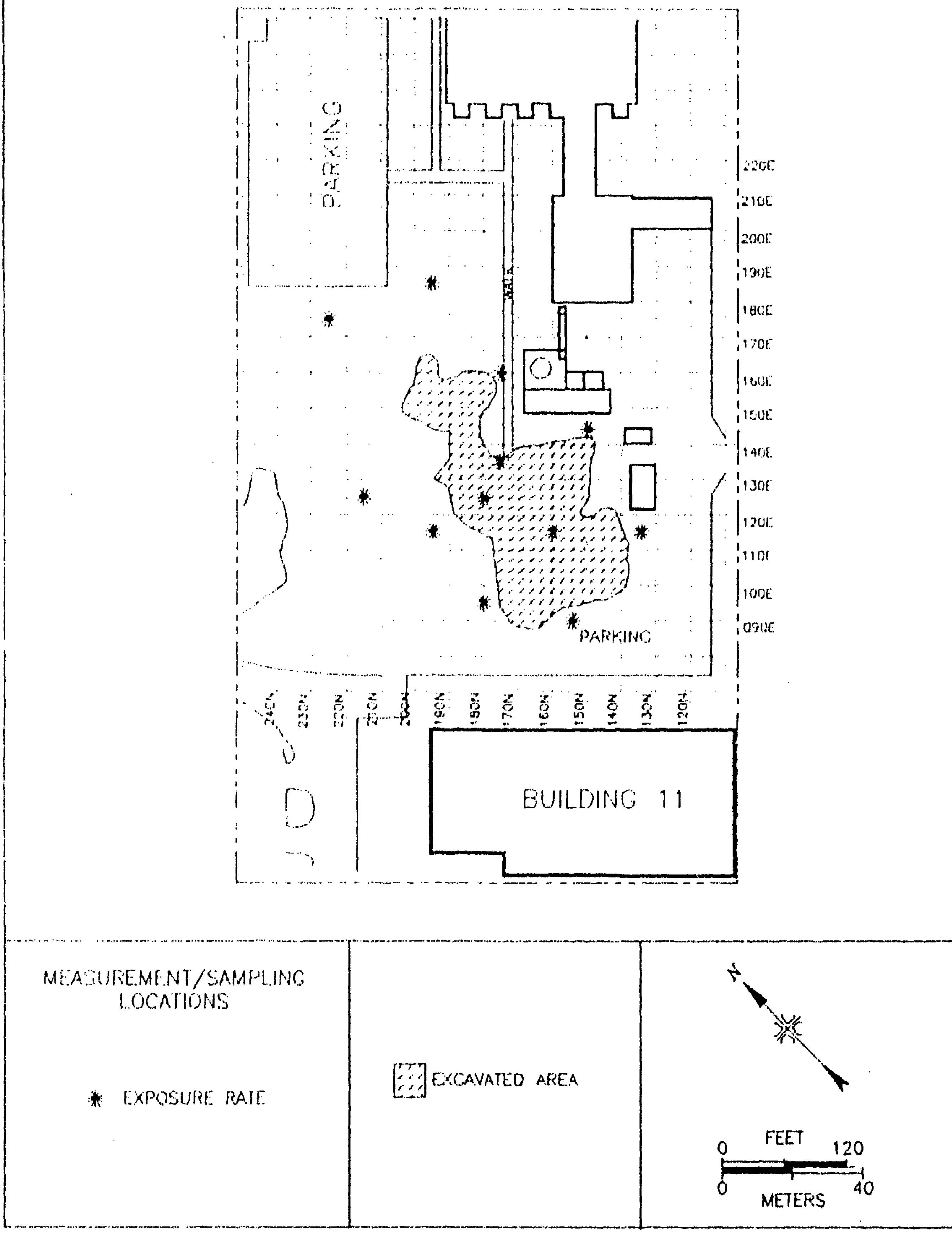

FIGURE 3: The Former Burial Site — Exposure Rate Measurement Locations

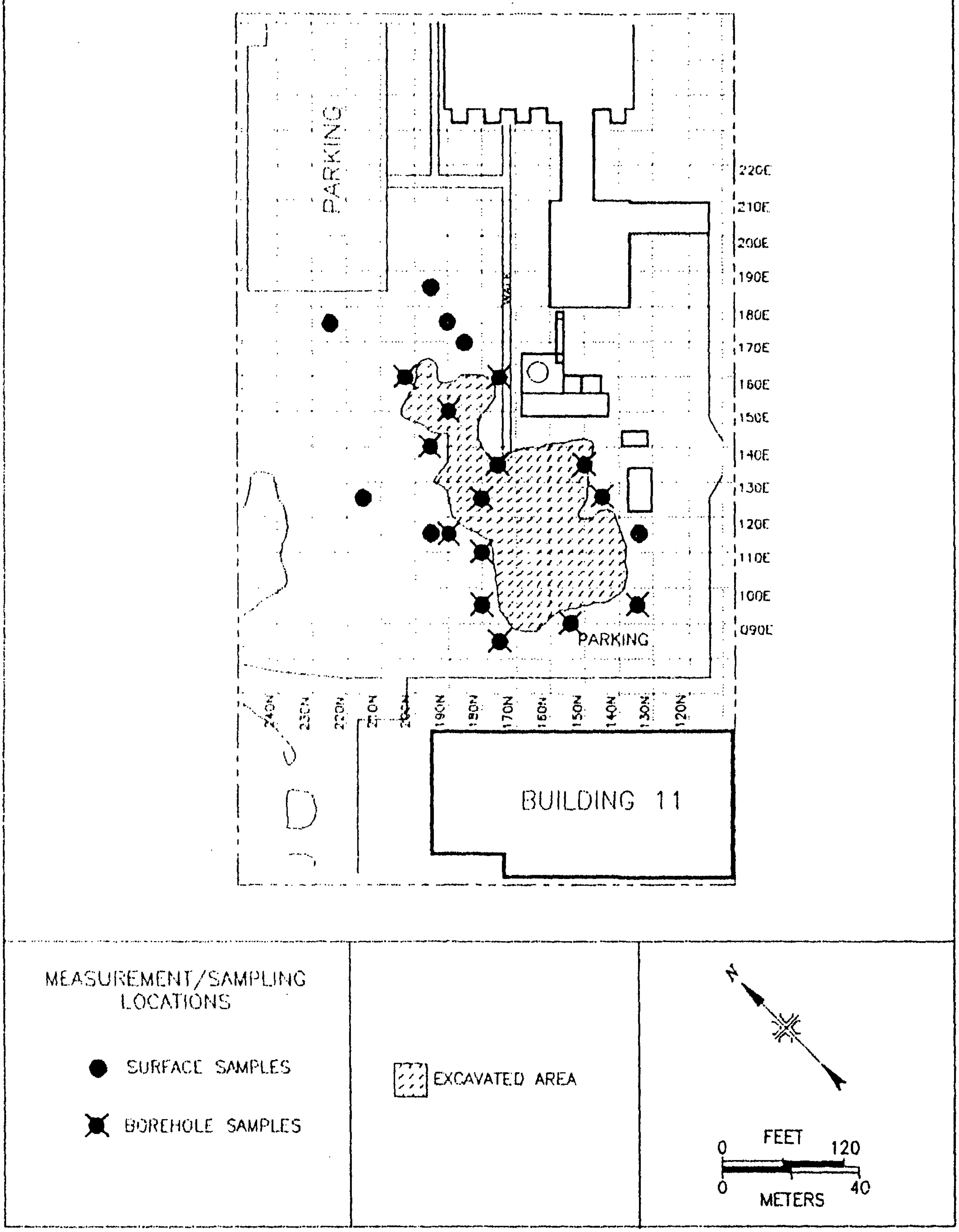

FIGURE 4: The Former Burial Site – Soil Sampling Locations

TABLE 1

EXPOSURE RATE MEASUREMENTS
TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Location[a]	Exposure Rate at 1 m above the surface (μR/h)
135N, 115E	9
150N, 145E	9
155N, 90E	11
160N, 115E	9
175N, 135E	9
175N, 160E	10
180N, 95E	11
180N, 125E	9
195N, 115E	10
195N, 185E	9
215N, 125E	9
225N, 175E	9

[a]Refer to Figure 3.

TABLE 2

URANIUM CONCENTRATIONS IN SOIL SAMPLES
TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Location[a]	Depth (cm)	Uranium Concentrations (pCi/g)[b]		
		U-235	U-238	Total U[c]
135N, 95E	0-15	0.3 ± 0.1	3.2 ± 1.2	10
	85-100	<0.1	0.6 ± 1.4	2.9
	185-200	0.2 ± 0.1	2.3 ± 1.2	6.9
135N, 115E	0-15	0.2 ± 0.1	0.9 ± 1.0	5.5
145N, 125E	0-15	<0.1	6.0 ± 1.7	8.3
	85-100	0.2 ± 0.1	4.4 ± 1.3	9.0
150N, 135E	0-15	<0.1	2.6 ± 1.1	4.9
	85-100	0.3 ± 0.1	4.1 ± 0.9	11
155N, 90E	0-15	<0.1	1.1 ± 1.0	3.4
	85-100	<0.1	2.2 ± 0.8	4.5
	185-200	0.2 ± 0.1	3.2 ± 1.4	7.8
175N, 85E	0-15	0.1 ± 0.1	1.5 ± 1.0	3.8
	85-100	<0.1	1.8 ± 1.4	4.1
	135-105	<0.1	1.6 ± 1.3	3.9
175N, 135E	0-15	<0.1	2.0 ± 1.5	4.3
	85-100	0.3 ± 0.1	7.2 ± 1.5	14
175N, 160E	0-15	0.2 ± 0.1	1.6 ± 1.1	5.6
	85-100	0.2 ± 0.1	1.6 ± 1.4	6.2
	185-200	0.2 ± 0.1	1.8 ± 0.9	6.4
180N, 95E	0-15	<0.2	3.7 ± 1.3	8.3
	85-100	<0.1	1.7 ± 1.2	4.0
	185-200	0.1 ± 0.1	3.4 ± 1.2	5.7
180N, 110E	0-15	0.4 ± 0.1	10.4 ± 2.1	20
	85-100	0.4 ± 0.1	12.7 ± 1.7	22
	135-150	<0.1	2.4 ± 1.8	4.7

TABLE 2 (Continued)

URANIUM CONCENTRATIONS IN SOIL SAMPLES
TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Location[a]	Depth (cm)	Uranium Concentrations (pCi/g)[b]		
		U-235	U-238	Total U[c]
185N, 125E	0-15	<0.1	1.7 ± 1.2	4.0
	85-100	0.3 ± 0.1	4.5 ± 1.3	11
185N, 170E	0-15	<0.1	0.7 ± 0.9	3.0
190N, 115E	0-15	<0.1	2.4 ± 1.5	4.7
	85-100	0.5 ± 0.1	2.1 ± 1.5	14
190N, 150E	0-15	<0.1	0.8 ± 1.0	3.1
	85-100	0.4 ± 0.1	6.5 ± 1.6	16
	185-200	0.6 ± 0.1	10.3 ± 1.8	24
190N, 175E	0-15	0.1 ± 0.1	1.5 ± 1.0	3.8
195N, 115E	0-15	0.4 ± 0.1	3.4 ± 1.6	13
195N, 140E	0-15	<0.1	1.2 ± 0.9	3.5
	85-100	0.3 ± 0.1	2.1 ± 1.1	9.0
	185-200	<0.1	1.7 ± 1.1	4.0
195N, 185E	0-15	<0.1	1.1 ± 0.8	3.4
200N, 160E	0-15	<0.1	1.2 ± 1.2	3.5
	85-100	0.6 ± 0.1	13 ± 2.0	27
	185-200	0.5 ± 0.1	2.8 ± 1.0	14
215N, 125E	0-15	<0.1	1.4 ± 0.9	3.7
225N, 175E	0-15	<0.1	1.6 ± 1.2	3.9

[a]Refer to Figure 4.
[b]Uncertainties represent the 95% confidence level based only on counting statistics.
[c]Total uranium concentrations are calculated based on a U-234 to U-235 activity ratio of 22:1.

REFERENCES

1. "Radiological Survey of the Texas Instruments Site, Attleboro, Massachusetts," Oak Ridge Associated Universities, January, 1985.

2. "Post Excavation Radiological Survey Report, Texas Instruments Incorporated Burial Site, Attleboro, Massachusetts," Creative Pollution Solutions, Inc., November 28, 1992.

3. Letter from A. Jaberaboansari (ORISE) to J. Roth (NRC), reference: "Interim Radiological Survey Report for the Texas Instruments Incorporated Burial Site", January 25, 1993.

4. "Remediation of the Former Radioactive Waste Burial Site", Final Report, Creative Pollution Solutions, Inc., September 1993.

5. "Confirmatory Survey Plan for the Texas Instruments Incorporated Burial Site, Attleboro, Massachusetts", Oak Ridge Institute for Science and Education, December 6, 1993.

6. Letter from A. J. Ansari (ORISE) to M. C. Roberts (NRC), reference: "Comments on the Final Report: Remediation of the Former Radioactive Waste Burial Site at Texas Instruments Incorporated", December 1, 1993.

7. U.S. Nuclear Regulatory Commission, "Disposal of Onsite Storage of Thorium and Uranium Wastes from Past Operations", 46 FR 52061, Washington, D.C., October 23, 1981.

APPENDIX A

MAJOR INSTRUMENTATION

APPENDIX A

MAJOR INSTRUMENTATION

The display of a specific product is not to be construed as an endorsement of the product or its manufacturer by the authors or their employers.

DIRECT RADIATION MEASUREMENT

Instruments

Eberline Pulse Ratemeter
Model PRM-6
(Eberline, Santa Fe, NM)

Ludlum Ratemeter-Scaler
Model 2200
(Ludlum Measurements, Inc.,
Sweetwater, TX)

Detectors

Reuter-Stokes Pressurized Ion Chamber
Model RSS-111
(Reuter-Stokes, Cleveland, OH)

Victoreen NaI Scintillation Detector
Model 489-55
3.2 cm x 3.8 cm Crystal
(Victoreen, Cleveland, OH)

LABORATORY ANALYTICAL INSTRUMENTATION

High Purity Extended Range Intrinsic Detectors
Model No: ERVDS30-25195
(Tennelec, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, TN) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

High-Purity Germanium Detector
Model GMX-23195-S, 23% Eff.
(EG&G ORTEC, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-16
(Gamma Products, Palos Hills, IL) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

SURVEY PROCEDURES

Surface Scans

Surface scans for gamma activity were performed by passing the probes slowly over the surface; the distance between the probe and the surface was maintained at a minimum. The scans were performed using NaI detectors coupled to countrate meters with audible indicators. Identification of elevated levels was based on increases in the audible signal from the recording and/or indicating instrument.

Exposure Rate Measurements

Measurements of gamma exposure rates were performed at 1 m above the surface, using a pressurized ionization chamber (PIC).

Soil Sampling

Approximately 1 kg of soil was collected at each sample location. Surface soil samples were collected at 0-15 cm depth. Samples from boreholes were collected from the surface (0-15 cm), the center (85-100 cm), and the bottom (185-200 cm) of each borehole. Collected samples were placed in a plastic bag, sealed, and labeled in accordance with ESSAP survey procedures.

ANALYTICAL PROCEDURES

Gamma Spectrometry

Samples of soil were dried, mixed, crushed, and/or homogenized as necessary, and a portion sealed in 0.5-liter Marinelli beaker or other appropriate container. The quantity placed in the

beaker was chosen to reproduce the calibrated counting geometry. Net material weights were determined and the samples counted using intrinsic germanium detectors coupled to a pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. Energy peaks used for determination of radionuclides of concern were:

U - 235	0.186 MeV
U - 238	0.063 MeV from Th-234*
Th-228	0.583 MeV from Tl-208
Th-232	0.911 MeV from Ac-228*

*Secular equilibrium assumed.

Spectra were also reviewed for other identifiable photopeaks.

UNCERTAINTIES AND DETECTION LIMITS

The uncertainties associated with the analytical data presented in the tables of this report represent the 95% confidence level for that data based only on counting statistics. Additional uncertainties associated with sampling and measurement procedures, have not been propagated into the data presented in this report.

Detection limits, referred to as minimum detectable activity (MDA), were based on 2.71 plus 4.66 times the standard deviation of the background count. When the activity was determined to be less than the MDA of the measurement procedure, the result was reported as less than MDA. Because of variations in background levels, measurement efficiencies, and contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument.

CALIBRATION AND QUALITY ASSURANCE

Calibration of all field and laboratory instrumentation was based on standards/sources, traceable to NIST, when such standards/sources were available. In cases where they were not available,

standards of an industry recognized organization were used. Calibration of pressurized ionization chambers was performed by the manufacturer.

Analytical and field survey activities were conducted in accordance with procedures from the following ESSAP documents:

- Survey Procedures Manual, Revision 7
- Laboratory Procedures Manual, Revision 7
- Quality Assurance Manual, Revision 6

The procedures contained in these manuals were developed to meet the requirements of DOE Order 5700.6C and ASME NQA-1 for Quality Assurance and contain measures to assess processes during their performance.

Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment operation is within acceptable statistical fluctuations.
- Participation in EPA and EML laboratory Quality Assurance Programs.
- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.

APPENDIX C

GUIDELINES FOR RESIDUAL CONCENTRATIONS OF THORIUM AND URANIUM WASTES IN SOIL

Guidelines for Residual Concentrations of Thorium and Uranium Wastes in Soil

On October 23, 1981, the Nuclear Regulatory Commission published in the Federal register a notice of Branch Technical Position on "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations." This document established guidelines for concentrations of uranium and thorium in soil, that will limit maximum radiation received by the public under various conditions of future land usage. These concentrations are as follows:

Material	Maximum Concentrations (pCi/g) for various options			
	1[a]	2[b]	3[c]	4[d]
Natural Thorium (Th-232 + Th-228) with daughters present and in equilibrium	10	50	--	500
Natural Uranium (U-238 + U-234) with daughters present and in equilibrium	10	--	40	200
Depleted Uranium:				
Soluble	35	100	--	1,000
Insoluble	35	300	--	3,000
Enriched Uranium:				
Soluble	30	100	--	1,000
Insoluble	30	250	--	2,500

[a]Based on EPA cleanup standards which limit radiation to 1 mrad/yr to lung and 3 mrad/yr to bone from ingestion and inhalation and 10 μR/h above background fro
m direct external exposure.
[b]Based on limiting individual dose to 170 mrem/yr.
[c]Based on limiting equivalent exposure to 0.02 working level or less.
[d]Based on limiting individual dose to 500 mrem/yr and in case of natural uranium, limiting exposure to 0.02 working level or less.

NRC CENTRAL FILES

JAN 26 1994

License No. SNM-23
Docket No. 070-00033
Control No. 118945

Armin Ansari, Ph.D.
Project Leader
Oak Ridge Institute for Science and Education
Environmental Survey and Site Assessment Program
P.O. Box 117
Oak Ridge, Tennessee 37831-0117

Dear Dr. Ansari:

Subject: COMMENTS ON THE DRAFT REPORT - CONFIRMATORY SURVEY OF THE TEXAS INSTRUMENTS, INC. FORMER BURIAL SITE, ATTLEBORO, MASSACHUSETTS

Thank you for the Draft Report -- Confirmatory Survey of the Texas Instruments, Inc. Former Burial Site, Attleboro, Massachusetts. Comments from the Region I staff are marked on an enclosed copy of the report.

We appreciate the prompt preparation of the draft report following the survey. Please let our office know when a final report is expected. You should contact Mark Roberts of my staff at (610) 337-5094 if you have any questions concerning our comments.

Thank you again for your assistance and cooperation in this matter.

Sincerely,

Original Signed By
John D. Kinneman

John D. Kinneman, Chief
Site Decommissioning Section
Division of Radiation Safety
and Safeguards

Enclosure: Copy of Draft Confirmatory Survey Report with NRC Region I comments

cc (w/o enclosure):
Michelle Landis, ORISE, ESSAP
James Berger, ORISE, ESSAP

DF02
1/0

bcc (w/o enclosure):
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~~T. Mo, NMSS~~ → NRC Central Files
D. Tiktinsky, NMSS
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M. Roberts, RI

MAR 0 8 1994

License No. SNM-23
Docket No. 070-00033
Control No. 118945

Mr. David Lederer
Remedial Project Manager
U.S. Environmental Protection Agency, Region I
J.F.K. Federal Building (HRM)
Boston, Massachusetts 02203

SUBJECT: MEETING REGARDING THE TEXAS INSTRUMENTS, INC. FACILITY - ATTLEBORO, MASSACHUSETTS

Dear Mr. Lederer:

This letter confirms a meeting on March 23, 1994 at the EPA Region I office to discuss the status of the Texas Instruments, Inc. site in Attleboro, Massachusetts. The purpose of the meeting is to discuss any radiological concerns that you may have regarding the site and the process that will lead to termination of License No. SNM-23, removal of this site from the NRC's Site Decommissioning Management Plan (SDMP) list and release of the site for unrestricted use. We should expect to meet from 2:30 p.m. to approximately 3:30 p.m. NRC representatives scheduled to attend the meeting are Mark C. Roberts, Senior Health Physicist, Site Decommissioning Section and me; however, C. William Hehl, Director, Division of Radiation Safety and Safeguards and James H. Joyner, Chief, Facilities Radiological Safety and Safeguards Branch may accompany us if their schedule permits.

Please contact M. Roberts at (610) 337-5094 should you have any questions concerning this meeting.

Thank you for your cooperati n in this matter.

Sincerely,

Original Signed By:

John D. Kinneman, Chief
Site Decommissioning Section
Division of Radiation Safety
and Safeguards

bcc:
Region I Docket Room (w/concurrences)
J. Austin, NMSS
M. Roberts, RI

DRSS:RI	DRSS:RI
Roberts	Kinneman
3/ /94	3/8/94

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NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PENNSYLVANIA 19406-1415

MAR 0 8 1994

License No. SNM-23
Docket No. 070-00033
Control No. 118945

Mr. David Lederer
Remedial Project Manager
U.S. Environmental Protection Agency, Region I
J.F.K. Federal Building (HRM)
Boston, Massachusetts 02203

SUBJECT: MEETING REGARDING THE TEXAS INSTRUMENTS, INC. FACILITY - ATTLEBORO, MASSACHUSETTS

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Please contact M. Roberts at (610) 337-5094 should you have any questions concerning this meeting.

Thank you for your cooperation in this matter.

Sincerely,

John D. Kinneman, Chief
Site Decommissioning Section
Division of Radiation Safety
and Safeguards

CONFIRMATORY SURVEY OF THE TEXAS INSTRUMENTS, INC. FORMER BURIAL SITE ATTLEBORO, MASSACHUSETTS

[DOCKET 070-00033]

A. J. ANSARI

Prepared for the
U.S. Nuclear Regulatory Commission
Region I Office

ORISE

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

Environmental Survey and Site Assessment Program
Energy/Environment Systems Division

ORISE

February 23, 1994

Mark C. Roberts
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19400

SUBJECT: FINAL REPORT—CONFIRMATORY SURVEY OF THE TEXAS INSTRUMENTS INCORPORATED FORMER BURIAL SITE, ATTLEBORO, MASSACHUSETTS [DOCKECT 070-00033]

Dear Mr. Roberts:

Enclosed are five copies of the subject document. The draft report was revised as requested. Per our telephone conversation on 2/3/94, there was no need to recalculate the total uranium values in Table 2. A U-234 to U-235 activity ratio of 22:1, used by the licensee, is appropriate, based on isotopic analysis performed for samples collected during the December 92 survey of this site.

If you have any questions or need additional information, please contact me at (615) 576-3355 or Michele Landis at (615) 576-2908.

Sincerely,

Armin J. Ansari, Ph.D.
Project Leader
Environmental Survey and
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AJA:rde

PDR

Enclosure

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CONFIRMATORY SURVEY OF THE TEXAS INSTRUMENTS, INC. FORMER BURIAL SITE ATTLEBORO, MASSACHUSETTS

Prepared by

A. J. Ansari

Environmental Survey and Site Assessment Program
Energy/Environment System Division
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Prepared for the

U.S. Nuclear Regulatory Commission
Region I Office

February 1994

FINAL REPORT

This report is based on work performed under an Interagency Agreement (NRC Fin. No. A-9076) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. Oak Ridge Institute for Science and Education performs complementary work under contract number DE-AC05-76OR00033 with the U.S. Department of Energy.

CONFIRMATORY SURVEY
OF THE TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Prepared by: ______________________ Date: 2/7/94
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Environmental Survey and Site Assessment Program

Reviewed by: ______________________ Date: 2/9/94
W. L. Beck, Acting Laboratory Manager
Environmental Survey and Site Assessment Program

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M. R. Landis, Project Manager
Environmental Survey and Site Assessment Program

Reviewed by: ______________________ Date: 2/4/94
A. T. Payne, Quality Assurance Officer
Environmental Survey and Site Assessment Program

Reviewed by: ______________________ Date: 2/9/94
J. D. Berger, Program Director
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ACKNOWLEDGEMENTS

The author would like to acknowledge the significant contributions of the following staff members:

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ILLUSTRATOR

M. A. Henke
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ABBREVIATIONS AND ACRONYMS

ASME	American Society of Mechanical Engineers
cm	centimeter
cm^2	square centimeter
cpm	counts per minute
CPS	Creative Pollution Solutions
EML	Environmental Measurement Laboratory
EPA	Environmental Protection Agency
ESSAP	Environmental Survey and Site Assessment Program
m	meter
m^2	square meter
M&C	Metals and Controls, Incorporated
MDA	minimum detectable activity
NaI	sodium iodide
NIST	National Institute for Standards Technology
NRC	Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
PIC	Pressurized Ionization Chamber
RSAP	Radiological Site Assessment Program
TI	Texas Instruments, Incorporated
μR/h	microroentgen per hour

CONFIRMATORY SURVEY
OF THE TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

INTRODUCTION AND SITE HISTORY

The Texas Instruments Incorporated site at Attleboro, Massachusetts, was owned and operated by Metals and Controls, Inc. (M&C) until 1959, at which time M&C merged with Texas Instruments, Incorporated (TI). The General Plate Division of M&C began processing nuclear materials in 1952, and between 1952 and 1959 fabricated uranium foils for reactor experiments and fuel components and complete reactor fuel cores for the U.S. Navy. Source material license D-549 was issued permitting acquisition and title to not more than 22.7 kg (50 pounds) of refined source material for use in the production of uranium foils; additional source material was acquired and used under contract with the U.S. Government. Special nuclear materials license No. SNM-23 was issued, permitting acquisition and title to 110 kg of enriched uranium for fabrication of the fuel components and cores. After the merger in 1959, Texas Instruments continued fabricating reactor fuel cores, primarily for research and production reactors. Also, source materials, i.e., natural uranium and thorium, were fabricated for sale to various corporations.

A 1964 Texas Instruments health and safety manual states that uranium- and thorium-contaminated noncombustible scrap material and machinery were collected in 55-gallon steel drums and were disposed of through authorized agencies, or were buried on-site in compliance with 10CFR20.304. Records indicate two known burials of radioactive material, one in 1958 of contaminated ductwork, and one in 1961 of 28.4 mCi of enriched uranium noncombustible scrap. The burial site was closed in 1967. Work with nuclear materials was gradually reduced beginning in 1968 and was terminated in 1974. The interiors of the three buildings where radioactive materials were used were decontaminated by the licensee and in 1983 the buildings were released for unrestricted use by the Nuclear Regulatory Commission (NRC).

The Radiological Site Assessment Program (RSAP) of the Oak Ridge Associated Universities (ORAU) conducted a radiological survey of portions of the facility's outdoor areas during April and May, 1984. The results of that survey indicated several areas with surface and/or subsurface uranium concentrations in excess of guidelines.[1] In the summer of 1992, Creative Pollution Solutions, Inc. was contracted by Texas Instruments Inc. to initiate remediation activities. The licensee submitted a post-excavation radiological survey report to the NRC in November of 1992.[2]

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) performed a confirmatory survey of the excavated area in December of 1992. The results of that survey indicated that the full extent of the burial site, particularly on the west side, adjacent to Building 11 parking lot, had not been determined.[3] Subsequently, further remediation of the former burial site was performed by Creative Pollution Solutions, Inc. Following those remediations, the licensee completed final survey activities and backfilling operations.[4]

The U.S. Nuclear Regulatory Commission, Region I Office, requested that the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) perform an independent confirmatory survey of the former burial site. This report summarizes the procedures and results of that survey.

SITE DESCRIPTION

The Texas Instruments Inc. Facility, Attleboro, MA is located in North Attleboro, approximately 48 kilometers south of Boston on Route 123 (Figure 1). The former burial site is located between Buildings 11 and 12 (Figure 2). The area of concern for remediation activities was approximately 10,000 m^2. The excavated area at the burial site was approximately 2,500 m^2 and the average depth of the excavated area was approximately 1.5 meters. The west end of the excavation extended into the parking lot, adjacent to Building 11. The excavated area has been backfilled and landscaped. The area which extended into the parking lot has been repaved.

OBJECTIVES

The objectives of the confirmatory process are to provide independent document reviews and radiological data, for use by the NRC in evaluating the adequacy and accuracy of the licensee's radiological survey data, relative to established guidelines.

DOCUMENT REVIEW

The final radiological status report, provided by the Texas Instruments Incorporated, was reviewed by ESSAP as part of the confirmatory activities.[4] Analytical procedures and methods utilized by the licensee were reviewed for adequacy and appropriateness. The data were reviewed for accuracy, completeness, and compliance with applicable NRC guidelines.

PROCEDURES

On December 14 and 15, 1993, ESSAP performed a confirmatory survey of the former burial site and the areas of concern immediately adjacent to the burial site. The survey was conducted in accordance with a survey plan which was submitted to and approved by the NRC, Region I Office.[5]

REFERENCE GRID

A 10 m x 10 m grid was established during ESSAP's radiological survey of this site in 1984 which was subsequently used by the licensee.[2,4] The same reference grid was used in this survey.

SURFACE SCANS

Surface scans of the former burial site (approximately 10,000 m^2) were performed using NaI detectors coupled to countrate meters with audible indicators. Surface scans for gamma radiation

were performed on 100% of the former excavation and the two meter perimeter immediately surrounding that area. Approximately 50% of the remaining surface area was also scanned.

EXPOSURE RATE MEASUREMENTS

Background exposure rates, determined during a previous ESSAP survey of this facility, were used for comparison.[1]

Exposure rate measurements were performed at 1 m above the surface at 12 locations, using a pressurized ionization chamber (PIC). Measurement locations are illustrated in Figure 3.

SOIL SAMPLING

The analytical results of background soil samples, collected during a previous ESSAP survey of this facility, were used for comparison.[1]

Five surface soil samples were obtained at the center of randomly selected grid blocks. In addition, two surface soil samples were collected from the area between grid coordinates 185N, 170E and 195N, 180E where the licensee had reported slightly elevated gamma radiation.[4] Sampling locations are illustrated in Figure 4.

Thirty-seven soil samples were collected from 14 boreholes. The boreholes were drilled on and around the former excavated area to depths of approximately 2 meters, except for a number of locations where relatively large pieces of rock were encountered at a depth of approximately 1-1.5 meters. On the west side of the excavation, boreholes were drilled 3 meters from the edge of the former excavation at approximately 20 meter intervals. For the remaining perimeter area, boreholes were drilled at approximately 40 meter intervals. The location of a number of boreholes had to be moved because of their proximity to buried water, gas, and compressed air lines.

The boreholes were scanned for gamma activity, using a collimated NaI detector coupled to a countrate meter with an audible indicator. Systematic soil samples were collected from the surface (0-15 cm), the middle (85-100 cm), and the bottom (185-200 cm) of each borehole. In the parking lot area, the "surface" soil sample was approximately 30 cm below the surface of the pavement. Furthermore, when the depth of a borehole was 1.5 m, the bottom soil sample was collected at 135-150 cm. When the depth of a borehole was 1 m, only two samples were collected from that borehole (0-15, and 85-100 cm).

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data were returned to ORISE's ESSAP laboratory in Oak Ridge, TN for analysis and interpretation. Exposure rates were reported in μR/h. Soil samples were analyzed by gamma spectrometry. Spectra were reviewed for U-235, U-238, Th-232, Th-228, and any other identifiable photopeaks. Soil sample results were reported in units of picocuries per gram (pCi/g). Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B. Results were compared to NRC guidelines which are provided in Appendix C.

FINDINGS AND RESULTS

DOCUMENT REVIEW

ESSAP reviewed the licensee's radiological survey data and comments were provided to the NRC.[6] In ESSAP's opinion, the licensee documents provide an adequate description of the radiological condition of the facility relative to the NRC guidelines for release for unrestricted use.

SURFACE SCANS

Surface scans for gamma activity did not identify any locations of elevated direct radiation.

EXPOSURE RATE MEASUREMENTS

The background exposure rates, previously measured at this site, ranged from 10 to 11 μR/h and averaged 10 μR/h.[1]

Exposure rates, measured at 12 locations in the vicinity of the former burial site, ranged from 9 to 11 μR/h. (Table 1).

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES

Total uranium concentrations in background soil samples, previously determined for this site, ranged from 1.0 to 2.4 pCi/g.[1]

Concentrations of U-235, U-238, and total uranium in surface soil samples ranged from <0.1 to 0.4 pCi/g, 0.7 to 10 pCi/g, and 3.0 to 20 pCi/g, respectively. Concentrations of U-235, U-238, and total uranium in subsurface soil samples ranged from <0.1 to 0.6 pCi/g, 0.6 to 13 pCi/g, and 2.9 to 27 pCi/g, respectively (Table 2).

COMPARISON OF RESULTS WITH GUIDELINES

The NRC guidelines for residual concentrations of radionuclides in soil, established for license termination or release of a facility for unrestricted use are presented in Appendix C. The primary contaminant of concern at this site is enriched uranium.

The soil concentration guideline for enriched uranium is 30 pCi/g.[7] The total uranium concentrations in all surface and subsurface soil samples were within this limit.

At this site, the applicable NRC guideline for exposure rate at 1 m above the surface is 10 μR/h above background, consistent with the Branch Technical Position.[7] All exposure rates were within this limit.

SUMMARY

During the period December 14 and 15, 1993, at the request of the NRC Region I Office, the Environmental Survey and Site Assessment Program of ORISE performed a confirmatory survey of the former burial site at Texas Instruments Incorporated. The survey activities consisted of surface scans for gamma activity, exposure rate measurements, and soil sampling.

Exposure rates were all within the 10 μR/h above background criterion. The radionuclide concentrations in surface and subsurface soil samples were less than the applicable guidelines for release for unrestricted use. In ESSAP's opinion, the licensee documents provide an adequate description of the radiological condition of the facility.

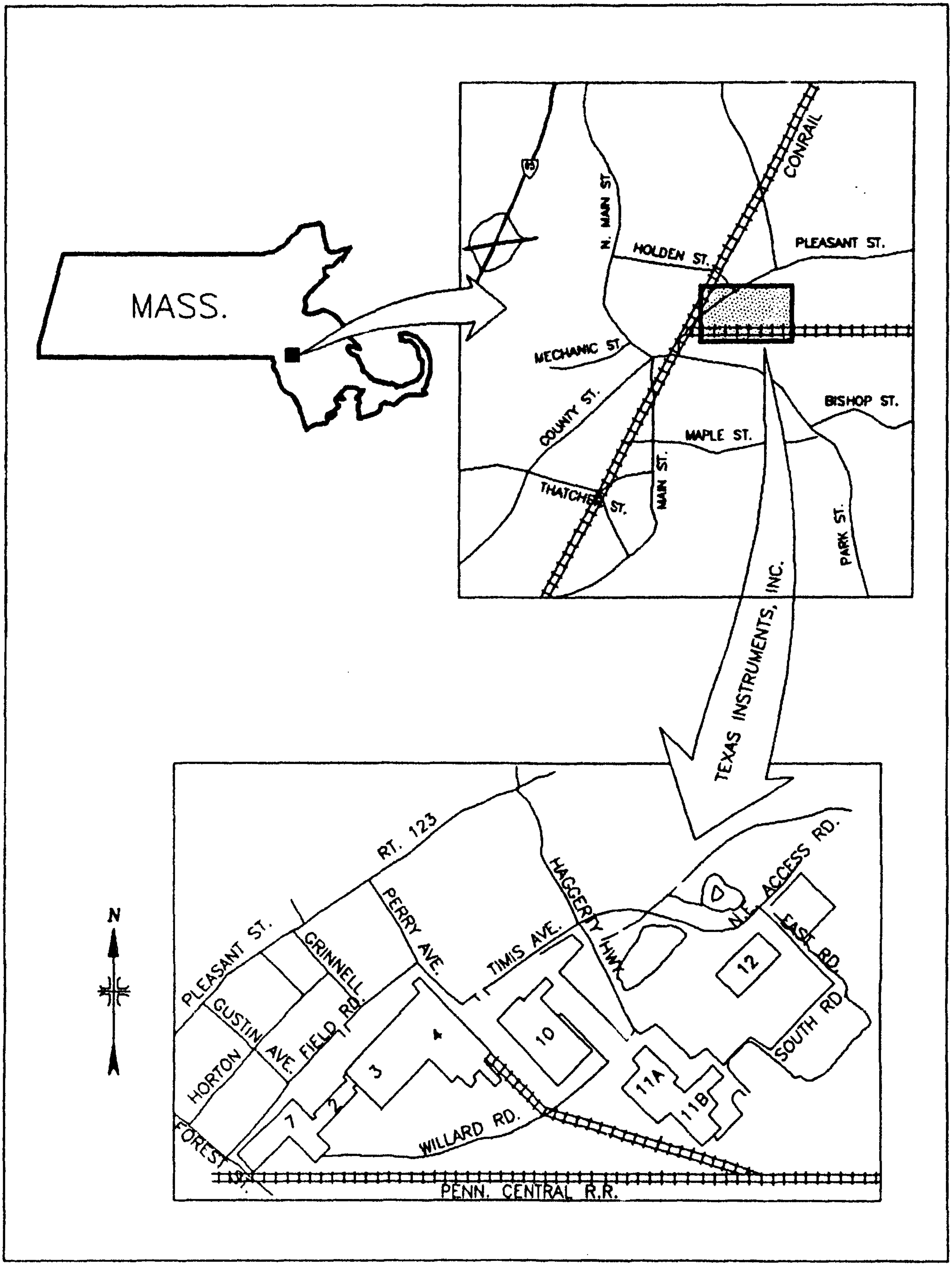

FIGURE 1: Map of Attleboro, Massachusetts – Location and Plan View of the Texas Instruments Site

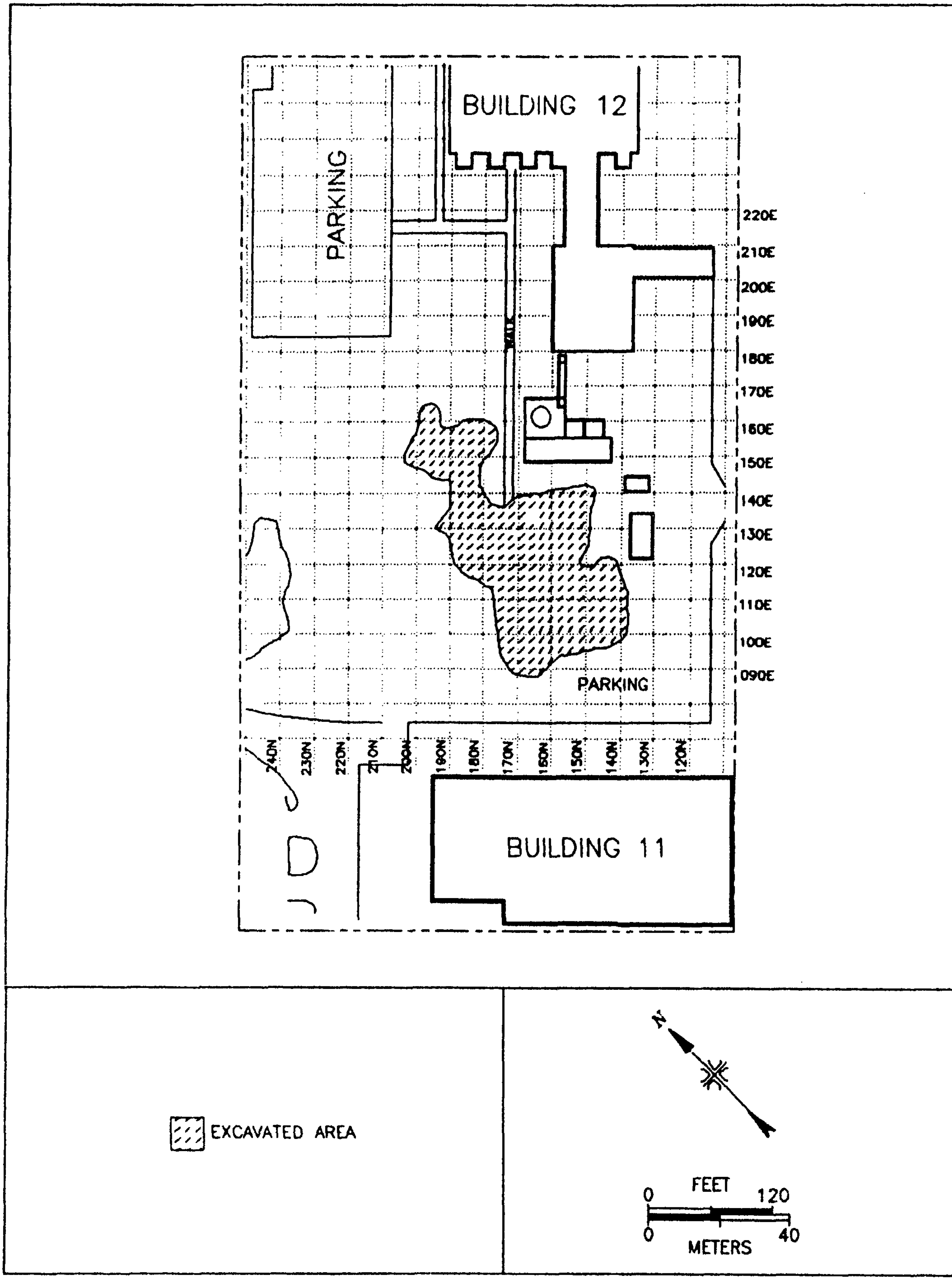

FIGURE 2: The Former Burial Site – Extent of Excavation

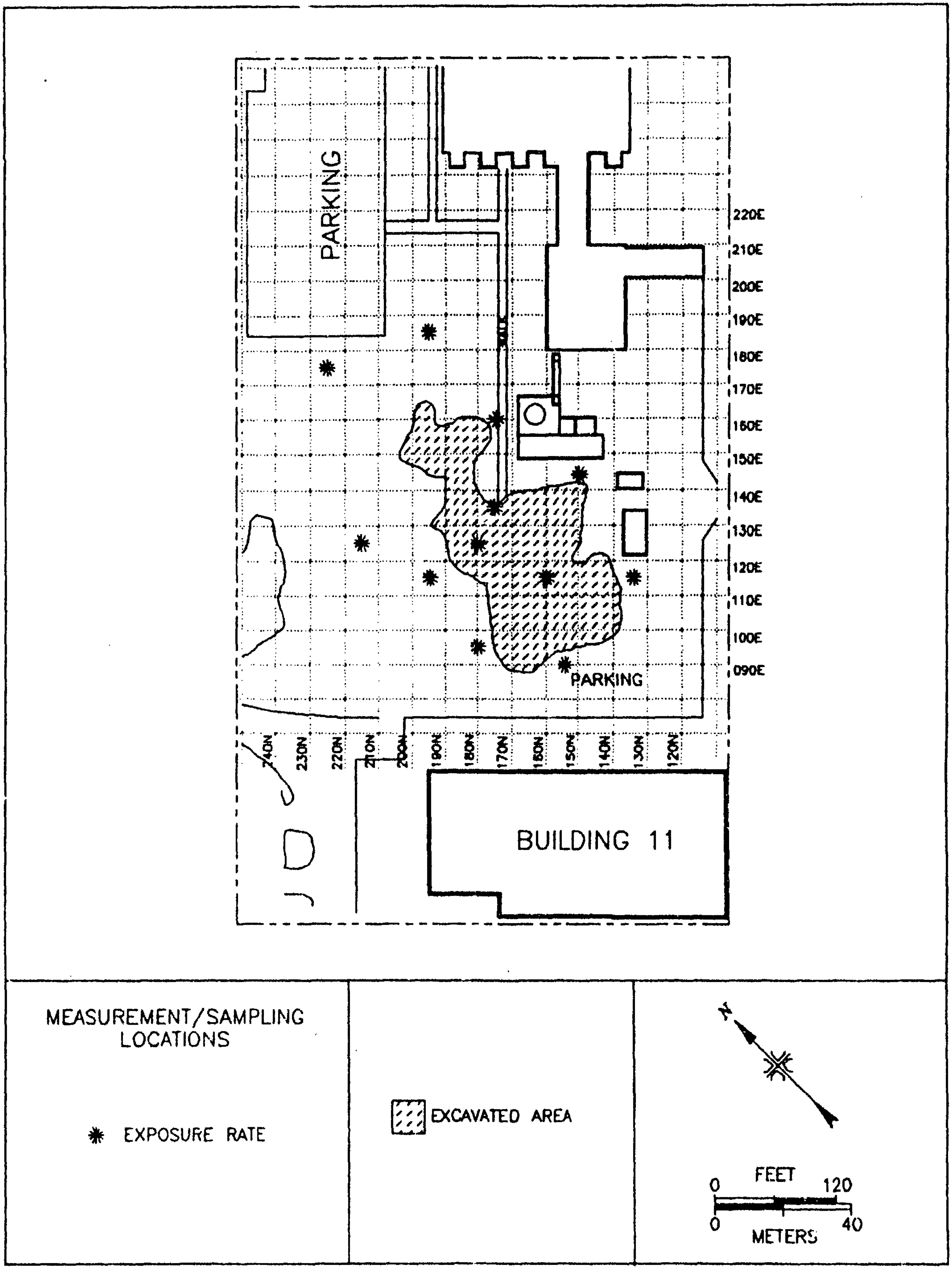

FIGURE 3: The Former Burial Site — Exposure Rate Measurement Locations

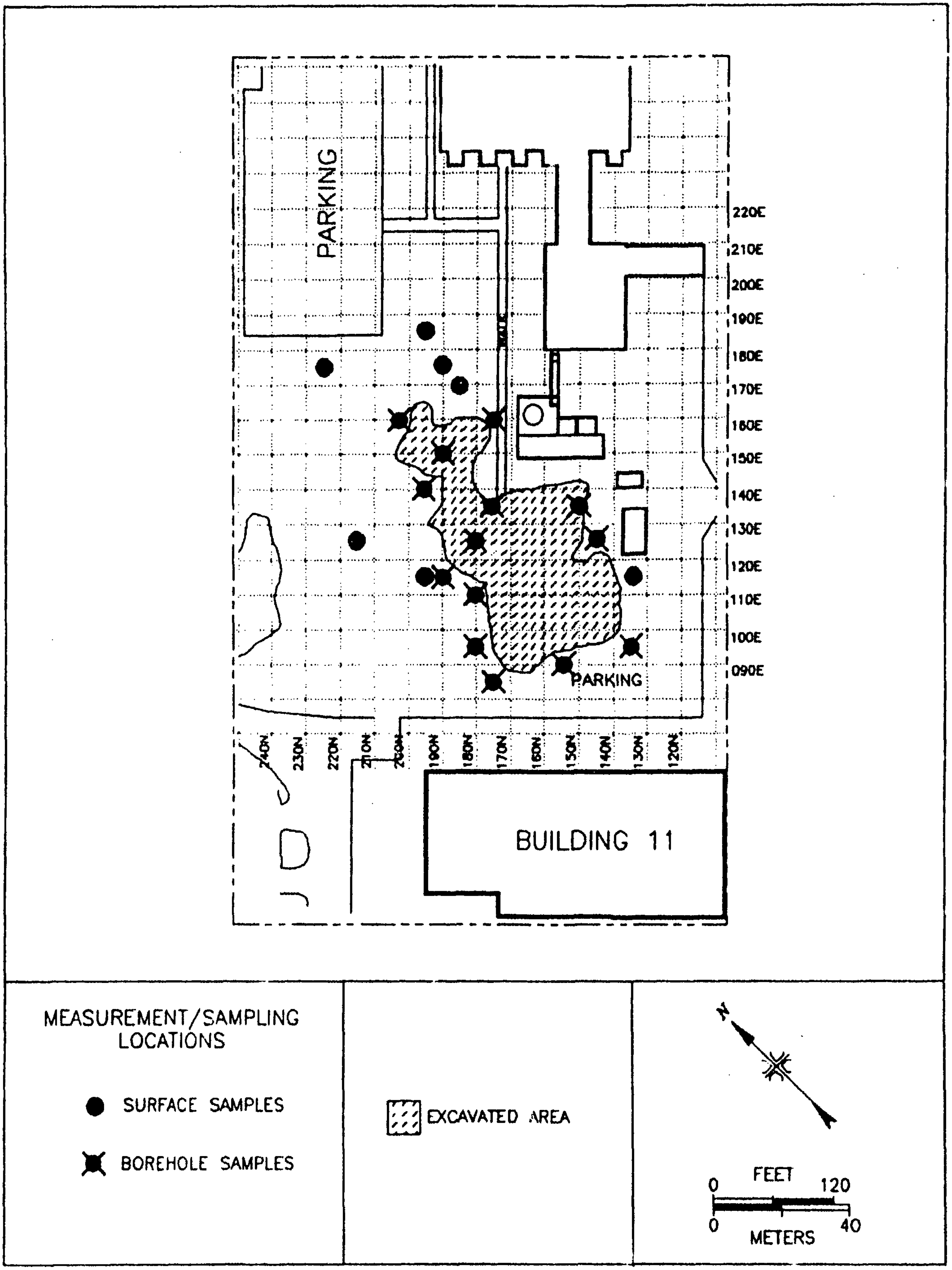

FIGURE 4: The Former Burial Site – Soil Sampling Locations

TABLE 1

EXPOSURE RATE MEASUREMENTS
TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Location[a]	Exposure Rate at 1 m above the surface (μR/h)
135N, 115E	9
150N, 145E	9
155N, 90E	11
160N, 115E	9
175N, 135E	9
175N, 160E	10
180N, 95E	11
180N, 125E	9
195N, 115E	10
195N, 185E	9
215N, 125E	9
225N, 175E	9

[a]Refer to Figure 3.

TABLE 2

URANIUM CONCENTRATIONS IN SOIL SAMPLES
TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Location[a]	Depth (cm)	Uranium Concentrations (pCi/g)[b]		
		U-235	U-238	Total U[c]
135N, 95E	0-15	0.3 ± 0.1	3.2 ± 1.2	10
	85-100	<0.1	0.6 ± 1.4	<2.9
	185-200	0.2 ± 0.1	2.3 ± 1.2	6.9
135N, 115E	0-15	0.2 ± 0.1	0.9 ± 1.0	5.5
145N, 125E	0-15	<0.1	6.0 ± 1.7	<8.3
	85-100	0.2 ± 0.1	4.4 ± 1.3	9.0
150N, 135E	0-15	<0.1	2.6 ± 1.1	<4.9
	85-100	0.3 ± 0.1	4.1 ± 0.9	11
155N, 90E	0-15	<0.1	1.1 ± 1.0	<3.4
	85-100	<0.1	2.2 ± 0.8	<4.5
	185-200	0.2 ± 0.1	3.2 ± 1.4	7.8
175N, 85E	0-15	0.1 ± 0.1	1.5 ± 1.0	3.8
	85-100	<0.1	1.8 ± 1.4	<4.1
	135-105	<0.1	1.6 ± 1.3	<3.9
175N, 135E	0-15	<0.1	2.0 ± 1.5	<4.3
	85-100	0.3 ± 0.1	7.2 ± 1.5	14
175N, 160E	0-15	0.2 ± 0.1	1.6 ± 1.1	5.6
	85-100	0.2 ± 0.1	1.6 ± 1.4	6.2
	185-200	0.2 ± 0.1	1.8 ± 0.9	6.4
180N, 95E	0-15	<0.2	3.7 ± 1.3	<8.3
	85-100	<0.1	1.7 ± 1.2	<4.0
	185-200	0.1 ± 0.1	3.4 ± 1.2	5.7
180N, 110E	0-15	0.4 ± 0.1	10.4 ± 2.1	20
	85-100	0.4 ± 0.1	12.7 ± 1.7	22
	135-150	<0.1	2.4 ± 1.8	<4.7

TABLE 2 (Continued)

URANIUM CONCENTRATIONS IN SOIL SAMPLES
TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Location[a]	Depth (cm)	Uranium Concentrations (pCi/g)[b]		
		U-235	U-238	Total U[c]
185N, 125E	0-15	<0.1	1.7 ± 1.2	<4.0
	85-100	0.3 ± 0.1	4.5 ± 1.3	11
185N, 170E	0-15	<0.1	0.7 ± 0.9	<3.0
190N, 115E	0-15	<0.1	2.4 ± 1.5	<4.7
	85-100	0.5 ± 0.1	2.1 ± 1.5	14
190N, 150E	0-15	<0.1	0.8 ± 1.0	<3.1
	85-100	0.4 ± 0.1	6.5 ± 1.6	16
	185-200	0.6 ± 0.1	10.3 ± 1.8	24
190N, 175E	0-15	0.1 ± 0.1	1.5 ± 1.0	3.8
195N, 115E	0-15	0.4 ± 0.1	3.4 ± 1.6	13
195N, 140E	0-15	<0.1	1.2 ± 0.9	<3.5
	85-100	0.3 ± 0.1	2.1 ± 1.1	9.0
	185-200	<0.1	1.7 ± 1.1	<4.0
195N, 185E	0-15	<0.1	1.1 ± 0.8	<3.4
200N, 160E	0-15	<0.1	1.2 ± 1.2	<3.5
	85-100	0.6 ± 0.1	13 ± 2.0	27
	185-200	0.5 ± 0.1	2.8 ± 1.0	14
215N, 125E	0-15	<0.1	1.4 ± 0.9	<3.7
225N, 175E	0-15	<0.1	1.6 ± 1.2	<3.9

[a]Refer to Figure 4.
[b]Uncertainties represent the 95% confidence level based only on counting statistics.
[c]Total uranium concentrations are calculated based on a U-234 to U-235 activity ratio of 22:1.

REFERENCES

1. "Radiological Survey of the Texas Instruments Site, Attleboro, Massachusetts," Oak Ridge Associated Universities, January, 1985.

2. "Post Excavation Radiological Survey Report, Texas Instruments Incorporated Burial Site, Attleboro, Massachusetts," Creative Pollution Solutions, Inc., November 28, 1992.

3. Letter from A. Jaberaboansari (ORISE) to J. Roth (NRC), reference: "Interim Radiological Survey Report for the Texas Instruments Incorporated Burial Site," January 25, 1993.

4. "Remediation of the Former Radioactive Waste Burial Site," Final Report, Creative Pollution Solutions, Inc., September 1993.

5. "Confirmatory Survey Plan for the Texas Instruments Incorporated Burial Site, Attleboro, Massachusetts," Oak Ridge Institute for Science and Education, December 6, 1993.

6. Letter from A. J. Ansari (ORISE) to M. C. Roberts (NRC), reference: "Comments on the Final Report: Remediation of the Former Radioactive Waste Burial Site at Texas Instruments Incorporated," December 1, 1993.

7. U.S. Nuclear Regulatory Commission, "Disposal of Onsite Storage of Thorium and Uranium Wastes from Past Operations," 46 FR 52061, Washington, D.C., October 23, 1981.

APPENDIX A

MAJOR INSTRUMENTATION

APPENDIX A

MAJOR INSTRUMENTATION

The display of a specific product is not to be construed as an endorsement of the product or its manufacturer by the authors or their employers.

DIRECT RADIATION MEASUREMENT

Instruments

Eberline Pulse Ratemeter
Model PRM-6
(Eberline, Santa Fe, NM)

Ludlum Ratemeter-Scaler
Model 2200
(Ludlum Measurements, Inc.,
Sweetwater, TX)

Detectors

Reuter-Stokes Pressurized Ion Chamber
Model RSS-111
(Reuter-Stokes, Cleveland, OH)

Victoreen NaI Scintillation Detector
Model 489-55
3.2 cm x 3.8 cm Crystal
(Victoreen, Cleveland, OH)

LABORATORY ANALYTICAL INSTRUMENTATION

High Purity Extended Range Intrinsic Detectors
Model No: ERVDS30-25195
(Tennelec, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, TN) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

High-Purity Germanium Detector
Model GMX-23195-S, 23% Eff.
(EG&G ORTEC, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-16
(Gamma Products, Palos Hills, IL) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

SURVEY PROCEDURES

Surface Scans

Surface scans for gamma activity were performed by passing the probes slowly over the surface; the distance between the probe and the surface was maintained at a minimum. The scans were performed using NaI detectors coupled to countrate meters with audible indicators. Identification of elevated levels was based on increases in the audible signal from the recording and/or indicating instrument.

Exposure Rate Measurements

Measurements of gamma exposure rates were performed at 1 m above the surface, using a pressurized ionization chamber (PIC).

Soil Sampling

Approximately 1 kg of soil was collected at each sample location. Surface soil samples were collected at 0-15 cm depth. Samples from boreholes were collected from the surface (0-15 cm), the center (85-100 cm), and the bottom (185-200 cm) of each borehole. When the depth of a borehole was 1.5 m, the bottom soil sample was collected at 135-150 cm. When the depth of a borehole was 1 m, only two samples were collected from that borehole (0-15, and 85-100 cm). Collected samples were placed in a plastic bag, sealed, and labeled in accordance with ESSAP survey procedures.

ANALYTICAL PROCEDURES

Gamma Spectrometry

Samples of soil were dried, mixed, crushed, and/or homogenized as necessary, and a portion sealed in 0.5-liter Marinelli beaker or other appropriate container. The quantity placed in the beaker was chosen to reproduce the calibrated counting geometry. Net material weights were determined and the samples counted using intrinsic germanium detectors coupled to a pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. Energy peaks used for determination of radionuclides of concern were:

U - 235	0.186 MeV
U - 238	0.063 MeV from Th-234*
Th-228	0.583 MeV from Tl-208
Th-232	0.911 MeV from Ac-228*

*Secular equilibrium assumed.

Spectra were also reviewed for other identifiable photopeaks.

UNCERTAINTIES AND DETECTION LIMITS

The uncertainties associated with the analytical data presented in the tables of this report represent the 95% confidence level for that data based only on counting statistics. Additional uncertainties associated with sampling and measurement procedures, have not been propagated into the data presented in this report.

Detection limits, referred to as minimum detectable activity (MDA), were based on 2.71 plus 4.66 times the standard deviation of the background count. When the activity was determined to be less than the MDA of the measurement procedure, the result was reported as less than MDA. Because of variations in background levels, measurement efficiencies, and contributions

from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument.

CALIBRATION AND QUALITY ASSURANCE

Calibration of all field and laboratory instrumentation was based on standards/sources, traceable to NIST, when such standards/sources were available. In cases where they were not available, standards of an industry recognized organization were used. Calibration of pressurized ionization chambers was performed by the manufacturer.

Analytical and field survey activities were conducted in accordance with procedures from the following ESSAP documents:

- Survey Procedures Manual, Revision 7
- Laboratory Procedures Manual, Revision 8
- Quality Assurance Manual, Revision 6

The procedures contained in these manuals were developed to meet the requirements of DOE Order 5700.6C and ASME NQA-1 for Quality Assurance and contain measures to assess processes during their performance.

Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment operation is within acceptable statistical fluctuations.
- Participation in EPA and EML laboratory Quality Assurance Programs.
- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.

APPENDIX C

GUIDELINES FOR RESIDUAL CONCENTRATIONS OF THORIUM AND URANIUM WASTES IN SOIL

Guidelines for Residual Concentrations of Thorium and Uranium Wastes in Soil

On October 23, 1981, the Nuclear Regulatory Commission published in the Federal register a notice of Branch Technical Position on "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations." This document established guidelines for concentrations of uranium and thorium in soil, that will limit maximum radiation received by the public under various conditions of future land usage. These concentrations are as follows:

Material	Maximum Concentrations (pCi/g) for various options			
	1[a]	2[b]	3[c]	4[d]
Natural Thorium (Th-232 + Th-228) with daughters present and in equilibrium	10	50	--	500
Natural Uranium (U-238 + U-234) with daughters present and in equilibrium	10	--	40	200
Depleted Uranium:				
Soluble	35	100	--	1,000
Insoluble	35	300	--	3,000
Enriched Uranium:				
Soluble	30	100	--	1,000
Insoluble	30	250	--	2,500

[a]Based on EPA cleanup standards which limit radiation to 1 mrad/yr to lung and 3 mrad/yr to bone from ingestion and inhalation and 10 μR/h above background from direct external exposure.
[b]Based on limiting individual dose to 170 mrem/yr.
[c]Based on limiting equivalent exposure to 0.02 working level or less.
[d]Based on limiting individual dose to 500 mrem/yr and in case of natural uranium, limiting exposure to 0.02 working level or less.

CONFIRMATORY SURVEY OF THE TEXAS INSTRUMENTS, INC. FORMER BURIAL SITE ATTLEBORO, MASSACHUSETTS

Prepared by

A. J. Ansari

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Prepared for the

U.S. Nuclear Regulatory Commission
Region I Office

February 1994

FINAL REPORT

This report is based on work performed under an Interagency Agreement (NRC Fin. No. A-9076) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. Oak Ridge Institute for Science and Education performs complementary work under contract number DE-AC05-76OR00033 with the U.S. Department of Energy.

CONFIRMATORY SURVEY
OF THE TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

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ACKNOWLEDGEMENTS

The author would like to acknowledge the significant contributions of the following staff members:

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ABBREVIATIONS AND ACRONYMS

ASME	American Society of Mechanical Engineers
cm	centimeter
cm^2	square centimeter
cpm	counts per minute
CPS	Creative Pollution Solutions
EML	Environmental Measurement Laboratory
EPA	Environmental Protection Agency
ESSAP	Environmental Survey and Site Assessment Program
m	meter
m^2	square meter
M&C	Metals and Controls, Incorporated
MDA	minimum detectable activity
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NRC	Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
PIC	Pressurized Ionization Chamber
RSAP	Radiological Site Assessment Program
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μR/h	microroentgen per hour

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The Texas Instruments Incorporated site at Attleboro, Massachusetts, was owned and operated by Metals and Controls, Inc. (M&C) until 1959, at which time M&C merged with Texas Instruments, Incorporated (TI). The General Plate Division of M&C began processing nuclear materials in 1952, and between 1952 and 1959 fabricated uranium foils for reactor experiments and fuel components and complete reactor fuel cores for the U.S. Navy. Source material license D-549 was issued permitting acquisition and title to not more than 22.7 kg (50 pounds) of refined source material for use in the production of uranium foils; additional source material was acquired and used under contract with the U.S. Government. Special nuclear materials license No. SNM-23 was issued, permitting acquisition and title to 110 kg of enriched uranium for fabrication of the fuel components and cores. After the merger in 1959, Texas Instruments continued fabricating reactor fuel cores, primarily for research and production reactors. Also, source materials, i.e., natural uranium and thorium, were fabricated for sale to various corporations.

A 1964 Texas Instruments health and safety manual states that uranium- and thorium-contaminated noncombustible scrap material and machinery were collected in 55-gallon steel drums and were disposed of through authorized agencies, or were buried on-site in compliance with 10CFR20.304. Records indicate two known burials of radioactive material, one in 1958 of contaminated ductwork, and one in 1961 of 28.4 mCi of enriched uranium noncombustible scrap. The burial site was closed in 1967. Work with nuclear materials was gradually reduced beginning in 1968 and was terminated in 1974. The interiors of the three buildings where radioactive materials were used were decontaminated by the licensee and in 1983 the buildings were released for unrestricted use by the Nuclear Regulatory Commission (NRC).

The Radiological Site Assessment Program (RSAP) of the Oak Ridge Associated Universities (ORAU) conducted a radiological survey of portions of the facility's outdoor areas during April and May, 1984. The results of that survey indicated several areas with surface and/or subsurface uranium concentrations in excess of guidelines.[1] In the summer of 1992, Creative Pollution Solutions, Inc. was contracted by Texas Instruments Inc. to initiate remediation activities. The licensee submitted a post-excavation radiological survey report to the NRC in November of 1992.[2]

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) performed a confirmatory survey of the excavated area in December of 1992. The results of that survey indicated that the full extent of the burial site, particularly on the west side, adjacent to Building 11 parking lot, had not been determined.[3] Subsequently, further remediation of the former burial site was performed by Creative Pollution Solutions, Inc. Following those remediations, the licensee completed final survey activities and backfilling operations.[4]

The U.S. Nuclear Regulatory Commission, Region I Office, requested that the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) perform an independent confirmatory survey of the former burial site. This report summarizes the procedures and results of that survey.

SITE DESCRIPTION

The Texas Instruments Inc. Facility, Attleboro, MA is located in North Attleboro, approximately 48 kilometers south of Boston on Route 123 (Figure 1). The former burial site is located between Buildings 11 and 12 (Figure 2). The area of concern for remediation activities was approximately 10,000 m^2. The excavated area at the burial site was approximately 2,500 m^2 and the average depth of the excavated area was approximately 1.5 meters. The west end of the excavation extended into the parking lot, adjacent to Building 11. The excavated area has been backfilled and landscaped. The area which extended into the parking lot has been repaved.

OBJECTIVES

The objectives of the confirmatory process are to provide independent document reviews and radiological data, for use by the NRC in evaluating the adequacy and accuracy of the licensee's radiological survey data, relative to established guidelines.

DOCUMENT REVIEW

The final radiological status report, provided by the Texas Instruments Incorporated, was reviewed by ESSAP as part of the confirmatory activities.[4] Analytical procedures and methods utilized by the licensee were reviewed for adequacy and appropriateness. The data were reviewed for accuracy, completeness, and compliance with applicable NRC guidelines.

PROCEDURES

On December 14 and 15, 1993, ESSAP performed a confirmatory survey of the former burial site and the areas of concern immediately adjacent to the burial site. The survey was conducted in accordance with a survey plan which was submitted to and approved by the NRC, Region I Office.[5]

REFERENCE GRID

A 10 m x 10 m grid was established during ESSAP's radiological survey of this site in 1984 which was subsequently used by the licensee.[2,4] The same reference grid was used in this survey.

SURFACE SCANS

Surface scans of the former burial site (approximately 10,000 m^2) were performed using NaI detectors coupled to countrate meters with audible indicators. Surface scans for gamma radiation

were performed on 100% of the former excavation and the two meter perimeter immediately surrounding that area. Approximately 50% of the remaining surface area was also scanned.

EXPOSURE RATE MEASUREMENTS

Background exposure rates, determined during a previous ESSAP survey of this facility, were used for comparison.[1]

Exposure rate measurements were performed at 1 m above the surface at 12 locations, using a pressurized ionization chamber (PIC). Measurement locations are illustrated in Figure 3.

SOIL SAMPLING

The analytical results of background soil samples, collected during a previous ESSAP survey of this facility, were used for comparison.[1]

Five surface soil samples were obtained at the center of randomly selected grid blocks. In addition, two surface soil samples were collected from the area between grid coordinates 185N, 170E and 195N, 180E where the licensee had reported slightly elevated gamma radiation.[4] Sampling locations are illustrated in Figure 4.

Thirty-seven soil samples were collected from 14 boreholes. The boreholes were drilled on and around the former excavated area to depths of approximately 2 meters, except for a number of locations where relatively large pieces of rock were encountered at a depth of approximately 1-1.5 meters. On the west side of the excavation, boreholes were drilled 3 meters from the edge of the former excavation at approximately 20 meter intervals. For the remaining perimeter area, boreholes were drilled at approximately 40 meter intervals. The location of a number of boreholes had to be moved because of their proximity to buried water, gas, and compressed air lines.

The boreholes were scanned for gamma activity, using a collimated NaI detector coupled to a countrate meter with an audible indicator. Systematic soil samples were collected from the surface (0-15 cm), the middle (85-100 cm), and the bottom (185-200 cm) of each borehole. In the parking lot area, the "surface" soil sample was approximately 30 cm below the surface of the pavement. Furthermore, when the depth of a borehole was 1.5 m, the bottom soil sample was collected at 135-150 cm. When the depth of a borehole was 1 m, only two samples were collected from that borehole (0-15, and 85-100 cm).

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data were returned to ORISE's ESSAP laboratory in Oak Ridge, TN for analysis and interpretation. Exposure rates were reported in μR/h. Soil samples were analyzed by gamma spectrometry. Spectra were reviewed for U-235, U-238, Th-232, Th-228, and any other identifiable photopeaks. Soil sample results were reported in units of picocuries per gram (pCi/g). Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B. Results were compared to NRC guidelines which are provided in Appendix C.

FINDINGS AND RESULTS

DOCUMENT REVIEW

ESSAP reviewed the licensee's radiological survey data and comments were provided to the NRC.[6] In ESSAP's opinion, the licensee documents provide an adequate description of the radiological condition of the facility relative to the NRC guidelines for release for unrestricted use.

SURFACE SCANS

Surface scans for gamma activity did not identify any locations of elevated direct radiation.

EXPOSURE RATE MEASUREMENTS

The background exposure rates, previously measured at this site, ranged from 10 to 11 μR/h and averaged 10 μR/h.[1]

Exposure rates, measured at 12 locations in the vicinity of the former burial site, ranged from 9 to 11 μR/h. (Table 1).

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES

Total uranium concentrations in background soil samples, previously determined for this site, ranged from 1.0 to 2.4 pCi/g.[1]

Concentrations of U-235, U-238, and total uranium in surface soil samples ranged from <0.1 to 0.4 pCi/g, 0.7 to 10 pCi/g, and 3.0 to 20 pCi/g, respectively. Concentrations of U-235, U-238, and total uranium in subsurface soil samples ranged from <0.1 to 0.6 pCi/g, 0.6 to 13 pCi/g, and 2.9 to 27 pCi/g, respectively (Table 2).

COMPARISON OF RESULTS WITH GUIDELINES

The NRC guidelines for residual concentrations of radionuclides in soil, established for license termination or release of a facility for unrestricted use are presented in Appendix C. The primary contaminant of concern at this site is enriched uranium.

The soil concentration guideline for enriched uranium is 30 pCi/g.[7] The total uranium concentrations in all surface and subsurface soil samples were within this limit.

At this site, the applicable NRC guideline for exposure rate at 1 m above the surface is 10 μR/h above background, consistent with the Branch Technical Position.[7] All exposure rates were within this limit.

SUMMARY

During the period December 14 and 15, 1993, at the request of the NRC Region I Office, the Environmental Survey and Site Assessment Program of ORISE performed a confirmatory survey of the former burial site at Texas Instruments Incorporated. The survey activities consisted of surface scans for gamma activity, exposure rate measurements, and soil sampling.

Exposure rates were all within the 10 μR/h above background criterion. The radionuclide concentrations in surface and subsurface soil samples were less than the applicable guidelines for release for unrestricted use. In ESSAP's opinion, the licensee documents provide an adequate description of the radiological condition of the facility.

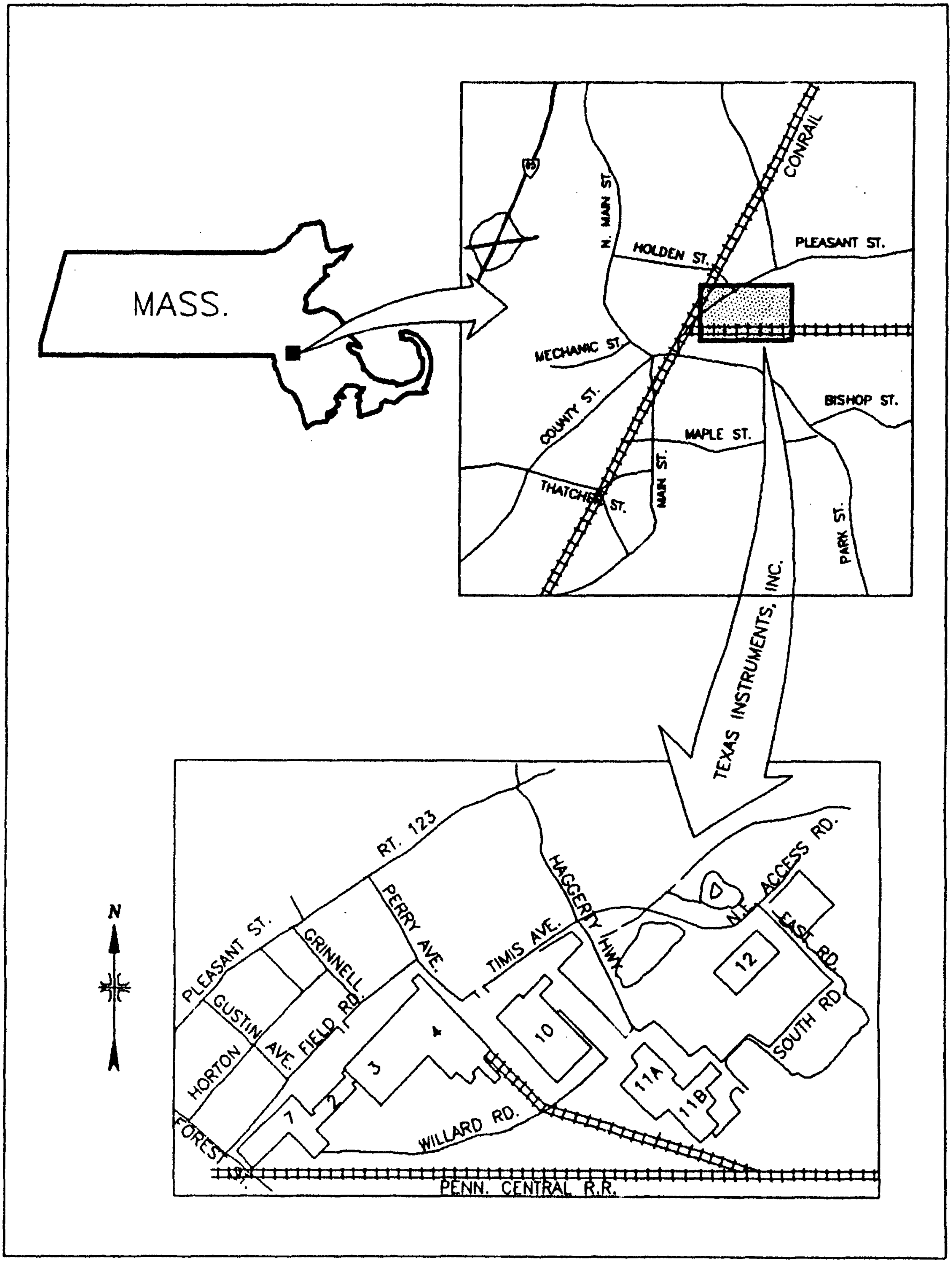

FIGURE 1: Map of Attleboro, Massachusetts – Location and Plan View of the Texas Instruments Site

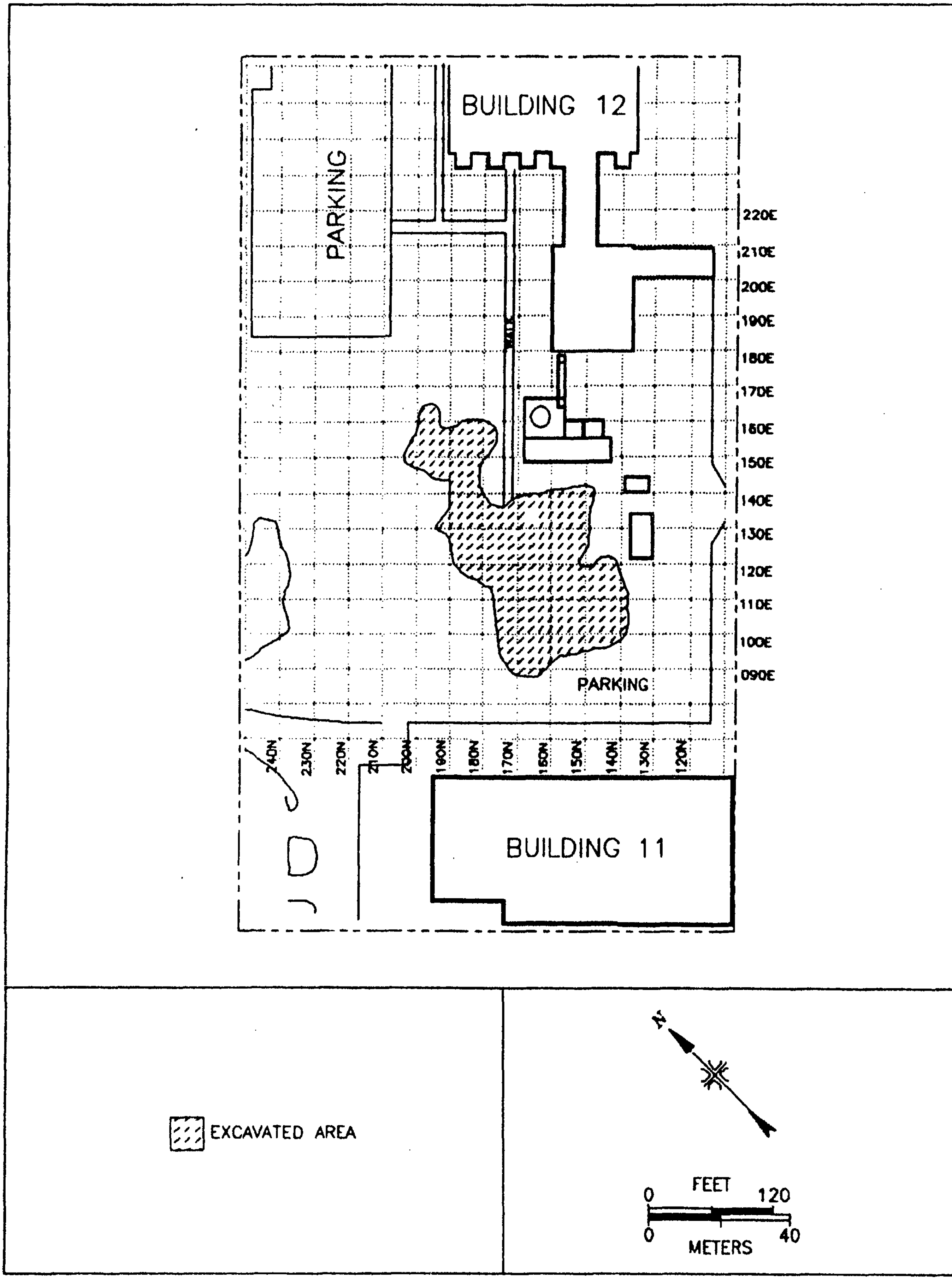

FIGURE 2: The Former Burial Site – Extent of Excavation

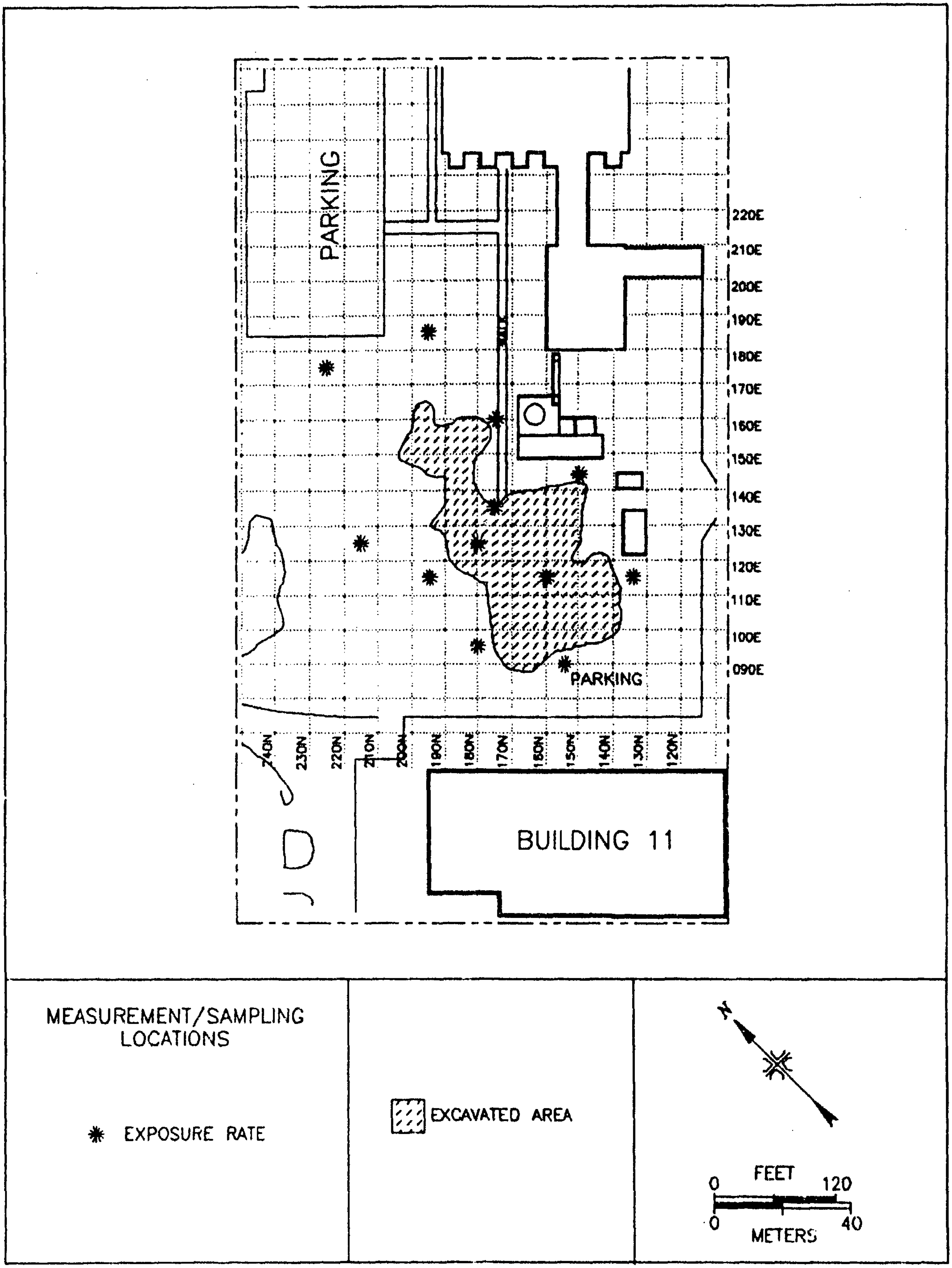

FIGURE 3: The Former Burial Site — Exposure Rate Measurement Locations

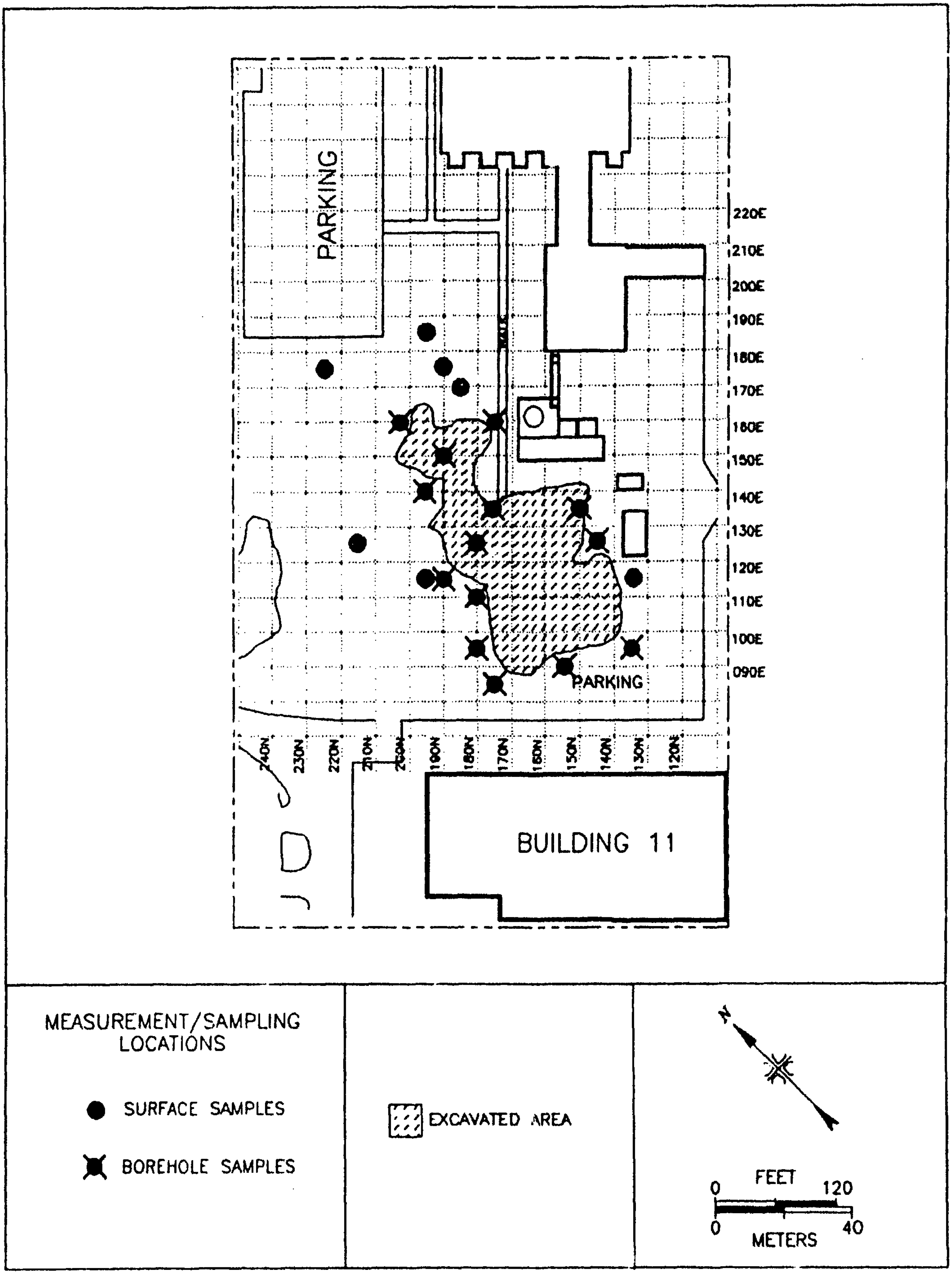

FIGURE 4: The Former Burial Site – Soil Sampling Locations

TABLE 1

EXPOSURE RATE MEASUREMENTS
TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Location[a]	Exposure Rate at 1 m above the surface (μR/h)
135N, 115E	9
150N, 145E	9
155N, 90E	11
160N, 115E	9
175N, 135E	9
175N, 160E	10
180N, 95E	11
180N, 125E	9
195N, 115E	10
195N, 185E	9
215N, 125E	9
225N, 175E	9

[a]Refer to Figure 3.

TABLE 2

URANIUM CONCENTRATIONS IN SOIL SAMPLES
TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Location[a]	Depth (cm)	Uranium Concentrations (pCi/g)[b]		
		U-235	U-238	Total U[c]
135N, 95E	0-15	0.3 ± 0.1	3.2 ± 1.2	10
	85-100	<0.1	0.6 ± 1.4	<2.9
	185-200	0.2 ± 0.1	2.3 ± 1.2	6.9
135N, 115E	0-15	0.2 ± 0.1	0.9 ± 1.0	5.5
145N, 125E	0-15	<0.1	6.0 ± 1.7	<8.3
	85-100	0.2 ± 0.1	4.4 ± 1.3	9.0
150N, 135E	0-15	<0.1	2.6 ± 1.1	<4.9
	85-100	0.3 ± 0.1	4.1 ± 0.9	11
155N, 90E	0-15	<0.1	1.1 ± 1.0	<3.4
	85-100	<0.1	2.2 ± 0.8	<4.5
	185-200	0.2 ± 0.1	3.2 ± 1.4	7.8
175N, 85E	0-15	0.1 ± 0.1	1.5 ± 1.0	3.8
	85-100	<0.1	1.8 ± 1.4	<4.1
	135-105	<0.1	1.6 ± 1.3	<3.9
175N, 135E	0-15	<0.1	2.0 ± 1.5	<4.3
	85-100	0.3 ± 0.1	7.2 ± 1.5	14
175N, 160E	0-15	0.2 ± 0.1	1.6 ± 1.1	5.6
	85-100	0.2 ± 0.1	1.6 ± 1.4	6.2
	185-200	0.2 ± 0.1	1.8 ± 0.9	6.4
180N, 95E	0-15	<0.2	3.7 ± 1.3	<8.3
	85-100	<0.1	1.7 ± 1.2	<4.0
	185-200	0.1 ± 0.1	3.4 ± 1.2	5.7
180N, 110E	0-15	0.4 ± 0.1	10.4 ± 2.1	20
	85-100	0.4 ± 0.1	12.7 ± 1.7	22
	135-150	<0.1	2.4 ± 1.8	<4.7

TABLE 2 (Continued)

URANIUM CONCENTRATIONS IN SOIL SAMPLES
TEXAS INSTRUMENTS, INC.
FORMER BURIAL SITE
ATTLEBORO, MASSACHUSETTS

Location[a]	Depth (cm)	Uranium Concentrations (pCi/g)[b]		
		U-235	U-238	Total U[c]
185N, 125E	0-15	<0.1	1.7 ± 1.2	<4.0
	85-100	0.3 ± 0.1	4.5 ± 1.3	11
185N, 170E	0-15	<0.1	0.7 ± 0.9	<3.0
190N, 115E	0-15	<0.1	2.4 ± 1.5	<4.7
	85-100	0.5 ± 0.1	2.1 ± 1.5	14
190N, 150E	0-15	<0.1	0.8 ± 1.0	<3.1
	85-100	0.4 ± 0.1	6.5 ± 1.6	16
	185-200	0.6 ± 0.1	10.3 ± 1.8	24
190N, 175E	0-15	0.1 ± 0.1	1.5 ± 1.0	3.8
195N, 115E	0-15	0.4 ± 0.1	3.4 ± 1.6	13
195N, 140E	0-15	<0.1	1.2 ± 0.9	<3.5
	85-100	0.3 ± 0.1	2.1 ± 1.1	9.0
	185-200	<0.1	1.7 ± 1.1	<4.0
195N, 185E	0-15	<0.1	1.1 ± 0.8	<3.4
200N, 160E	0-15	<0.1	1.2 ± 1.2	<3.5
	85-100	0.6 ± 0.1	13 ± 2.0	27
	185-200	0.5 ± 0.1	2.8 ± 1.0	14
215N, 125E	0-15	<0.1	1.4 ± 0.9	<3.7
225N, 175E	0-15	<0.1	1.6 ± 1.2	<3.9

[a]Refer to Figure 4.
[b]Uncertainties represent the 95% confidence level based only on counting statistics.
[c]Total uranium concentrations are calculated based on a U-234 to U-235 activity ratio of 22:1.

REFERENCES

1. "Radiological Survey of the Texas Instruments Site, Attleboro, Massachusetts," Oak Ridge Associated Universities, January, 1985.

2. "Post Excavation Radiological Survey Report, Texas Instruments Incorporated Burial Site, Attleboro, Massachusetts," Creative Pollution Solutions, Inc., November 28, 1992.

3. Letter from A. Jaberaboansari (ORISE) to J. Roth (NRC), reference: "Interim Radiological Survey Report for the Texas Instruments Incorporated Burial Site," January 25, 1993.

4. "Remediation of the Former Radioactive Waste Burial Site," Final Report, Creative Pollution Solutions, Inc., September 1993.

5. "Confirmatory Survey Plan for the Texas Instruments Incorporated Burial Site, Attleboro, Massachusetts," Oak Ridge Institute for Science and Education, December 6, 1993.

6. Letter from A. J. Ansari (ORISE) to M. C. Roberts (NRC), reference: "Comments on the Final Report: Remediation of the Former Radioactive Waste Burial Site at Texas Instruments Incorporated," December 1, 1993.

7. U.S. Nuclear Regulatory Commission, "Disposal of Onsite Storage of Thorium and Uranium Wastes from Past Operations," 46 FR 52061, Washington, D.C., October 23, 1981.

APPENDIX A

MAJOR INSTRUMENTATION

APPENDIX A

MAJOR INSTRUMENTATION

The display of a specific product is not to be construed as an endorsement of the product or its manufacturer by the authors or their employers.

DIRECT RADIATION MEASUREMENT

Instruments

Eberline Pulse Ratemeter
Model PRM-6
(Eberline, Santa Fe, NM)

Ludlum Ratemeter-Scaler
Model 2200
(Ludlum Measurements, Inc.,
Sweetwater, TX)

Detectors

Reuter-Stokes Pressurized Ion Chamber
Model RSS-111
(Reuter-Stokes, Cleveland, OH)

Victoreen NaI Scintillation Detector
Model 489-55
3.2 cm x 3.8 cm Crystal
(Victoreen, Cleveland, OH)

LABORATORY ANALYTICAL INSTRUMENTATION

High Purity Extended Range Intrinsic Detectors
Model No: ERVDS30-25195
(Tennelec, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, TN) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

High-Purity Germanium Detector
Model GMX-23195-S, 23% Eff.
(EG&G ORTEC, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-16
(Gamma Products, Palos Hills, IL) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

SURVEY PROCEDURES

Surface Scans

Surface scans for gamma activity were performed by passing the probes slowly over the surface; the distance between the probe and the surface was maintained at a minimum. The scans were performed using NaI detectors coupled to countrate meters with audible indicators. Identification of elevated levels was based on increases in the audible signal from the recording and/or indicating instrument.

Exposure Rate Measurements

Measurements of gamma exposure rates were performed at 1 m above the surface, using a pressurized ionization chamber (PIC).

Soil Sampling

Approximately 1 kg of soil was collected at each sample location. Surface soil samples were collected at 0-15 cm depth. Samples from boreholes were collected from the surface (0-15 cm), the center (85-100 cm), and the bottom (185-200 cm) of each borehole. When the depth of a borehole was 1.5 m, the bottom soil sample was collected at 135-150 cm. When the depth of a borehole was 1 m, only two samples were collected from that borehole (0-15, and 85-100 cm). Collected samples were placed in a plastic bag, sealed, and labeled in accordance with ESSAP survey procedures.

ANALYTICAL PROCEDURES

Gamma Spectrometry

Samples of soil were dried, mixed, crushed, and/or homogenized as necessary, and a portion sealed in 0.5-liter Marinelli beaker or other appropriate container. The quantity placed in the beaker was chosen to reproduce the calibrated counting geometry. Net material weights were determined and the samples counted using intrinsic germanium detectors coupled to a pulse height analyzer system. Background and Compton stripping, peak search, peak idenufication, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. Energy peaks used for determination of radionuclides of concern were:

U - 235	0.186 MeV
U - 238	0.063 MeV from Th-234*
Th-228	0.583 MeV from Tl-208
Th-232	0.911 MeV from Ac-228*

*Secular equilibrium assumed.

Spectra were also reviewed for other identifiable photopeaks.

UNCERTAINTIES AND DETECTION LIMITS

The uncertainties associated with the analytical data presented in the tables of this report represent the 95% confidence level for that data based only on counting statistics. Additional uncertainties associated with sampling and measurement procedures, have not been propagated into the data presented in this report.

Detection limits, referred to as minimum detectable activity (MDA), were based on 2.71 plus 4.66 times the standard deviation of the background count. When the activity was determined to be less than the MDA of the measurement procedure, the result was reported as less than MDA. Because of variations in background levels, measurement efficiencies, and contributions

from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument.

CALIBRATION AND QUALITY ASSURANCE

Calibration of all field and laboratory instrumentation was based on standards/sources, traceable to NIST, when such standards/sources were available. In cases where they were not available, standards of an industry recognized organization were used. Calibration of pressurized ionization chambers was performed by the manufacturer.

Analytical and field survey activities were conducted in accordance with procedures from the following ESSAP documents:

- Survey Procedures Manual, Revision 7
- Laboratory Procedures Manual, Revision 8
- Quality Assurance Manual, Revision 6

The procedures contained in these manuals were developed to meet the requirements of DOE Order 5700.6C and ASME NQA-1 for Quality Assurance and contain measures to assess processes during their performance.

Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment operation is within acceptable statistical fluctuations.
- Participation in EPA and EML laboratory Quality Assurance Programs.
- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.

APPENDIX C

GUIDELINES FOR RESIDUAL CONCENTRATIONS OF THORIUM AND URANIUM WASTES IN SOIL

Guidelines for Residual Concentrations of Thorium and Uranium Wastes in Soil

On October 23, 1981, the Nuclear Regulatory Commission published in the Federal register a notice of Branch Technical Position on "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations." This document established guidelines for concentrations of uranium and thorium in soil, that will limit maximum radiation received by the public under various conditions of future land usage. These concentrations are as follows:

Material	Maximum Concentrations (pCi/g) for various options			
	1[a]	2[b]	3[c]	4[d]
Natural Thorium (Th-232 + Th-228) with daughters present and in equilibrium	10	50	--	500
Natural Uranium (U-238 + U-234) with daughters present and in equilibrium	10	--	40	200
Depleted Uranium:				
Soluble	35	100	--	1,000
Insoluble	35	300	--	3,000
Enriched Uranium:				
Soluble	30	100	--	1,000
Insoluble	30	250	--	2,500

[a]Based on EPA cleanup standards which limit radiation to 1 mrad/yr to lung and 3 mrad/yr to bone from ingestion and inhalation and 10 μR/h above background from direct external exposure.
[b]Based on limiting individual dose to 170 mrem/yr.
[c]Based on limiting equivalent exposure to 0.02 working level or less.
[d]Based on limiting individual dose to 500 mrem/yr and in case of natural uranium, limiting exposure to 0.02 working level or less.

JUL 29 1994

Docket No. 070-00033 License No. SNM-23

Texas Instruments, Inc.
ATTN: Werner Schuele
Vice President, Materials & Controls Group
34 Forest Street
Attleboro, Massachusetts 02703

Dear Mr. Schuele:

SUBJECT: ROUTINE INSPECTION NO. 070-00033/94-001

On May 10 and 25, 1994, Mark C. Roberts of this office conducted a routine safety inspection at the above address of activities authorized by the above listed NRC license. The inspection was limited to a review of soil remediation activities in progress in the vicinity of Building 5. John D. Kinneman, Chief, Site Decommissioning Section, accompanied Mr. Roberts on May 10, 1994. The findings of the inspection were discussed with Werner Schuele, Frank Veale and you at the conclusion of the inspection. A copy of the inspection report is enclosed.

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

In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and the enclosed inspection report will be placed in the Public Document Room. No reply to this letter is required.

Sincerely,

Original Signed By:
John D. Kinneman

John D. Kinneman, Chief
Site Decommissioning Section
Facilities Radiological Safety
and Safeguards Branch
Division of Radiation Safety
and Safeguards

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Enclosure:
NRC Region I Inspection Report No. 070-00033/94-001

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cc:
Michael F. Elliot, DIV Environmental Manae

Public Document Room (PDR)
Nuclear Safety Information Center (NSIC)
Commonwealth of Massachusetts

bcc:
Region I Docket Room (w/concurrences)

DRSS:RI	DRSS:RI
Roberts/gcb	Kinneman
7/ /94	7/ 20/94

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 070-00033/94-001

Docket Nos. 070-00033

License Nos. SNM-22

Licensee: Texas Instruments, Inc.
34 Forest Avenue
Attleboro, Massachusetts 02703

Facility Name: Texas Instruments, Inc.

Inspection At: Texas Instruments, Inc.
Attleboro, Massachusetts

Inspection Conducted: May 10 and 25, 1994

Inspector: _______________ _______
Mark C. Roberts date
Senior Health Physicist

Approved by: _______________ 7/20/94
John D. Kinneman, Chief date
Site Decommissioning Section

Inspection Summary: Routine, announced decommissioning inspection conducted May 10 and 25, 1994 (Inspection No. 070-00033/94-001).

Areas Inspected: Organization and project coordination; radiological surveys and remediation; analytical measurements and survey instrumentation; posting and labeli ; radiation protection procedures; radioactive waste transportation and disposal; training and instructions to workers.

Results: No violations were identified.

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DETAILS

1. Persons Contacted

*Werner Schuele, Senior Vice President, Materials & Controls Group and Site Manager, Texas Instruments, Inc. (TI)
*Frank Veale, Manager, Environmental Safety and Health Department, TI
*Michael Elliott, Environmental Manager, TI
Richard Derby, Hazardous Waste Coordinator, TI
Mark Griffon, Health Physicist, Creative Pollution Solutions,Inc. (CPS)
Fred McWilliams, Health Physicist, CPS
John Leighton, Field Supervisor, Franklin Environmental

Various members of the health physics/remediation field staff

*Denotes those present at exit interview.

2. Background

The Texas Instruments, Inc. (TI) facility is located in Attleboro, Massachusetts, 48 kilometers (30 miles) south of Boston. The site is approximately 40 hectares (100 acres) with twelve major buildings. Operations with radioactive materials commenced at the site in 1952 when the General Plate Division of Metals and Controls, Inc. began to fabricate enriched uranium foils. This company merged with TI in 1957. Texas Instruments fabricated enriched uranium fuel elements for the U. S. Navy and commercial customers from 1957 through 1983. Remediation and final surveys of contaminated portions of some of the site buildings were completed in 1985 and are documented in various reports.

Scrap material and equipment contaminated with enriched uranium were buried in a disposal area between Buildings 11 and 12. This area was the subject of remediation and final surveys which were completed in October 1993. A confirmatory survey in this area was conducted by the Oak Ridge Institute for Science and Education in December 1993.

During late 1993 and into 1994, the licensee performed additional radiological surveys to ensure that all areas that may have been contaminated with radioactive material in excess of current criteria for release for unrestricted use were identified. The surveys identified three areas in the vicinity of Building 5 with total uranium concentrations in the soil in excess of 30 pCi/g. These areas, originally identified as suspect through interviews with employees and former employees, were apparently former waste treatment (incineration) and handling areas. According to the licensee's remediation plan, approximately 275 m^3 (9,700 ft^3) of contaminated soil was scheduled to be removed from these areas. Based on telephone conversations with the licensee's representatives following the implementation of the remediation plan, the estimate of the volume of contaminated soil for disposal was increased to approximately 1,400 m^3 (50,000 ft^3) after identifying additional contamination under an asphalt paved area. The inspection was performed to review the remediation and survey activities then in progress in the areas in the vicinity of Building 5.

3. Organization and Project Coordination

The remediation project is managed by the Environmental Manager. This individual reports to the Environmental Safety and Health (ES&H) Manager who reports to the Site Manager. The Environmental Manager coordinates the activities of the health physics contractor, the remediation contractor and TI personnel as they relate to the remediation project. The Environmental Manager conducts a weekly project meeting with representatives from the remediation and health physics contractors and TI representatives from Security, Communications, Facilities-Utilities and Hazardous Waste Disposal. Representatives from other groups are included as necessary. The weekly meeting serves to schedule and coordinate the activities for the week.

The inspector attended the planning meeting held on May 10, 1994. Items discussed during this meeting included the schedule for the loading of waste onto trucks, security requirements for the support of the truck loading operation, additional equipment needs and the extension of the size of the current area under remediation.

No safety concerns were identified.

4. Radiological Surveys and Remediation

Radiological surveys at the surface of the soil indicated elevated radiation levels in three areas in the vicinity of Building 5. Soil sampling and analysis confirmed the presence of uranium contamination at concentrations as high as 200 - 250 pCi/g (for total uranium). The contaminated soil was generally within about 30 centimeters (1 foot) of the surface; however, contamination was found at a depth of 1.5 to 1.8 meters (5 to 6 feet) in the area nearest Building 5 and at a depth of approximately 60 centimeters (2 feet) in the paved area currently under remediation. These areas are identified as the Baseline Excavation, Outlying Area #1 and Outlying Area #2 and indicated on the accompanying map (Attachment 1).

Texas Instruments has completed removal of contaminated soil in the Baseline Excavation area and in Outlying Area #1. Results of samples taken in the area between the Baseline Excavation area and Outlying Area #1 indicated soil contamination exceeding the guidelines for release for unrestricted use. This area was also remediated and the two separate areas now form one larger excavation. The Environmental Manager stated that samples obtained from this area now indicate that concentrations of enriched uranium are less than the criterion for release for unrestricted use. The area has been backfilled for safety and drainage purposes; however, archived soil samples from this area are available for future analysis.

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borings through the asphalt, but more extensive contamination has been discovered following the removal of the asphalt layer. Heavy equipment is used to remove an 8 - 10 centimeter (3 - 4 inch) layer of contaminated soil which is then placed in a staging area. The soil is then sent through a screening device to remove rocks. The rocks recovered from this process are surveyed prior to removal to a clean area and are eventually used to backfill areas where remediation has been completed. The contaminated soil is placed into large dumpsters or piles for loading into trucks or railroad cars for disposal. Soil samples are taken after the removal of each soil layer and analyzed to determine the concentration of total uranium. The removal and survey process is repeated until the concentrations of uranium in the soil meet the criterion for release for unrestricted use. Final sampling and analysis is then performed using an established 20 foot by 20 foot (6.1 meter by 6.1 meter) grid pattern. A composite obtained from the floor of the excavation is taken and analyzed from each grid square.

On May 25, 1994 the inspector returned to the site to review sampling and analysis data for portions of Outlying Area #2. Since TI excavated an area larger than anticipated, they needed more room to stage contaminated soil and clean rocks and to maneuver equipment to be used for loading railroad cars. The inspector examined the analytical data from samples obtained from the center of Outlying Area #2. The analytical results from these samples indicated that the uranium concentration met the criterion for release for unrestricted use. In discussions with the Environmental Manager, the inspector discussed the NRC's desire to leave excavations open, where possible, for better access for confirmatory measurements. However, the TI representative stated that in many cases excavations must be filled prior to the completion of confirmatory measurements. Since TI needed to fill at least a portion of the current excavation, the inspector split samples obtained from the floor of the excavation. Texas Instruments' representatives confirmed that archived samples would be available from this area for future analysis. The analysis of the split and archived samples may reduce or eliminate the need to obtain post-excavation samples by core drilling. The analysis of these samples will also serve to validate the analytical method used by TI's consultant. This method is discussed in Section 5 of this report.

The Environmental Manager reported the results of the analysis of the split samples to the inspector on May 26, 1994. Two of the samples obtained from the floor of the excavation had total uranium concentrations in excess of the criterion for release for unrestricted use. An investigation by the Environmental Manager determined that these two samples were obtained from an area where contaminated soil was staged following remediation. Not all of the contaminated soil was relocated prior to sampling. These areas were scheduled for further remediation and resampling.

The licensee's contractor performed a radiological survey on the roof of Building 5. The licensee reported that all readings were indistinguishable from the instrument background.

No safety concerns were identified.

5. <u>Analytical Measurements and Survey Instrumentation</u>

Texas Instruments' consultant, Creative Pollution Solutions, Inc., provides health physics and radiological analytical services to support the remediation project. Since the contamination in the soil is uranium of varied enrichments, CPS refined an analytical method to rapidly and accurately evaluate soil samples for total uranium content. The method is a gross alpha scintillation analysis using a zinc sulphide (ZnS) wafer coupled to a photomultiplier tube. A sample can be prepared and counted in less than an hour and the results compare favorably to those obtained by alpha spectrometry.

Soil samples are initially prepared by removing small rocks from the sample jar and mixing the remaining sample until it is relatively homogenous. Approximately 100 grams of the sample is then dried in an oven and then sieved. A ZnS wafer is placed in the bottom of a transparent plastic petri dish and an aliquot of the sample (typically about 20 grams) is added to the petri dish. Sufficient sample is used to provide an infinite thickness relative to the range of the alpha particles in the sample. The technique is independent of the sample volume as long as the minimum thickness is achieved. The technique has been "calibrated" by correlation to the total uranium activity determined from alpha spectrometry results. This analysis has a direct correlation to total uranium concentration for total uranium concentrations less than approximately a few hundred pCi/g. A sample count time of ten minutes is typically used to achieve a sensitivity of less than 5 pCi/g. The inspector split samples with TI for analysis by the Region I analytical laboratory. Selected samples will also be analyzed by alpha spectrometry by the NRC's contractor. The uranium concentration results for these samples will be reported in subsequent correspondence after completion of the analyses.

No safety concerns were identified.

6. <u>Posting and Labeling</u>

Entry to contaminated or potentially contaminated areas is indicated by appropriate ropes and signs. An NRC Form-3 was posted in the access trailer.

No safety concerns were identified.

7. <u>Radiation Protection Procedures</u>

Each person entering and exiting the contaminated work area is required to record entry and exit times on a log sheet. Personal protective equipment consisting of shoe covers or boots and disposable gloves are required for work in the contaminated work area. Personnel exiting the contaminated area have been instructed to monitor themselves with the pancake GM probe and count rate-meter positioned at the exit to the area. Personnel working in the contaminated work area were observed to be wearing the designated personnel protective equipment and monitoring for contamination upon exiting.

The inspector reviewed the Radiological Health and Safety Plan dated April 24, 1994. Included in this document are characterization data, a training outline, monitoring and sampling plans and action levels for air sampling, personnel exposure and surface contamination. The inspector observed that the guidelines for surface contamination were not the most current guidance from the NRC. The inspector stated that he would send the current guideline to TI as soon as he returned to the office. The Environmental Manager stated that TI would incorporate the current guidance into the Radiological Health and Safety Plan.

No safety concerns were identified.

8. Radioactive Waste Transportation and Disposal

The contaminated soil removed from the excavations is loaded onto trucks for disposal at the Envirocare facility in Clive, Utah. Each truck holds a volume of approximately 11 - 12 m^3 (15 - 16 yd^3). As of May 10, 1994, approximately 150 m^3 (200 yd^3) of contaminated soil has been shipped for disposal. The contaminated soil is shipped as Radioactive Material, Low Specific Activity (LSA), n.o.s., UN2912 in accordance with U.S. Department of Transportation regulations (49 CFR 173.425). The vehicles are consigned as exclusive use and each vehicle is placarded on four sides. The inspector examined the completed shipping papers for shipment No. 0249-01-0066 and six other shipments that had been sent from the site on May 7, 1994. The records appeared complete and accurate. Since the volume of contaminated soil is larger than the original estimates, TI representatives stated that future shipments of contaminated soil to the Envirocare facility will be done via railroad car.

No safety concerns were identified.

9. Training and Instructions to Workers

Workers involved in the remediation activities are trained in accordance with section VI of the Radiological Health and Safety Plan for the project. Topics include contamination controls, dose control, personnel access and frisking procedures. A log is kept of the training; but was not examined by the inspector. Specific training was also provided to workers in the metals reclamation area (Building 5) due to their proximity to the remediation activities. All supervisors at TI were briefed via electronic mail of the general scope of the remediation project.

No safety concerns were identified.

10. Exit Interview

The results of the inspection were discussed with the licensee representatives identified in Section 1.

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 070-00033/94-001

Docket Nos. 070-00033

License Nos. SNM-22

Licensee: Texas Instruments, Inc.
34 Forest Avenue
Attleboro, Massachusetts 02703

Facility Name: Texas Instruments, Inc.

Inspection At: Texas Instruments, Inc.
Attleboro, Massachusetts

Inspection Conducted: May 10 and 25, 1994

Inspector: Mark C. Roberts, Senior Health Physicist — date

Approved by: John D. Kinneman, Chief, Site Decommissioning Section — 7/20/94 date

Inspection Summary: Routine, announced decommissioning inspection conducted May 10 and 25, 1994 (Inspection No. 070-00033/94-001).

Areas Inspected: Organization and project coordination; radiological surveys and remediation; analytical measurements and survey instrumentation; posting and labeli ·; radiation protection procedures; radioactive waste transportation and disposal; training and instructions to workers.

Results: No violations were identified.

DETAILS

1. Persons Contacted

*Werner Schuele, Senior Vice President, Materials & Controls Group and Site Manager, Texas Instruments, Inc. (TI)
*Frank Veale, Manager, Environmental Safety and Health Department, TI
*Michael Elliott, Environmental Manager, TI
Richard Derby, Hazardous Waste Coordinator, TI
Mark Griffon, Health Physicist, Creative Pollution Solutions,Inc. (CPS)
Fred McWilliams, Health Physicist, CPS
John Leighton, Field Supervisor, Franklin Environmental

Various members of the health physics/remediation field staff

*Denotes those present at exit interview.

2. Background

The Texas Instruments, Inc. (TI) facility is located in Attleboro, Massachusetts, 48 kilometers (30 miles) south of Boston. The site is approximately 40 hectares (100 acres) with twelve major buildings. Operations with radioactive materials commenced at the site in 1952 when the General Plate Division of Metals and Controls, Inc. began to fabricate enriched uranium foils. This company merged with TI in 1957. Texas Instruments fabricated enriched uranium fuel elements for the U. S. Navy and commercial customers from 1957 through 1983. Remediation and final surveys of contaminated portions of some of the site buildings were completed in 1985 and are documented in various reports.

Scrap material and equipment contaminated with enriched uranium were buried in a disposal area between Buildings 11 and 12. This area was the subject of remediation and final surveys which were completed in October 1993. A confirmatory survey in this area was conducted by the Oak Ridge Institute for Science and Education in December 1993.

During late 1993 and into 1994, the licensee performed additional radiological surveys to ensure that all areas that may have been contaminated with radioactive material in excess of current criteria for release for unrestricted use were identified. The surveys identified three areas in the vicinity of Building 5 with total uranium concentrations in the soil in excess of 30 pCi/g. These areas, originally identified as suspect through interviews with employees and former employees, were apparently former waste treatment (incineration) and handling areas. According to the licensee's remediation plan, approximately 275 m^3 (9,700 ft^3) of contaminated soil was scheduled to be removed from these areas. Based on telephone conversations with the licensee's representatives following the implementation of the remediation plan, the estimate of the volume of contaminated soil for disposal was increased to approximately 1,400 m^3 (50,000 ft^3) after identifying additional contamination under an asphalt paved area. The inspection was performed to review the remediation and survey activities then in progress in the areas in the vicinity of Building 5.

3. Organization and Project Coordination

The remediation project is managed by the Environmental Manager. This individual reports to the Environmental Safety and Health (ES&H) Manager who reports to the Site Manager. The Environmental Manager coordinates the activities of the health physics contractor, the remediation contractor and TI personnel as they relate to the remediation project. The Environmental Manager conducts a weekly project meeting with representatives from the remediation and health physics contractors and TI representatives from Security, Communications, Facilities-Utilities and Hazardous Waste Disposal. Representatives from other groups are included as necessary. The weekly meeting serves to schedule and coordinate the activities for the week.

The inspector attended the planning meeting held on May 10, 1994. Items discussed during this meeting included the schedule for the loading of waste onto trucks, security requirements for the support of the truck loading operation, additional equipment needs and the extension of the size of the current area under remediation.

No safety concerns were identified.

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Radiological surveys at the surface of the soil indicated elevated radiation levels in three areas in the vicinity of Building 5. Soil sampling and analysis confirmed the presence of uranium contamination at concentrations as high as 200 - 250 pCi/g (for total uranium). The contaminated soil was generally within about 30 centimeters (1 foot) of the surface; however, contamination was found at a depth of 1.5 to 1.8 meters (5 to 6 feet) in the area nearest Building 5 and at a depth of approximately 60 centimeters (2 feet) in the paved area currently under remediation. These areas are identified as the Baseline Excavation, Outlying Area #1 and Outlying Area #2 and indicated on the accompanying map (Attachment 1).

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The Environmental Manager reported the results of the analysis of the split samples to the inspector on May 26, 1994. Two of the samples obtained from the floor of the excavation had total uranium concentrations in excess of the criterion for release for unrestricted use. An investigation by the Environmental Manager determined that these two samples were obtained from an area where contaminated soil was staged following remediation. Not all of the contaminated soil was relocated prior to sampling. These areas were scheduled for further remediation and resampling.

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10. Exit Interview

The results of the inspection were discussed with the licensee representatives identified in Section 1.

November 16, 1994

MN NO. 94-135

U. S. Nuclear Regulatory Commission
Region I
Notice of Licensee Meeting

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

Name of Facility: Texas Instruments, Incorporated

Docket No. 070-00033

Time and Date of Meeting: 8:30 a.m., November 23, 1994

Location of Meeting: U. S. Nuclear Regulatory Commission
475 Allendale Road
DRSS Conference Room
King of Prussia, Pennsylvania 19406

Purpose of Meeting: Open meeting to present supplement to site characterization and remediation plant for Texas Instruments, Incorporated Attleboro site.

NRC Attendees: James H. Joyner, Chief, Facilities Radiological Safety and Safeguards Branch
John D. Kinneman, Chief, Site Decommissioning Section (SDS)
Mark C. Roberts, Senior Health Physicist, SDS

Licensee Attendees: Francis J. Veale, Jr., Environmental Safety & Health Manager
Michael J. Elliott, Environmental Manager
Mark Griffon, Consultant, CPS, Incorporated

Note: This Meeting is OPEN to the public. Attendance by NRC personnel should be made known by 5:00 p.m. on November 21, 1994 via a telephone call to Mark Roberts, Region I, 475 Allendale Road, King of Prussia, Pa 19406, (610) 337-5094. Handicapped persons requiring assistance to attend or participate in the meeting should make their requests known to Mr. Roberts no later than two business days prior to the meeting.

Prepared By: [signature]
Mark C. Roberts, Senior Health Physicist
Site Decommissioning Section

Approved By: [signature]
John D. Kinneman, Chief
Site Decommissioning Section

Distribution (Via E-Mail)
James M. Taylor, Executive Director for Operations
Hugh L. Thompson, Jr., Deputy Executive Director for
Nuclear Materials Safety, Safeguards and Operations Support
James Lieberman, Director, Office of Enforcement
Robert M. Bernero, Director, Office of Nuclear Material
Safety and Safeguards
William M. Dean, Regional Coordinator, EDO
Carl Paperiello, Director, Division of Industrial
and Medical Nuclear Safety, NMSS
Malcolm Knapp, Director, Division of Waste Management, NMSS
John H. Austin, Chief, LLW and Decommissioning Projects Branch, NMSS
John E. Glenn, Chief Medical, Academic, and Commercial
Use Safety Branch, NMSS
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DRA Secretary

c70-00033

Texas Instruments Incorporated

TEXAS INSTRUMENTS

34 Forest Street
P.O. Box 2964
Attleboro, MA 02703 0964

(508) 236 3800

December 20, 1994

Mr. Mark Roberts, CHP
Senior Health Physicist
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406

Dear Mark,

As promised, please find enclosed two copies of the four missing pages from Appendix A of TI's Supplement to the 1992 Remediation Plan (December 1994).

Also, as we discussed on the phone today, following is the revised draft license amendment that we are proposing. Our counsel, Maurice Axelrad, re-wrote it based on your previous comments. Please review this, hopefully it will be of use to you.

Sample License Condition

19. In order to assure that TI's facility and site are decommissioned in accordance with a decommissioning plan approved by the NRC and the criteria identified in the Site Decommissioning Plan Action Plan of April 16, 1992, TI shall complete such decommissioning by performing radiological surveys and remediation activities in accordance with the "Supplement to the 1992 Remediation Plan" (the Plan Supplement) submitted December 1994. At any time that TI determines that a milestone completion date specified in section 5.0 of the Plan Supplement is not achievable, TI will notify the NRC in advance and will promptly provide a revised schedule to the NRC. TI's satisfactory completion of the activities described in the Plan Supplement, including such confirmatory surveys as may be performed by the NRC, will enable TI's license to be terminated and the facility and site to be released for unrestricted use.

Sincerely,

Materials & Controls Group

Michael J. Elliott
Environmental Manager
Environmental, Safety & Health Dept.

Encl.

9501110491 941220
PDR ADOCK 07000033
C PDR

RETURN ORIGINAL TO

Texas Instruments Incorporated

TEXAS INSTRUMENTS

34 Forest Street
P.O. Box 2964
Attleboro, MA 02703 0964

(508) 236 3800

December 19, 1994

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
Article No. Z 074 994 106

SNM No. 23
Docket No. 70-33

Mr. Mark Roberts, CHP
Senior Health Physicist
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406

Re: Supplement to the 1992 Remediation Plan

Dear Mr. Roberts:

As you know, Texas Instruments Incorporated (TI), Materials & Controls Group has been decommissioning its facility and site at Attleboro, MA, in accordance with a decommissioning plan, including criteria, previously approved by the NRC.

Enclosed is a "Supplement to the 1992 Remediation Plan" (December 1994) (the Supplement) that TI has prepared in order to document the specific actions that TI is taking to complete the decommissioning of the site and facility, and thus achieve termination of Special Nuclear Materials License No. 23 and release of the entire facility and site for unrestricted use.

We would appreciate the NRC's approval of the Supplement by a license amendment which reaffirms that satisfactory performance of the described activities will complete the decommissioning of the facility and site in accordance with criteria identified in the Site Decommissioning Management Plan Action Plan of April 16, 1992.

Sincerely,

Materials & Controls Group

Michael J. Elliott
Environmental Manager
Environmental, Safety & Health Dept.

Encl: "Supplement to the 1992 Remediation Plan" (December 1994)

RETURN ORIGINAL TO

SNM-23

SUPPLEMENT TO THE 1992 REMEDIATION PLAN

TEXAS INSTRUMENTS INCORPORATED
ATTLEBORO, MASSACHUSETTS

SPECIAL NUCLEAR MATERIAL LICENSE No. 23
DOCKET No. 70-33

REV. 0.0

For Submission to:

The U.S. Nuclear Regulatory Commission
Region I - NMSS
475 Allendale Road
King of Prussia, PA 19406

Prepared by:

Texas Instruments Incorporated
Materials & Controls Group
Environmental, Safety & Health Department
P.O. Box 2964
34 Forest Street
Attleboro, MA 02703-0964

DECEMBER 1994

SUPPLEMENT TO THE 1992 REMEDIATION PLAN

TEXAS INSTRUMENTS INCORPORATED
ATTLEBORO, MASSACHUSETTS

SPECIAL NUCLEAR MATERIAL LICENSE No. 23
DOCKET No. 70-33

REV. 0.0

For Submission to:

The U.S. Nuclear Regulatory Commission
Region I - NMSS
475 Allendale Road
King of Prussia, PA 19406

Prepared by:

Texas Instruments Incorporated
Materials & Controls Group
Environmental, Safety & Health Department
P.O. Box 2964
34 Forest Street, MS 10-02
Attleboro, MA 02703-0964

DECEMBER 1994

TABLE OF CONTENTS

LIST OF FIGURES

1.0 PURPOSE OF THE SUPPLEMENT

Texas Instruments Incorporated, Materials & Controls Group (TI), has been decommissioning its facility and site at Attleboro, Massachusetts, under Special Nuclear Material License No. 23 (the License). As described below, these activities have been conducted in accordance with a decommissioning plan, including criteria, previously approved by the U.S. Nuclear Regulatory Commission (NRC).

The purpose of this "Supplement to the 1992 Remediation Plan" (the Supplement) is to document the specific actions that TI is taking to complete the decommissioning of the facility and site, and thus achieve termination of the License and release of the entire facility and site for unrestricted use.

2.0 BACKGROUND

2.1 HISTORICAL OPERATIONS

In 1952, the Atomic Energy Commission (AEC) engaged Metals & Controls Corporation to fabricate uranium fuel elements for experimental research reactors. In these early years between 1952 and 1955, nuclear operations were confined to the "Fissionable and Source Material" (FSM) Manufacturing Area located in the northern portion of Bldg L (which by today's nomenclature, corresponds to a portion of Bldg 4), and a rolling mill within Bldg C, (currently known as Bldg 3).

By 1955, as the nuclear operations expanded, Metals & Controls Corporation formed a wholly owned subsidiary known as M&C Nuclear. In that same time frame, the AEC issued Special Nuclear Material License No. 23 for the fabrication and assembly of uranium fuel elements. Again in 1955, Bldg N (currently known as Bldg 10) was constructed as a dedicated facility to house the nuclear manufacturing operations.

Throughout its history, M&C Nuclear manufactured fuel assemblies primarily for the U.S. Naval Reactor Program. In 1959, TI acquired the Metals & Controls Corporation. TI continued fabrication of Naval Reactor fuel elements through 1968.

After 1968, TI manufactured fuel elements exclusively for the High Flux Isotope Reactor (HFIR) Program under a government contract with Oak Ridge National Laboratories. During the HFIR Program, the nuclear manufacturing operations were reduced in size to a small area in the northwest portion of Bldg 10.

By 1981, TI disengaged from the HFIR Program, and by so doing, it permanently concluded its involvement in uranium fuel element manufacturing..

2.2 PAST DECOMMISSIONING ACTIVITIES

2.2.1 Early Decontamination and Decommissioning (D&D) Activities

As nuclear manufacturing activities were discontinued in various buildings or portions thereof in the 1950s and 1960s, D&D efforts were conducted, but the records of such early efforts are either destroyed in accordance with the records retention policy or unavailable.

In 1981, when TI permanently ceased its involvement in nuclear manufacturing activities, TI initiated final D&D efforts in accordance with an NRC-approved Decommissioning Plan contained in its License.

2.2.2 1982 D&D of Building Interiors

In 1982, TI conducted D&D activities within the interior of the portion of Bldg 10 that had housed the HFIR operation. These activities were expanded to include systematic, radiological surveys of the portions of all other buildings (i.e. Bldgs 3, 4, and the remainder of 10) where nuclear operations had previously existed, but for which, there existed little, if any, documentation of past D&D activities.

Subsequent to the 1982 D&D activities, TI submitted two reports to the NRC, dated May 14, 1982 and November 1, 1982, documenting surveys that showed compliance with the applicable decommissioning criteria. The NRC performed confirmatory surveys and released the building interiors for unrestricted use as recorded in inspection reports dated October 14, 1992 and March 8, 1983. License termination, however was withheld, pending further investigations into the former radioactive waste burial site (Bldg 12 Burial Site) between Bldgs 11 and 12.

2.2.3 1982 Radiological Surveys of the Bldg 12 Burial Site Conducted by TI

The Bldg 12 Burial Site is believed to have been in operation from the early to mid 1950s through approximately the early to mid 1960s. Burial practices were conducted for the onsite disposal of contaminated scrap and debris.

In 1982, TI conducted two surface and subsurface radiological surveys primarily addressing the Bldg 12 Burial Site location. Accordingly, TI submitted two reports to the NRC, dated July 20, 1982 and January 17, 1983 documenting the results of its efforts. These reports concluded that residual radiation at the TI site did not pose a significant risk of harm to public health or the environment. Therefore, TI requested that the License be terminated and that the site should be released for unrestricted use.

2.2.4 1983 Confirmatory Survey Conducted by ORAU for NRC

During the summer of 1983, the NRC mobilized Oak Ridge Associated Universities (ORAU) to conduct an independent radiological assessment of the TI site. ORAU surveyed the Bldg 12 Burial Site location and around the perimeter of Bldg 10. ORAU submitted a report to the NRC with its findings in 1984.

The ORAU report contained results that supported TI's position that residual radiation did not pose a significant or immediate health concern. However, the report also documented

the presence of isolated areas of soil contamination in excess of the NRC's guidance policy for unrestricted release, Option 1 of the 1981 Branch Technical Position (1981 BTP) (46 FR 52061, October 23, 1981).

2.2.5 Remediation of Soils Adjacent to the HFIR Loading Ramp

Under the direction of the NRC, TI removed an area of surface soil contamination adjacent to the former HFIR loading ramp along the west side of Bldg 10 in the 1983 time frame. After excavation, this material was packaged and dispositioned to a licensed low level radioactive waste disposal facility in Barnwell, South Carolina.

2.2.6 Remediation of the Building 12 Burial Site

During a meeting in April, 1990, the NRC indicated that the Bldg 12 Burial Site would have to be remediated in order to terminate the License. The NRC asked for and received TI's commitment to remediate the Bldg 12 Burial Site.

The NRC also informed TI at the April, 1990 meeting that TI had been added to a list of sites targeted for accelerated efforts toward decommissioning. On April 16, 1992, the NRC published this list as part of the SDMP Action Plan.

After evaluating a wide range of technical options, and after having performed additional subsurface radiological characterization surveys, TI submitted the "Remedation Plan for the Identified Bldg 12 Burial Area" (the 1992 Remediation Plan) to the NRC in July, 1992. The NRC approved the plan in August, 1992 in Amendment No. 16 to the License.

On August 31, 1992, TI initiated the Burial site remediation. The project spanned the course of a year, reaching completion in July, 1993. During that time, TI transported 63,000 cubic feet of contaminated soil and debris for disposal at a licensed facility in Utah. TI documented the project activities and the final survey results in a final report dated September, 1993.

In December, 1993, the NRC and its contractor, Oak Ridge Institute for Science and Environment (ORISE), formerly known as ORAU, conducted a confirmatory survey of the Bldg 12 Burial Site project. Subsequently, ORISE issued a survey report in February 1994 and concluded that the Bldg 12 Burial Site remediation had achieved the NRC guidance criteria contained in the 1981 BTP for unrestricted release.

2.2.7 Remediation of the Metals Recovery Area

In final preparation for license termination activities, TI investigated the Metals Recovery Area in the vicinity of Bldg 5 because such area had been used for waste processing during the time of the nuclear operations. In late 1993, TI conducted preliminary surveys and

identified the existence of elevated radiation levels on the southwest side of Bldg 5. Subsequent surveys, including subsurface soil measurements (March, 1994) indicated the need to perform remediation activities at this location. TI notified the NRC of its intentions in March, 1994, and received the NRC's approval to proceed with the remediation. Remediation activities commenced on April 28, 1994, and were completed by November 14, 1994. The remediation project generated 115,000 cubic feet of contaminated soil which were also dispositioned to the licensed disposal facility in Utah.

3.0 TI'S CONTINUING ACTIVITIES TOWARD COMPLETION OF DECOMMISSIONING

In addition to the decommissioning activities described in the previous section that were performed in the past, TI has identified several activities that, once completed, will satisfy all the decommissioning requirements for the Attleboro facility and site. As an initial step, TI has reviewed historical documents, including reports and photographs and previous radiological surveys. TI has also interviewed selected employees who had been employed at the time of the nuclear operations or who might know something about past practices. These steps were taken to provide additional assurance that locations of previous nuclear activities were identified, and to assist in the classification of "affected" versus "unaffected" areas as described below.

The additional activities to be completed by TI can be divided into two broad categories: supplemental radiological surveys and remediation activities. With respect to the radiological surveys, the types of surveys, survey unit areas, and sampling protocol, etc. are described in Appendix A, "Supplemental Radiological Surveys".

As regards the remediation activities, though there are no substantive differences from the practices described in the 1992 Remediation Plan, the minor improvements afforded through actual field experience are described in Section 3.3.3, "Refinements to the 1992 Remediation Plan". TI plans to apply these enhancements at any additional areas requiring remediation.

3.1 RADIOLOGICAL SURVEYS OF OPEN LAND AREAS

The activities that are described below, commenced in July, 1994, and all field work will be completed by December, 1994. TI's consultant is in the process of preparing a radiological survey report summarizing the findings of this effort.

At the outset, TI decided to survey 100% of all land areas that were developed at the time of the nuclear operations.

Undeveloped areas (e.g. the dense woods to the east of the site) were excluded, as for all practical purposes, they were inaccessible by any reasonable means. (See Figure A1 in Appendix A.) The only other land areas that were specifically excluded from consideration were the previously remediated locations such as the Bldg 12 Burial Site, the Metals Recovery Area, and the Soils Adjacent to the HFIR Loading Dock.

Within the developed areas, TI further subdivided the land as either "affected" or "unaffected" (See Figures A1 and A2 in Appendix A). As will be described below, the distinction between affected and unaffected influenced the level of radiological survey that was performed for a given land area.

The definition of the different land categories and a description of each of the affected areas are found in Appendix A. TI based its land classification decisions on information collected from numerous sources of data, and logic that was consistent with definitions that appear in NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination" (Draft Report for Comment).

3.1.1 Surveys in the Affected Land Areas

Radiological surveys in affected areas were performed, as described in Sections 7.1 and 7.3 of Appendix A, similar to a "Final Survey" as contained in the 1992 Remediation Plan. A reference grid with 10m X 10m grid cells was established across any given survey unit. Systematic subsurface soil samples and exposure rate measurements were taken within the survey unit. Survey units were centered on suspect locations, and as necessary, they were expanded to a known boundary and/or until the soil concentrations were consistently below the cleanup criteria.

3.1.2 Survey in the Unaffected Land Areas

Radiological surveys were also performed in the unaffected areas according to the protocol described in Sections 7.1 and 7.3 of Appendix A.. TI's protocol exceeds the NUREG guidance with respect to surface scans. TI surveyed 100% of the unaffected open land areas. Additionally, TI is performing soil sampling within the affected area which consisted of 30 randomly selected surface soil samples and an unspecified number of biased samples.

3.1.3 Radiological Survey Reports for Open Land Areas

The results of the supplemental radiological surveys (other than for the Metals Recovery Area) will be compiled and submitted to the NRC in a Supplement Survey Report.

Since the Metals Recovery Area was in the process of being actively remediated, the radiological survey data constitutes part of the final survey data. Therefore, the survey data specific to this area will be submitted as part of the Metals Recovery Area Final Report, similar to the 1993 Burial Site Final Report.

3.2 RADIOLOGICAL SURVEYS OF BUILDING INTERIORS

The radiological surveys of the building interiors are in progress. This effort commenced in August, 1994, and is expected to be completed over the winter months in 1995.

The review of historical documents and employee interviews that TI conducted for defining affected and unaffected land areas, also served to classify building interiors. A description of identified building interiors subject to supplemental surveying is contained in Sections 5.0 and 6.0 of Appendix A. Details of the respective survey protocols are found in Sections 7.2 and 7.4 of Appendix A.

3.2.1 Surveys in Previously Decommissioned Building Interiors

TI decided to perform a supplemental survey even for the building interiors that had previously been decommissioned and released for unrestricted use by the NRC (i.e. portions of Bldgs 3 and 4, and most of Bldg 10). In these locations, TI's contractor scanned 100% of the accessible floor and wall space within 10m X 10m grid cells at 30 random locations within each of the original survey units that were defined in TI's 1982 D&D Final Reports.

For Bldg 3, the survey unit area was sufficiently small that the random survey covered the entire amount of accessible floor and wall space within the survey unit. At the same time, overhead areas, including pipes and structural members were also surveyed. At Bldgs 4 and 10, the 30 random locations within each of the survey units identified some elevated radiation levels, thus necessitating further surveying in accordance with the sampling protocol for an affected area.

Additional survey work is being planned for Bldgs 4 and 10 that will include previously inaccessible areas, as well as drains and trenches. Because of the logistical complications of performing such surveys in active manufacturing areas, the foregoing work will take place over an extended period on the order of a month or two.

3.2.2 Surveys in Affected Building Interiors

Bldg 5, part of the Metals Recovery Area, was identified as an affected area. A radiological scan survey was performed on 100% of the accessible space within the area of the original building boundaries that existed during the time of the nuclear operations. A small area of elevated radiation was detected at one of the floor/wall junctures. Similar to Bldgs 4 and 10, expanded surveys are slated for the upcoming winter months.

TI's historical review identified two additional affected areas, one occupying a portion of Bldg 1, and the other occupying a portion of Bldg 11. TI's contractor scanned 100% of the accessible floor and wall areas, and a representative portion of the overhead areas at both locations. Neither area demonstrated any evidence of elevated radiation levels.

3.2.3 Surveys in Unaffected Building Interiors

TI has classified as unaffected areas the floors and wall surfaces of areas where nuclear activities had not been conducted in buildings that contain previously decommissioned areas or affected areas (i.e. Bldgs 1, 3, 4, 5, 10, and 11). As recommended in NUREG/CR 5849, TI plans to perform random scan surveys over 10% of each unaffected area. This will also include random scan surveys on the roofs of the same buildings. This work will occur simultaneously with the additional work described above.

TI determined that no surveys were needed in buildings where no nuclear activities had been conducted.

3.2.4 Radiological Survey Report for Building Interiors

Just as in the case of the open land areas, the results of the building interior supplemental radiological surveys will be documented in a report format. It is TI's intention to complete additional supplemental radiological surveys of Buildings 4, 5 and 10 concurrent with decontamination activities. Therefore, the supplemental survey report for the building interiors will be included in the Final Report for overall remediation.

3.3 REMEDIATION PLAN AND DECOMMISSIONING CRITERIA

Using the results of the supplemental radiological surveys, TI will identify any additional areas requiring remediation pursuant to the criteria listed below. Once the areas requiring remediation have been identified, a separate work plan will be developed specific to each area. The work plans will be consistent with the practices approved in the 1992 Remediation Plan, as refined, see Section 3.3.3, below.

3.3.1 Decommissioning Criteria for Soils

Consistent with the limits specified in Option 1 of the 1981 BTP for unrestricted release of soils containing residual uranium contamination, the applicable criteria for the TI site, as determined through isotopic analysis, correspond to enriched uranium in some locations and depleted uranium at other locations. In the case of enriched uranium, the

concentration, measured as total uranium, shall not exceed 30 pCi/gm on average. For depleted uranium, the concentration, measured as total uranium, shall not exceed 35 pCi/gm on average.

Similarly, the previously approved 1992 Remediation Plan included a criterion of 30 pCi/gm measured as total uranium.

In applying these criteria for defining limits of excavation, TI will be comparing grid cell averages calculated from the radiological survey data against the applicable limit. After soil processing, these criteria will also be used to establish final disposition for soils.

3.3.2 Decommissioning Criteria for Facilities and Equipment

Annex ^ of TI's License originally established decommissioning criteria for facilities and equipm : by referencing Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclea. Reactors" (NRC, 1974). Since the issuance of Reg Guide 1.86, the NRC has on several occasions updated and tailored those criteria for application to holders of material licenses. On May 11, 1994, the NRC provided to TI the most recent version entitled "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted use or Termination of Licenses for Byproduct, Source or Special Nuclear Materials" prepared by the NRC, Office of Nuclear Material Safety and Safeguards, Division of Fuel Cycle, Medical, Academic and Commercial Use Safety, dated April 1993. These criteria will be used in completing the work described in this Supplement.

These criteria will be used for two purposes. First, TI will use them to define sections of building interiors requiring remediation. To this end, data collected during the radiological surveys of the building interiors will be compared against the guideline limits. Remediation procedures will be designed to render all surface areas suitable for unrestricted release as defined by the applicable criteria.

TI will also use the guidelines in the field during soil remediation activities when potentially contaminated debris is encountered requiring determination of final disposition. The debris will be surveyed, and decontaminated as necessary, to achieve compliance with the applicable guidelines.

3.3.3 Refinements to the 1992 Remediation Plan

3.3.3.1 Open Land Areas

The remediation of open land areas will proceed as described within the 1992 Remediation Plan. Excavated soils will be processed using conventional methods to

remove bulk aggregate. The extent of excavations will be defined through the systematic supplemental surveys performed as described in Sections 6.0 and 7.0 of Appendix A.

Based on the results of those surveys, areas with soils of highest contamination will be identified for remediation as described in Phase I of the 1992 Remediation Plan. Those excavated soils will be segregated to preclude contamination of soils below the criteria.

The remaining identified soils will then be excavated and processed to remove debris and aggregate and re-sampled to determine disposition as described in Phase II of the 1992 Remediation Plan.

In-process excavation surveys will proceed in the manner described within the 1992 Remediation Plan for both Phase I and Phase II areas.

3.3.3.2 Building Interiors

Building interiors for which decontamination may be required will be identified through the supplemental surveys as described in Sections 6.0 and 7.0 of Appendix A. Preliminary surveys have identified several areas of fixed contamination slightly greater than the release criteria. ("Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Materials," NRC, Office of Nuclear Material Safety and Safeguards, Division of Fuel Cycle, Medical, Academic and Commercial Use Safety, dated April 1993).

The method of decontamination to be used for building interiors may consist of any of the commonly employed destructive and non-destructive techniques such as scrubbing, chemical/strippable coatings, scarification or sand blasting. The particular technique employed will be dependent upon the extent of area to be decontaminated/remediated, the nature of the contaminant, and the results of small area testing of the various techniques. Since the nature of the contaminant is the same as in land areas requiring remediation, the Radiological Health and Safety Plan (Appendix C) remains applicable. Additional controls necessary for performing decontamination work inside building areas will be detailed within the workplan for each area.

3.4 FINAL SURVEY

3.4.1 Remediated Land Areas

For any additional remediated land areas, a final survey will be performed, as described in Section 8.1 of Appendix A, that is similar to the practice described in the approved 1992 Remediation Plan. In-process soil samples that are collected from the floor of the excavation during remediation will serve, in part, as final survey data. These samples will be analyzed in the onsite field laboratory using the gross alpha counting technique. In accordance with QA/QC protocol, 5% of the samples will be sent to an offsite laboratory for confirmatory analysis by gamma spectroscopy. Additionally, 1% of the samples collected which were sent to the offsite laboratory will also be analyzed by alpha spectroscopy.

All of the in-process floor samples and all of the supplemental radiological survey samples on which TI is relying for final survey data at any additional remediated locations will be archived and stored onsite in a locked, protected location. The archived samples will be maintained until the NRC has determined that the site is eligible to be released for unrestricted use.

To the extent that supplemental radiological survey data is used as final survey data, and to the extent that the sampling location pattern deviates from the suggested pattern described in NUREG/CR-5849, Section 8.3 and Attachment A of Appendix A include a conservative statistical evaluation showing that the sampling pattern used in the supplemental radiological survey is adequate to use as the final survey to demonstrate compliance with the applicable criterion and with the necessary 95% level of confidence. Within the remediated areas, where TI is relying, in part, on in-process floor sample data, the sample pattern density generally exceeds the guidelines in NUREG/CR-5849, and therefore easily satisfies the 95% confidence criteria.

3.4.2 Remediated Building Interiors

For any additional remediated building interiors, a final survey will be performed according to the practices described in Section 8.2 of Appendix A. This survey will be performed as an integral part of the D&D activities. Data will be recorded and maintained according to established QA/QC protocol.

The sampling protocol will be consistent with suggested guidelines contained in NUREG/CR-5849.

3.5 FINAL REPORT

Upon completion of the final surveys, TI will compile all the final survey data, for both open land areas and building interiors, into a final report. The final report will be structured similar to the 1993 Burial Site Final Report that was previously submitted to the NRC.

Attached to the final report, TI will include the results of a groundwater radiological monitoring program. This program, described in Appendix B, is modeled on the sampling and analysis protocol performed in 1993 under the direction of the NRC, and reported in Appendix F - "Site Hydrology" of the 1993 Burial Site Final Report. Consistent with the earlier efforts, the monitoring program will address groundwater quality downgradient of areas specifically identified for soil remediation activities. The groundwater samples will be collected, analyzed at an offsite laboratory, and compared against the EPA Drinking Water Criteria for Radionuclides (40 CFR 141), specifically, 15 pCi/l for gross alpha and 50 pCi/l for gross beta in the dissolved aqueous phase. In the event that any sample exceeds the criteria, isotopic analysis for uranium and thorium will be performed for that sample.

In the case of the Metals Recovery Area, and in the event that any other decommissioning activities are completed well in advance (i.e. by three months or more) of the majority of the work, a stand-alone final report for the individual area will be submitted in advance to the NRC separately.

4.0 ORGANIZATION FOR COMPLETING DECOMMISSIONING ACTIVITIES

4.1 HEALTH & SAFETY

The radiological contractor is responsible for maintaining the health physics programs for all activities within the decommissioning process. The "Radiological Health and Safety Plan, Rev. 3.0" which appears in Appendix C of this Supplement is a modified version of the original plan bearing the same title that was submitted to the NRC in July, 1992 as an attachment to the previously approved 1992 Remediation Plan, and later, in September, 1993, as Attachment A of the 1993 Burial Site Final Report. The original plan was modeled on the health & safety plan contained in TI's License. The original 1992 plan was modified for this effort in order to maintain applicability to all on-site decommissioning activities.

4.2 MANAGEMENT STRUCTURE

The organization and structure associated with the activities described in this Supplement will vary dependent upon the particular activity at any given time. In general terms, a project team is established for each activity. The composition of the team is tailored to the particular details of each activity. Figure 2 represents a typical organization chart for a generic activity associated with decommissioning.

TI provides project management and oversight under the direction of the Environmental Manager of the Materials & Controls Group, or his designee.

The radiological contractor provides support services during all phases of the decommissioning process. This contractor offers technical advice and guidance, and physically participates in or supervises the survey and remediation activities within the protocol established in this Supplement.

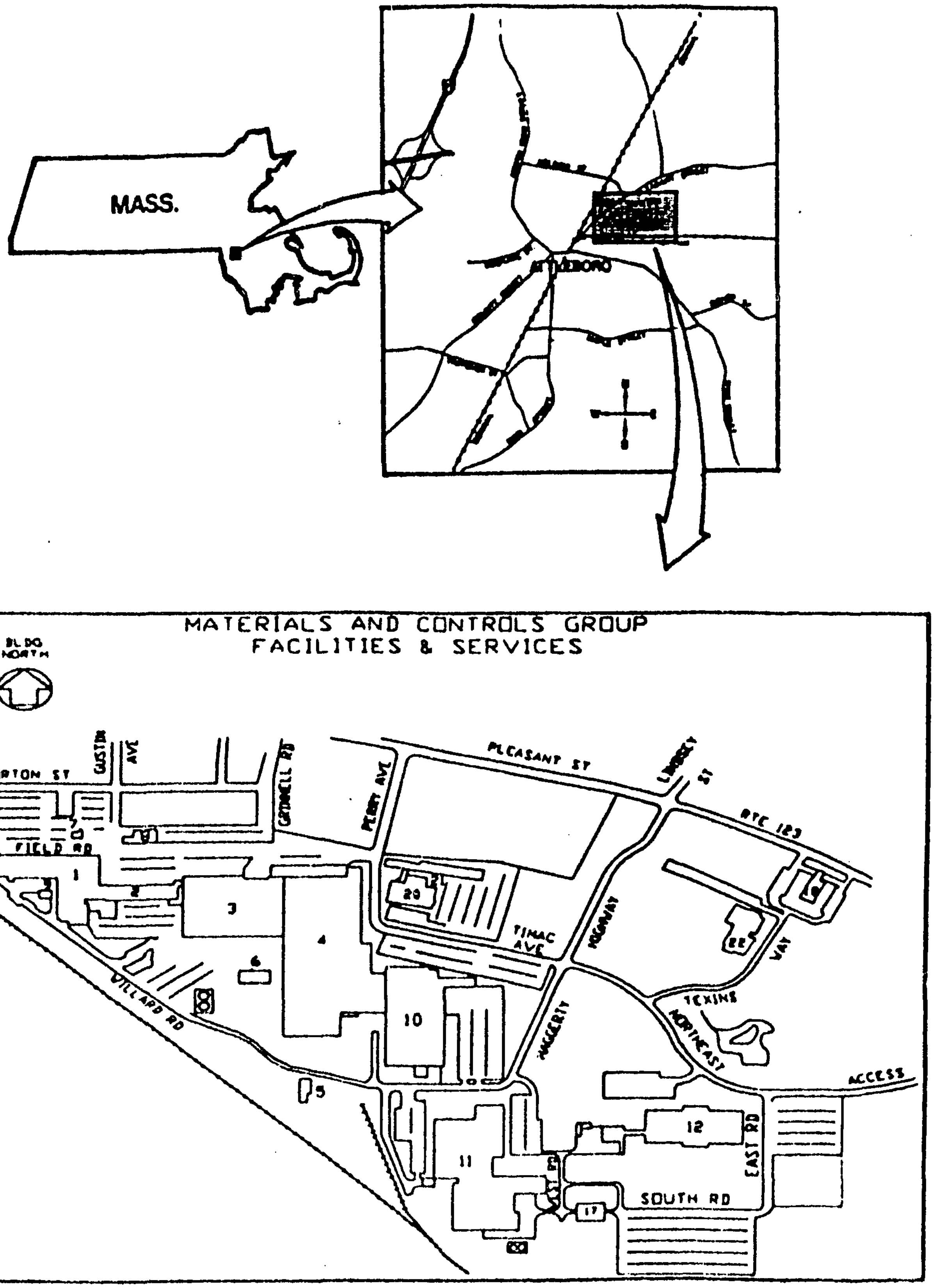
Support contractors are coordinated through the efforts of the project team. Though the meeting frequency varies dependent upon the specific requirements of the activity at hand, this team, chaired by the project manager, meets regularly (usually weekly) to maintain focus toward the desired objective. Minutes of the project meetings are recorded and issued to all team members. In addition, ad-hoc meetings are convened to deal with specific issues as circumstances dictate.

5.0 SCHEDULE

The following schedule outlines significant milestones toward completion of the decommissioning process. While the dates shown are meant to be attained and TI has extended every reasonable effort to scope out the project, the schedule is an aggressive one. Any unforeseen circumstances could adversely impact the currently estimated completion dates. At any time that TI determines that a milestone completion date is not achievable, TI will notify the NRC in advance and will promptly provide a revised schedule to the NRC.

5.1	Submit the Supplement to the 1992 Remediation Plan	12/94
5.2	NRC issues License Amendment	01/95
5.3	Submit Supplemental Radiological Survey Results -complete for open land areas -partial for building interiors	01/95
5.4	Identify any additional areas requiring remediation	01/95
5.5	Develop area specific remediation work plans	02/95
5.6	Submit Metals Recovery Area Final Report	02/95
5.7	Complete remediation activities	09/95
5.8	Complete TI Final Surveys and submit Final Report	10/95
5.9	NRC performs confirmatory surveys	11/95
5.10	NRC terminates license and releases facility and site for unrestricted use	02/96

Figure 1
Site Plan

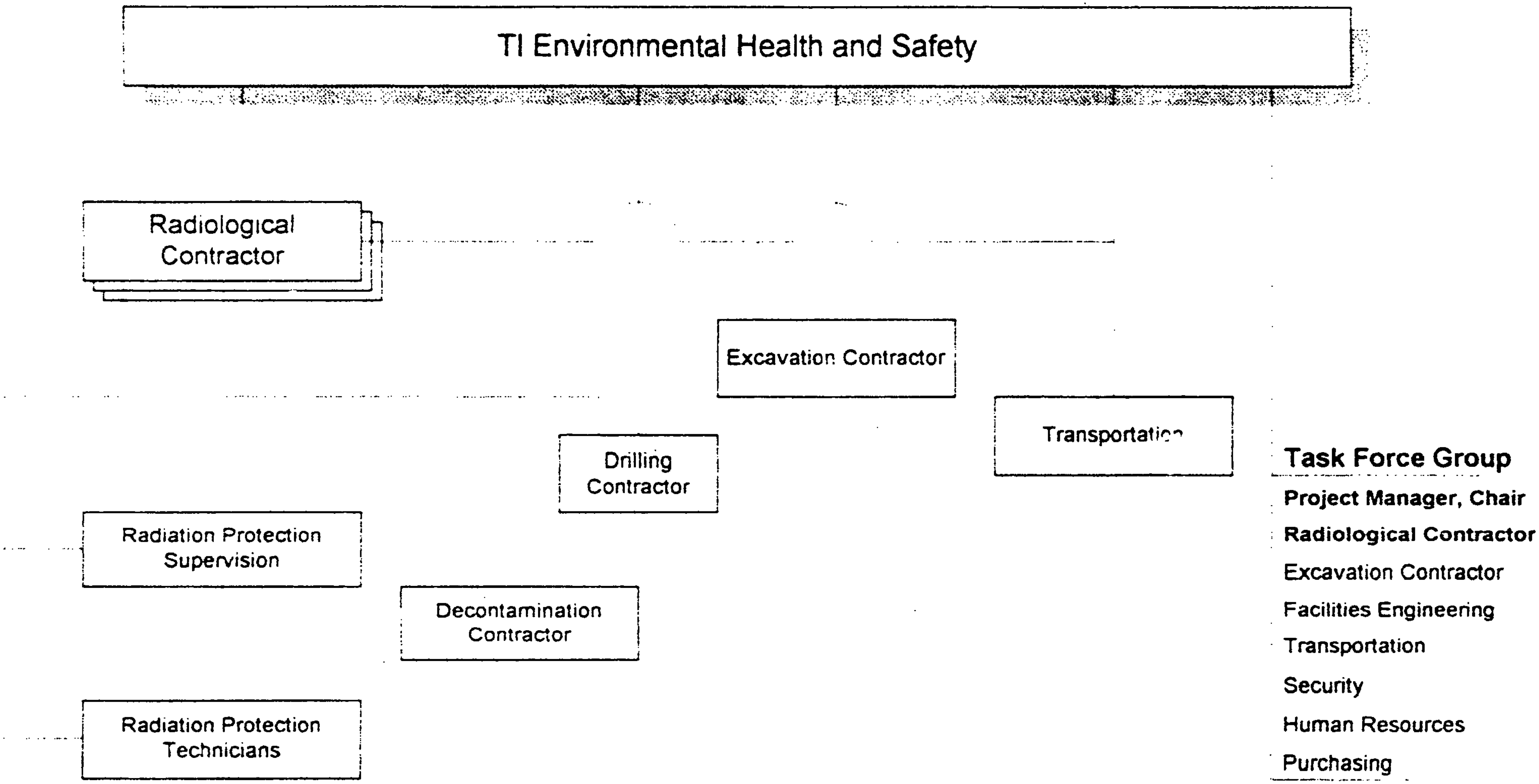


Figu

Texas Instruments Incorporated

Decommissioning Project Organization

(Generic Project Team)



Appendix A:
Supplemental Radiological Survey Plan

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APPENDIX A

SUPPLEMENTAL RADIOLOGICAL SURVEY PLAN IN SUPPORT OF THE SUPPLEMENT TO THE 1992 REMEDIATION PLAN

TEXAS INSTRUMENTS INCORPORATED
ATTLEBORO, MASSACHUSETTS

SPECIAL NUCLEAR MATERIAL LICENSE No. 23
DOCKET No. 70-33

REV. 0.0

For Submission to:

The U.S. Nuclear Regulatory Commission
Region I - NMSS
475 Allendale Road
King of Prussia, PA 19406

Jointly Prepared by:

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DECEMBER 1994

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1.0 PURPOSE

The purpose of this plan is to summarize the methodology and scope of the supplemental radiological surveys that Texas Instruments Incorporated (TI) is conducting, or will conduct, on its facility and site at Attleboro, Massachusetts. These surveys fall into two broad categories; 1) those that augment previously collected information by further defining the facility and site characteristics, and 2) those that serve as a final survey to demonstrate compliance with the decommissioning criteria. The two are not unrelated, and in certain cases, they are the same.

2.0 DOCUMENT AND HISTORY REVIEW

The TI Environmental Department, its consultants, and retained counsel performed a review of historical documents including reports, drawings, maps and photographs, previous radiological surveys, and interviewed selected employees who had knowledge of past nuclear operations in order to identify any open land areas and building interiors that had the potential for residual contamination. Details of this review are contained in TI files. The results of this review are reflected in the supplemental survey design, Sections 3.0 to 7.0, as it influenced the selection of areas and methods for further study.

3.0 DEFINITION OF AREAS

NUREG/CR-5849, "Manual for Conducting Radiological Surveys in support of License Termination" defines "affected areas" and "unaffected areas" as follows:

Affected Areas:

> "Areas that have potential radioactive contamination (based on plant operating history) or known radioactive contamination (based on past or preliminary radiological surveillance)."
>
> Note: At TI, this would normally include areas where radioactive materials were used, processed, stored, handled, and/or buried, and immediately surrounding areas.

Unaffected Areas:

> "All areas not classified as affected. These areas are not expected to contain residual radioactivity, based on a knowledge of site history and previous survey information."

As a subset of "unaffected areas", TI added one more definition for "undeveloped areas" that warrant no radiological surveys.

Undeveloped Areas:

> Areas that have never been developed by TI and have remained intact or untouched since the inception of the site; the category of areas that TI did not own at the time of the nuclear operations; and nearby, offsite areas that TI may have formerly owned or used, but are separated by a public way that would render movement of materials impractical and unlikely.
>
> Typically, such areas include the woodlands east of the site, as well as, developed areas acquired by TI subsequent to the naval reactor program (i.e. post 1968).

4.0 AREAS EXCLUDED FROM SUPPLEMENTAL RADIOLOGICAL SURVEYS

4.1 GENERAL SITE

The TI Attleboro site covers a large area in excess of 250 acres (refer to Figure 1, attached to the supplement). Just over 90 acres has ever been developed. Thus over 60% of the site constitutes undeveloped areas, as shown in attached Figure A1, for which a radiological survey was not performed.

4.2 SPECIFIC LOCATIONS

Contaminated surface soils adjacent to the former HFIR Loading Dock on the west side of Building 10 were identified by the NRC. TI conducted a soil remediation project in the 1983 time frame with the concurrence of the NRC. Contaminated soils were dispositioned to a licensed radioactive waste disposal facility in Barnwell, South Carolina. For this reason, and due to the fact that this location has since been developed, it was excluded from further surveys.

The Former Radioactive Waste Burial Site between Buildings 11 and 12 (Bldg 12 Burial Site) was remediated during 1992 and 1993. TI submitted a Final Report in September, 1993. NRC's contractor, Oak Ridge Institute for Science and Environment (ORISE), performed a confirmatory survey and issued its report in February, 1994. Accordingly, no supplemental radiological survey of the Bldg 12 Burial Site is being performed.

A portion of the Metals Recovery Area had already been remediated when TI commenced the supplemental, systematic radiological surveys in July, 1994. In fact, the performance of additional surveys was, in a large part, motivated by the desire to scope the size of the Metals Recovery Area undergoing active remediation. For the portion of this area not covered by the supplemental, systematic surveys described in Section 7.0, final survey data, as described in Section 8.0, has been collected and will ensure proper coverage of the area.

5.0 AREAS SUBJECT TO SUPPLEMENTAL RADIOLOGICAL SURVEYS

5.1 OPEN LAND AREAS

The remaining land areas at the Attleboro site have been categorized by TI as either affected or unaffected, as shown in Figures A1 and A2, in accordance with NRC guidance.

Supplemental, systematic radiological surveys, of the type described in Section 7.0 below, have been or will be performed for affected and unaffected areas, respectively.

5.2 BUILDING INTERIORS

With respect to building interiors, TI decided to perform a supplemental survey even for building interiors that had previously been decommissioned and released for unrestricted use by the NRC in 1982. Those supplemental surveys are of the type described in Section 7.2.1.

Areas other than previously decommissioned locations where nuclear activities are believed to have been conducted were classified as "affected areas," and supplemental, systematic surveys of the type described in Section 7.2.1 have been or will be performed.

TI has classified as unaffected areas the remaining portions of buildings that contain affected areas or previously decommissioned areas. For unaffected areas, surveys of the type described in Section 7.2.2 will be performed.

TI determined that no surveys were needed in buildings where no nuclear activities had been conducted.

6.0 DESCRIPTION OF AREAS

To help visualize the locations which are referenced below, refer to the attached Figures A1 and A2 for the land areas and Figure A3 for the building interiors.

All compass directions are given according to TI's standard practice in reference to "Building North", which is approximately equivalent to geographic Northwest.

In general, the following descriptions will be structured in such a way to provide information about the physical location, the alleged origin of potential contamination, the expected spatial distribution, and actual findings where known.

6.1 AFFECTED LAND AREAS

6.1.1 Stockade Area

Located on the south side of Willard Road between Bldgs 10 and 11.

The origin of the contamination is believed to be the result of staging waste washwater and pickling acid solutions in drums placed on the ground surface within an area enclosed by a stockade fence.

Contaminated soils were found from just below the current ground surface to a maximum depth of 10 feet at the original source area. Elsewhere, the contamination seems to have been spread away from the source, in a southwesterly direction, and mixed with fill that was placed in low lying areas to create Parking Lot "K". Contaminated soils beyond the source penetrate, on average, to a depth of 3 feet, and in a couple of locations, down to 5 - 6 feet.

6.1.2 Railroad Spur

Located on the southern property boundary between the Metals Recovery Area and Parking Lot "K".

Contamination in this area forms a transition zone between the Metals Recovery Area and the Stockade Area. The contamination could have come from either area. It is not known that any nuclear material handling took place here. Contamination was found to be distributed at shallow depths, generally less than 3 feet below the ground surface.

6.1.3 Switchgear Building

Located south of the Metals Recovery Area, almost in the vertex of the angle formed by the junction of the railroad tracks and the railroad spur.

Prior to the construction of the Switchgear Building in the early 1980s, the area was predominantly a low lying wetland. This area was identified as a suspect location as it had received some fill from the foot of the hill west of Bldg 5.

Based on knowledge of the construction methods and fill operations, systematic sampling at this location was performed to a depth of 10 feet below ground surface in the immediate vicinity of the building. Elsewhere, subsurface samples were driven to the standard three foot depth. This sampling demonstrated that there was no radioactive contaminated soils in excess of the applicable criteria.

6.1.4 Bldg 10 Perimeter

The location, as the title implies, is the open land areas surrounding the perimeter of Bldg 10 out to a distance of approximately 20m. In past surveys, slightly elevated radioactivity measurements were detected in close proximity to the building walls in a few locations. Therefore, the distance of 20m was chosen as a conservative assumption of the limit of potential dispersion had any potential contamination been disturbed.

This area was considered suspect due to a couple of historical facts: Most of the nuclear manufacturing operations occurred in this building, and there had been an earlier remediation activity at the former HFIR loading ramp on the west side. It was also chosen because radiological surveys conducted by ORAU in 1984 had identified some elevated meter readings and evidence of surface soil contamination.

Based on these facts, the majority of potential soil contamination was expected to be present within the top 3 feet of the surface, and in one location on the northwest corner of the building, at a depth of 4 to 6 feet. The systematic sampling conducted substantiated the finding of the surface contamination in only one grid cell south of the Building 10 Lab Wing. As expected, the contamination was found to be within the top 3 feet of the surface.

6.1.5 Bldg 10 Alleged Zirc Burning Area

Located in the southeast portion of the Bldg 10 Parking Lot "M" and of unspecified dimensions.

This area was listed as suspect because of zirconium chip burning on the ground surface that allegedly took place there in about the same time frame as similar activities at the Metals Recovery Area. Since the Metals Recovery Area has been shown to contain extensive soil contamination requiring remediation, TI conservatively decided to perform soil sampling at the Bldg 10 location as well.

Because the potential contaminants were associated with activities on the ground surface, it was anticipated that any contamination would be found within the top 3 feet of soil below the asphalt macadam. Systematic sampling revealed no elevated levels of contamination at this location.

6.1.6 Bldg 12 South Lawn

Located in the landscaped lawn area south of Bldg 12 and of unspecified dimensions.

Elevated surface radiation levels were identified in couple of spots on the lawn by ORAU in 1983. It is believed that final grading at the conclusion of the Bldg 12 construction project in 1968 distributed a thin layer of contaminated material in a southeasterly direction emanating from the source at the former Burial Site location. Since historical photographs show that the former Burial Site remained undisturbed while Bldg 12 was under construction, no contamination is expected to exist under the building.

Based on earlier subsurface investigations, potentially contaminated soils were expected to exist at a depth of 2 to 4 feet below the ground surface. This was confirmed by the systematic sampling.

6.1.7 North and West Sides of Bldg 12 Exclusive of the Burial Site

Located at the lawns, and under parking lots and driveways on the north and west sides of Bldg 12. The northern border extends up to an undeveloped area, and the western border extends as far as the east side of Bldg 11. The footprint of the excavated area at the Bldg 12 Burial Site is excluded from consideration as it has been adequately surveyed as part of the 1993 Final Survey.

Potential contamination in this area is believed to be related to the Bldg 12 Burial Site as is the case for contamination encountered at the South Lawn.

As such, any potential contamination was expected to exist at a depth of 2 to 4 feet below the ground surface. This was confirmed by the systematic sampling. Sampling identified approximately a 3000 sq. ft.area of soil whose average grid cell concentrations marginally exceeded the cleanup criteria

6.1.8 Bldg 11 Drainage Ditch

The location was well defined based on comparing historical site layout drawings and topographic maps to current site layout drawings. The location of this former topographic feature extends from the Bldg 11-C Wing eastward under the South Road, just north of Bldg 17, and then curves in a somewhat northerly direction into the Bldg 12 South Lawn.

The drainage ditch formerly received effluent from a wastewater process in the southwestern extremity of Bldg "O" (currently, the middle of Bldg 11). Since it was alleged that waste processing in Bldg "O" was associated with nuclear operations, sampling was performed on the drainage ditch to detect the possible presence of contaminated sediments.

Due to the likely depth of the drainage ditch, any potential contamination was expected to be confined to shallow depths within 1 to 3 feet of the surface. The systematic sampling revealed no elevated levels of soil contamination at this location.

6.1.9 Hill South of Bldg 17

This area is a gently sloped, elevated surface feature covering approximately half an acre just south of Bldg 17.

Soil and debris found at this location were transported there from various onsite construction projects since the 1985 time frame. One of the projects that generated some portion of the soil volume was the Bldg 4-10 Connector that was built on the west side of Bldg 10 in 1986. Since ORAU had identified some shallow soil contamination on the west side of Bldg 10, any soil contamination that might have been disturbed by the project would have been deposited at the Bldg 17 Hill.

Since the exact vertical and horizontal distribution within the hill where the materials from the Bldg 4-10 Connector had been deposited are unknown, TI sampled the entire hill down to the depth of the original groundsurface, or about 15 feet below grade at the highest point. The systematic sampling identified a small area of contamination approximately 2,000 sq. feet to a maximum depth of six feet below the surface

6.1.10 Bldg 12 Air-Line Debris

Located on the eastern boundary of the developed portion of the Attleboro site. A small area of approximately 2500 sq. ft. was pinpointed by an employee who was involved in the placement of soils at this location in 1980.

During the installation of a buried, compressed air-line between Bldgs 11 and 12 in 1980, one leg of the excavation cut through a portion of the Bldg 12 Burial Site. After

conferring with the NRC, TI employees sorted through the contaminated excavated material to remove debris with elevated radiation measurements. The material demonstrating elevated radiation levels was packaged and dispositioned to a licensed disposal facility in Barnwell, South Carolina. The remaining soil was re-buried at its current location on the eastern edge of the developed portion of the Attleboro site.

Since the current location is a popular spot for placing construction project and groundskeeping spoils and debris, a low hill with an elevation of approximately 10 to 15 feet above the original ground surface has evolved above the spot where the potentially contaminated soil was buried. Assuming that the 1980 burial would not have extended far below the original ground surface, the sampling depths for this exercise extended down to 25 feet below the existing ground surface. Systematic sampling confirmed our expectations. Elevated soil contamination was found within a narrow stratum at a depth of 15 feet below the existing ground surface.

6.2 UNAFFECTED AREAS

6.2.1 Metal Hydroxide Sludge Lagoons

Located to the south of Bldg 12 Parking Lot "R", and covering a rectangular area of approximately one acre.

An earlier letter to the NRC (June 1994) denoted this area as a suspect location because of its association with past waste operations. Subsequently, TI has determined that this area should not be given any more attention than an unaffected area. A knowledgeable Facilities Department employee has provided information that the sludge lagoons were constructed at the same time that the present-day industrial wastewater treatment plant was installed in 1977. Metal hydroxide sludge generated by TI's industrial wastewater treatment plant had been placed at the lagoons between 1977 and 1980. The metal hydroxide sludge was hard-piped directly from the wastewater treatment plant to the lagoons. In 1981, the lagoons were closed and capped. They were never used for any other purpose. Furthermore, during the active life of the lagoons, TI's only nuclear operations were associated with the HFIR operation. None of the contaminated land areas are believed to have resulted from any activities during the HFIR operation. Therefore, based on engineering controls in place at the time, and due to the nature of the HFIR operation, it seems highly unlikely that the sludge lagoons could have been contaminated with radioactive materials.

6.2.2 Overall Site

For other land areas that fit the category of "developed areas", 100% walkover surveys, random soil samples and biased samples are being performed per the method described in

Sections 7.1 and 7.3. The protocol for the unaffected areas is consistent with the guidance contained in NUREG/CR-5849.

6.3 PREVIOUSLY DECOMMISSIONED BUILDING INTERIORS

6.3.1 Bldg 10

Within Bldg 10 there are four survey units which were surveyed, decommissioned and released as part of the 1982 D&D activities. These four units are:

HFIR - An area in the northwest portion of the building which housed the High Flux Isotope Reactor (HFIR) Program. Uranium oxide powder was processed in this area to produce HFIR fuel elements.

UMA - Unclad Manufacturing Area - This area was also located in the northwest portion of the building, but covered a larger area than HFIR. Exposed uranium oxide associated with the Naval Reactor Program was processed in this area.

CMA - Clad Manufacturing Area - This area encompassed most of the building at that time. Clad fuel material associated with the Naval Reactor Program was assembled into fuel elements.

R&D Labs - This area is located on the first floor, and easternmost extremity of the lab wing in the northeast portion of the building. This operation supported manufacturing during the Naval Reactor Program including R&D, and metallurgical quality control.

6.3.2 Building 4, Bay L, FSM Area

Bldg 4, formerly Bldg L, housed the Fissionable and Source Material (FSM) manufacturing area and the associated laboratory in Bay L prior to 1955. The operations would have been very similar to the Naval Reactor work, but on a smaller scale. The work would not have involved complete fabrication of the fully-assembled fuel elements, but it would have involved cladding fuel material for the Atomic Energy Commission (AEC).

6.3.3 Building 3

Bldg 3, formerly Bldg C, housed a rolling mill that supported the FSM operation. The rolling mill was located in the southwest corner of the original footprint of the building. Currently, that location is be near the center of the existing building.

6.4 AFFECTED BUILDING INTERIORS

6.4.1 Bldg 10 High Bay

High Bay Assembly Area in Bldg 10 - Southernmost extremity of the building. This 67 foot high structure housed the final assembly area for the finished naval reactor fuel elements.

This area is being surveyed as an affected area, since there is no documentation, known to TI, of previous surveys for release for unrestricted use of this area.

6.4.2 Bldg 4, Bays D and K, and the remainder of Bay L

These building bays are adjacent to where the FSM area was housed. The only reason they are being surveyed as affected areas is because it was alleged that nuclear operations were also conducted in these locations. It is not known that any nuclear manufacturing took place in these areas.

6.4.3 Bldg 3, Tumbling

This area, located in the southwest portion of the existing building footprint, was originally believed to be the site of nuclear operations in this building. Subsequently, an interview with a past employee about the rolling mill operation, and a review of the building construction history, revealed that the actual rolling mill was located toward the center of the existing building, but by then, TI's contractor had already surveyed this spot as an affected area.

6.4.4 Building 5

This building is located within the Metals Recovery Area. The original building footprint during the time of the nuclear operations was smaller than it is today. Since it had been associated with nuclear waste processing operations in the past, it was treated as an affected area. According to a 1961 insurance report, the area housed a water evaporation process and an incinerator.

6.4.5 Building 11 Former Wastewater Processing Area

This area was listed was because it was alleged that the former wastewater processing area was associated with the nuclear operations. TI has no other reason to believe there were any nuclear materials handled in this location.

6.4.6 Bldg 1 Alleged Former Incinerator

A former employee indicated that "in the early days", before the incinerator was located in Bldg 5, incineration of contaminated rags, boots, and paper, etc., was performed in the former boiler that was then located in Building 1. Today the former boiler room has been converted into the current mail room.

6.5 UNAFFECTED BUILDING INTERIORS

The remaining portions of buildings where some portion has been classified as previously decommissioned or affected, have been classified as unaffected (as shown in Figure A3). This includes the roofs as well as the interiors.

7.0 SUPPLEMENTAL SURVEY METHODS AND REPORT

This section describes the survey methods used for the supplemental radiological surveys. The methods described in this section are applicable for supplemental surveys, in-process surveys conducted during remediation, and final surveys. All supplemental surveys, including in-process surveys will be conducted such that the results of the surveys can be used, in part, for the final survey.

7.1 SURVEY DESCRIPTION OF THE OPEN LAND AREAS

7.1.1 Affected Open Land Areas

Reference grids are established in part to facilitate the selection of sampling/measurement locations, to provide a mechanism for referencing a sample/measurement back to a specific location, and to provide a convenient means for averaging activity/activity concentration levels. The grid system that is used during this supplemental survey is a system of intersecting lines established at 10 meter intervals and referenced to a convenient benchmark, such as a corner of a building that is tied into the Massachusetts Grid Coordinates. The coordinate system for this reference grid is based on compass direction and distance.

Within the grid system identified for each affected area, 100% surface scans are performed. Elevated readings are referenced to a facility map and surface soil samples are collected at these locations. Direct measurements are obtained as static measurements at locations chosen for the subsurface soil samples.

Due to shielding from overburden (if present) and self shielding provided by soils, activity deposited at depths is not readily identified by surface scans or static measurements. Therefore, systematic subsurface soil samples are collected within the affected area at grid line intersections and grid cell center points. The use of systematic subsurface soil samples provides greater sensitivity than surface soil samples.

7.1.2 Unaffected Open Land Areas

Within the unaffected areas, 100% surface scans are performed. The methodology is identical to the method described for the affected areas except grids are not established. Locations of elevated readings are identified and located on a facility map and referenced

to a convenient bench mark that is tied into the Massachusetts Grid Coordinates. Surface and subsurface soil samples are collected at each location.

A minimum of 30 random subsurface samples are collected throughout the unaffected area. In addition to the random samples, biased sample locations are chosen for further sampling. Biased sampling include, but will not be limited to, surface soil sampling, subsurface soil sampling, and catch basin drains. The basis for biasing samples is predicated on results obtained from the normal survey methods, path of travel considerations, proximity to and distance between affected areas.

7.2 SURVEY DESCRIPTION OF THE BUILDING INTERIORS

7.2.1 Affected Areas / Previously Decommissioned Areas

Preliminary surveys have identified some elevated radiation levels within Building 4 and Building 10 which necessitated further surveys within these areas in accordance with the protocol for affected areas. In addition, the previously decommissioned area within Building 3 was a relatively small area and therefore was also treated as an affected area for survey purposes. Therefore, all previously decommissioned areas are being treated as affected areas and are being surveyed in accordance with the criteria described within this section.

A one meter by one meter grid system is established on the horizontal surfaces within the affected areas. This grid system provides reference locations for the conduct of supplemental surveys, site decontamination activities, and final survey. Vertical surfaces to an elevation of 2 meters are likewise defined.

Survey measurements consist of the following: walkover direct scans, direct measurements (static), and removable surface activity measurements. Affected areas include 100% surface scans of the floors and lower wall surfaces (2 meters). Static measurements are obtained at grid intersections. Upper walls, ceilings, and overhead structures are each surveyed with a minimum of 30 (1 per 20 m^2) measurement locations on vertical and horizontal structures where radioactive material may have accumulated. The collection of 30 samples for overhead areas is considered adquate since these areas were generally previously decommissioned or are unlikely to have residual activity in excess of 25% of the guideline. For any area in which measurements demonstrate levels in excess of 25% of guidelines, the sampling density is increased

7.2.2 Unaffected Areas

Unaffected areas are scanned for 10% of the floor and lower wall surface area with at least 30 randomly selected measurement locations or an average measurement of 1 per 50 m^2

of building surface area whichever is greater. Measurements with results in excess of 25% of the guideline require a reclassification to an affected area protocol.

7.3 SURVEY METHOD FOR OPEN LAND AREAS

7.3.1 Walkover Scans

These scans are performed using a standard 1" by 1" NaI(Tl) detector coupled to a rate meter with an audio output. The use of head phones provides a sensitive method to determine the presence of elevated readings. Scanning proceeds at a rate not to exceed 0.5 m/s. Elevated readings are identified as values exceeding approximately 1.5 times nominal background readings and located on a facility map and referenced to a common bench mark.

7.3.2 Static Measurements

Static Measurements are performed using a standard 1" by 1" NaI(Tl) detector coupled to a rate meter and/or scaler. Static measurements are recorded as count rate or total counts integrated over a fixed integrating time period. Static measurements are generally obtained at reference grid coordinates as described above.

7.3.3 Surface Soil Measurements

Surface soil measurements are obtained at locations exhibiting elevated NaI(Tl) readings (7.3.1 and 7.3.2). Surface Soil Samples may also be collected on a random or biased sampling scheme. These samples are obtained by removing the immediate vegetation layer and sampling the soil to a nominal depth of six inches with a nominal diameter of 2-4 inches. The locations of the samples are identified on a facility map and referenced to a common bench mark

7.3.4 Subsurface Soil Samples

Subsurface soil samples are obtained using spilt spoon sampling methods. Split spoon samples are collected at each grid intersection and grid center. Samples are obtained in one foot or two foot increments depending on the area surveyed and the expectation of soil contamination at a given depth. NUREG guidance specifies that split spoon samples shall not exceed 1 meter increments. At each subsequent increment, smaller diameter spoons are used in an attempt to avoid cross contamination of soils from the shallower depth to the underlying depths. Each spoon is also decontaminated to preclude potential

for cross contamination. The total depth of each sample also varies, depending upon the maximum depth of suspected contamination. If contamination is identified at the maximum depth of the split spoon sample then the general area is re-sampled to determine the relative depth of contamination. Typical depths for split spoon sampling generally range from 3 to 6 feet and the maximum depth extends to 25 feet.

The soil samples obtained are analyzed for total uranium using the gross alpha screening technique (TI 1992 Remediation Plan). Within each affected area, 5% of the samples collected will be sent to an off-site laboratory for gamma spectroscopy analysis. In addition, 1% of the samples collected, which were sent to the off-site laboratory, will be analyzed by alpha spectroscopy. The off-site laboratory analysis will be performed for two primary purposes: (1) as a quality assurance measure for the alpha screening technique and (2) to determine the isotopic distribution represented in each affected area.

7.3.5 Bore Hole Measurements

During the conduct of split spoon sampling, NaI(Tl) measurements are obtained at various depths within the drill hole location. These measurements are made in an attempt to better identify the depth of contamination should it exist at levels readily detected using a NaI(Tl) detector arrangement. The results are recorded on the daily activity logs. Typical responses must be compared to the anticipated background and geometry affects presented. A transition of 2Π to 4Π geometry is made and therefore will result in background results that approach twice that of surface readings.

7.3.6 Exposure Rate Measurements

Exposure rate measurements are obtained at 1 meter elevations at grid intersections within the affected area and at locations defined by elevated readings obtained during the scanning procedure. These measurements may be made using a Bicron microrem meter, a Ludlum micro-R meter, a NaI(Tl) ratemeter, or a high pressure ionization chamber. Those instruments demonstrating a strong energy dependence, such as those incorporating NaI(Tl) detectors, will be referenced to an exposure rate obtained for the spectra distribution encountered in field. Reference may be made to established exposure rate locations or to an instrument depicting minimal energy dependence. The energy dependence of NaI(Tl) is very pronounced and will over respond to lower energy photon spectral distributions (approximately a factor of 1.5), as encountered with uranium contaminated sites, when calibrated to ^{137}Cs photons. The reference guideline is 15 $\mu R/h$ above background.

7.4 SURVEY METHODS FOR BUILDING INTERIOR

7.4.1 Surface Scans and Direct Measurements

Surface scans are conducted using a pancake type GM probe over the areas of interest in close proximity to the surface at a rate not greater than 0.1 m/s. Direct measurements are conducted (also using a pancake GM probe) at grid intersections in a static condition. The scans and direct measurements also included lower wall surfaces at 1 and 2 meter elevations.

Surface scans and direct static measurements will be performed using GM pancake type meters (Ludlum model 44-88 and model 44-9). These instruments were calibrated against traceable sources. Nominal calibration factors of 260 cpm (gross counts) per 5000 dpm /100 cm^2 and 630 cpm (gross counts) per 15,000 dpm /100 cm^2 were obtained.

7.4.2 Removable Contamination

Removable contamination measurements will be conducted using a filter paper smear over a 100 cm^2 area. The filter paper is then analyzed in a laboratory environment using a Ludlum Model 43-10-1 coupled to a Ludlum Model 2200 Scaler. Removable contamination surveys will be conducted with a minimum of five measurements per 100 square meter area within the floor area, overhead area, and walls within the building.

7.4.3 Exposure Rate Measurements

In accordance with NUREG guidance, no gamma emitting radionuclides of significant yield are present due to the nature of the contaminant being Uranium in a surface geometry and therefore exposure rate measurements are not required.

7.5 SUPPLEMENTAL SURVEY REPORT

7.5.1 Open Land Areas

The results of the supplemental radiological surveys for all open land areas (except for the Metals Recovery Area) will be compiled and submitted to the NRC in a report format.

The Metals Recovery Area is treated separately as it was an area of active remediation during radiolaogical survey activities. All radiological survey results for this area will be

included in the Metals Recovery Area Final Report, similar to the 1993 Burial Site Final Report.

7.5.2 Building Interiors

The results of the building interior supplemental radiological surveys will be documented in a report format. Since the additional building interior supplemental surveys will occur concurrently with remediation activities, all supplemental survey reports for building interiors will be included in the Final Report for the overal decontamination activities as described in Section 9.0.

8.0 FINAL SURVEY PLAN

Final surveys are conducted subsequent to remediation and decontamination activities to determine final status as compared to acceptance criteria used for final decommissioning and license termination. As stated within NUREG/CR-5849, the final status survey may incorporate other surveys such as the supplemental surveys and in-process excavation surveys. The supplemental surveys have been designed so that they may be readily incorporated as acceptable final survey data. Those areas which have been remediated or decontaminated will be subject to the same surveys, however, in process excavation surveys will be used as part of the data base.

8.1 LAND AREA FINAL SURVEYS

8.1.1 Affected Areas

Post excavation surveys, will include walk over scans and static measurements. Fill material, used for backfilling operations will be sampled and assayed. All soil samples used for final status survey, whether they were from supplemental surveys, in-process remediation surveys, or final status surveys will be archived and retained until NRC determines that the facility and site is eligible to be released for free release.

Subsurface soil sampling data is used to verify that the remediated area was appropriately extended. These subsurface soil samples are taken within 10 m x 10 m grids at each grid intersection and the center of each grid (see section 7.3.4). The subsurface soil sampling data collected during the supplemental surveys is used for final survey data as appropriate. A statistical evaluation of this sampling pattern is included within section 8.3.

In addition to subsurface soil sampling, in-process surface soil samples are performed during the excavation on the floor of the excavated area. The sample pattern used for these samples is a more dense pattern than described for the subsurface soil sampling (for example, samples on every grid intersection within approximate 10 ft x 10 ft grids rather than on the larger 10 m x 10 m grids).

8.1.2 Unaffected Areas

Final surveys for the unaffected open land areas will be solely based on the data collected during the supplemental radiological surveys described in Section 7.1.2.

8.2 BUILDING INTERIOR FINAL SURVEYS

8.2.1 Affected Areas / Previously Decommissioned Areas

Building interior surveys conducted during the supplemental surveys are performed in accordance with NUREG/CR-5849 for final surveys. Those areas requiring remediation will be surveyed during remediation and this data may be used in part, for final survey data. Once remediation efforts have been completed, those areas will be subject to full final radiological surveys. Areas immediately adjacent to the remediated areas will also be re-surveyed to ensure that no cross contamination had occurred during the remediation efforts.

8.2.2 Unaffected Areas

All surveys conducted for unaffected areas during the supplemental radiological surveys are acceptable for final survey status.

8.3 STATISTICAL EVALUATION OF THE FINAL SURVEY SAMPLING PATTERN

8.3.1 Open Land Areas

Subsurface soil sampling data is used to verify that the remediated area is appropriately extended. The sampling scheme for subsurface soil sampling is chosen based on a typical sample unit size whereby the total number of subsurface soil samples obtained is sufficient to allow for a 95% confidence interval for each sample unit. The method selected differs from NUREG-CR5849 largely due to the extent of the affected areas. Over 1700 split spoon sample locations were identified resulting in approximately 6000 samples for analyses.

For application to the final survey a minimum sample unit size must be determined for the sample scheme chosen. This may be best determined by application of the Chi-Square statistic for a normally distributed population. The probability that the chi-square statistic distribution is less than the variable, x, at 95% confidence for a variance of 37 is 7.4 meters (see Attachment A). This variance was obtained through analysis of a large sample population of samples obtained in the field. This radius, would allow for a minimum of eight samples spaced at a distance no greater than 7.4 meters within a 20m x20m survey unit and will also satisfy the student t-test.

With regard to sampling for the purpose of grid cell averaging, for any grid exceeding the criteria, increased sample density is performed as suggested in the NUREG guidance (i.e., 13 locations within a 10m x 10m grid cell).

Attachment A includes the summary statistical evaluation that demonstrates the analytical model in support of the above-stated assertions. In practical terms, the statistical evaluation provides justification for TI's sampling pattern. For a typical survey unit sized at TI, TI's sampling pattern assures a 95% confidence level that the decommissioning criteria has been achieved.

In addition to the subsurface soil samples surface soil samples are taken from the excavation floor during the remediation to be used for final survey data. This sampling pattern (approximately 100 square foot grids) exceeds that defined within the NUREG/CR-5849 and therefore is within the desired 95% confidence limit.

8.3.2 Building Interiors

The final surveys for building interiors are performed in accordance with NUREG/CR-5849 guidance. The sampling pattern is based on a one square meter grid pattern. As specified in NUREG-CR5849, this sampling pattern will fall within the desired 95% confidence limit.

9.0 FINAL REPORT

Upon completion of the final surveys, TI will compile all the final survey data, for both open land areas and building interiors, into a final report. The final report will be structured similar to the 1993 Burial Site Final Report that was previously submitted to the NRC.

Attachment A to Appendix A

Summary Statistical Model for x-y Grid System

Developed for

Texas Instruments Incorporated
Materials and Controls Group

By

Laura Schulman
Applied Mathematician and Statistician
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Attachment A: Summary Statistical Model for x-y Grid System

In this model, the goal is to estimate a radius within which 95% of the uranium will be detected. Suppose X and Y are normally distributed with mean zero and variance 37. This is a feasible assumption because the probability that uranium will be detected increases closer to the source and decreases the greater the distance from the source. The variance is an estimate based on the large number of samples taken over a large area. The following calculations show how the radius of 95% detection was found:

$X \sim N(0,37)$
$Y \sim N(0,37)$

(X^2)/37+(Y^2)/37 < R) = .95

Here, P stands for 'the probability that'

P(X^2+Y^2/37 < R) = .95

P(X^2+Y^2 < 37(.1)) = .95

So the radius has chi squared distribution with 2 degrees of freedom. Therefore, if the radius is less than 3.7 meters, then 95% accuracy will be achieved.

In conclusion, to have 95% confidence that any uranium over the limit will be detected, it is ncessary to take a sample about every 7.4 meters. In a grid pattern, it is suffic:.nt to test 8 points in a 20 meter x 20 meter area with no more than 7.4 meters between any two nearest points.

Figure A1
Map of Open Land Areas Depicting Undeveloped and Unaffected Land Areas

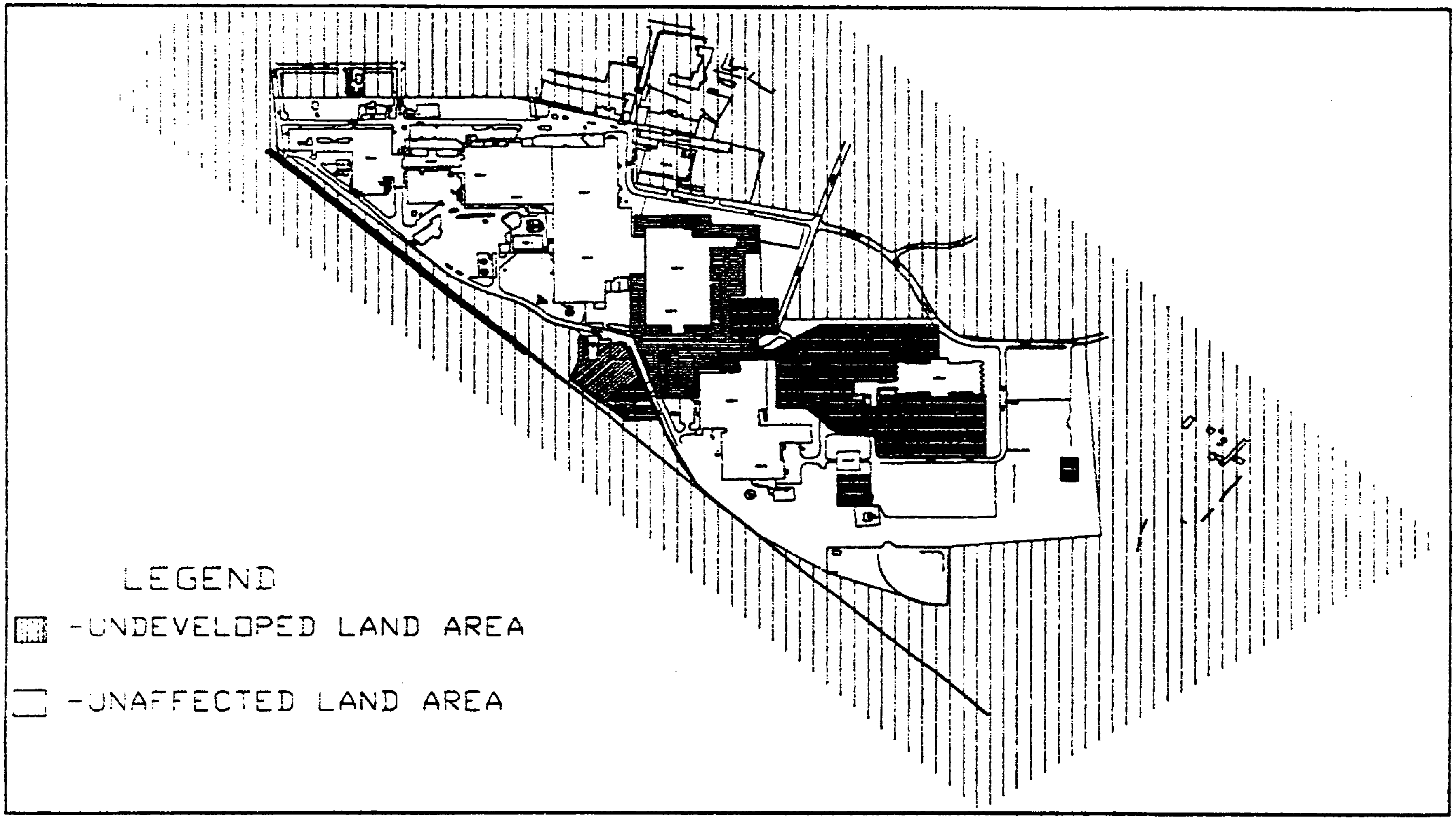


Figure A2
Map of Open Land Areas Depicting Affected and Previously Remediated Areas

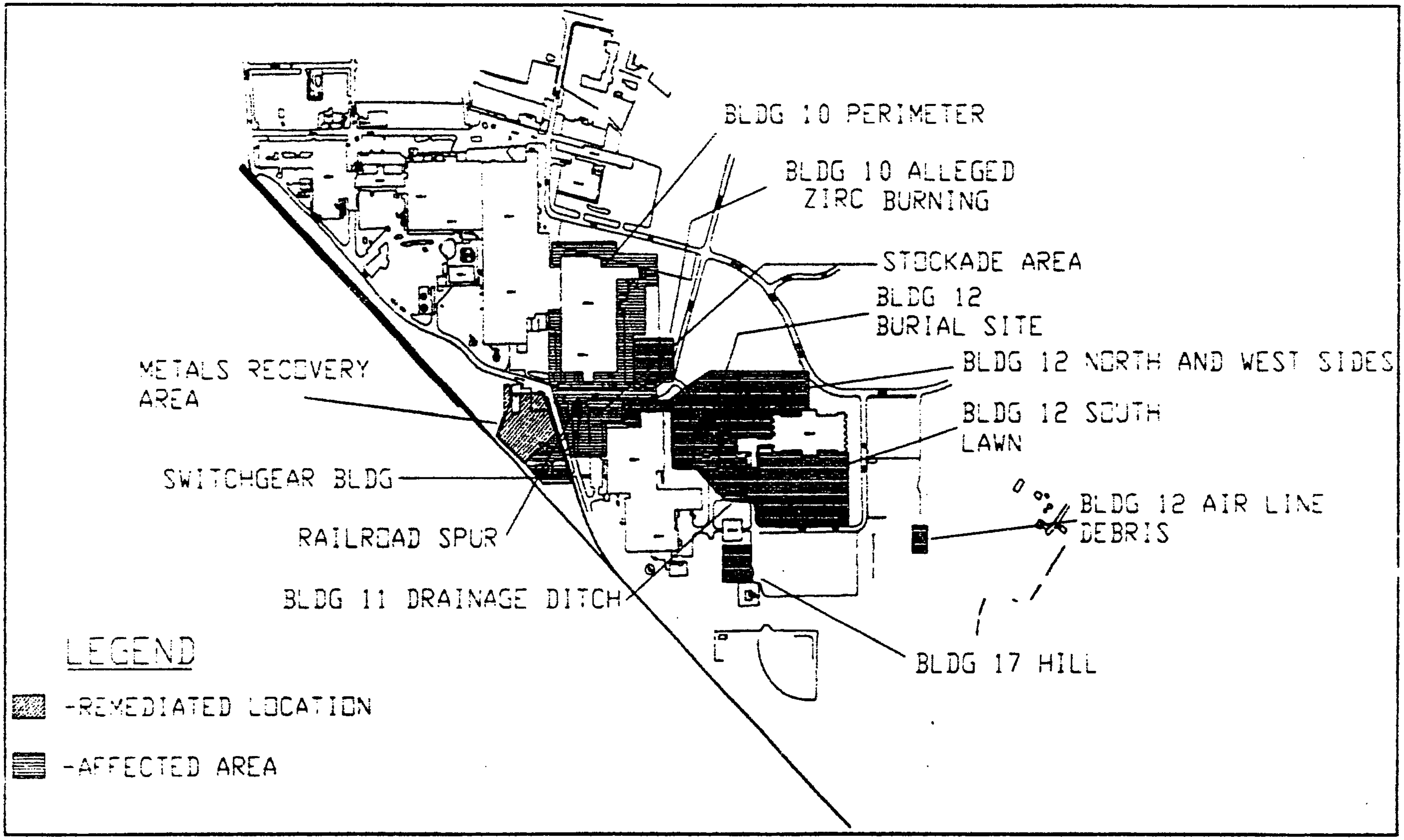
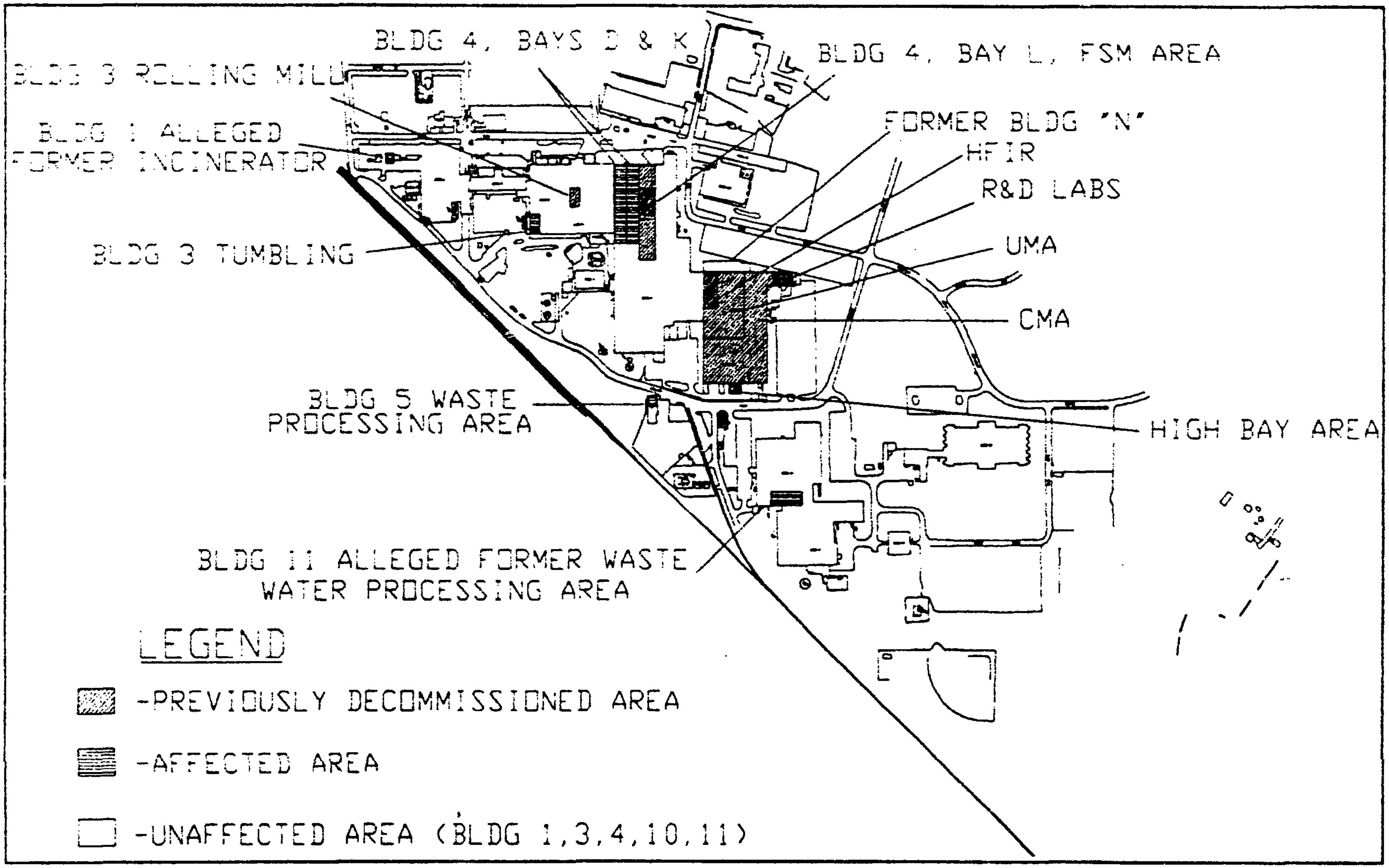


Figure A3
Map of Building Areas Depicting Affected, Unaffected, and Previously Decommissioned Areas



Appendix B:
Groundwater Radiological Monitoring Work Plan

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APPENDIX B

GROUNDWATER RADIOLOGICAL MONITORING WORK PLAN

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December 19, 1994

NES DOCUMENT #82A8594, REV. 1

Document Authorization Form

Groundwater Radiological Monitoring Workplan
Texas Instruments Facility
Attleboro, Massachusetts

Prepared for:

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Attleboro, Massachusetts

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December 16, 1994

NES DOCUMENT #82A8594, REV. 1

Stuart S. Manley Senior Environmental Scientist	12/16/94 Date
Todd L. Bachand Section Manager Technical Services	12.16.94 Date
Robert J. Weireter Senior Department Manager Geosciences and Technical Services	12.16.94 Date

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FIGURES

ATTACHMENTS

1. INTRODUCTION

This document was prepared by Integrated Environmental Services, a division of NES, Inc. (NES/IES) for Texas Instruments Incorporated (TI) to present a plan for radiological monitoring of groundwater at the TI facility in Attleboro, Massachusetts (the "Site"). TI has proposed to remediate several areas where radiologically contaminated soil has been documented. Subsequent to the remediation of these areas, herein described as a Remediated Area (RA), groundwater monitoring will be performed to determine whether radiological constituents are contained in the groundwater. Identification and discussion of each RA is not included in this report.

1.1 PURPOSE

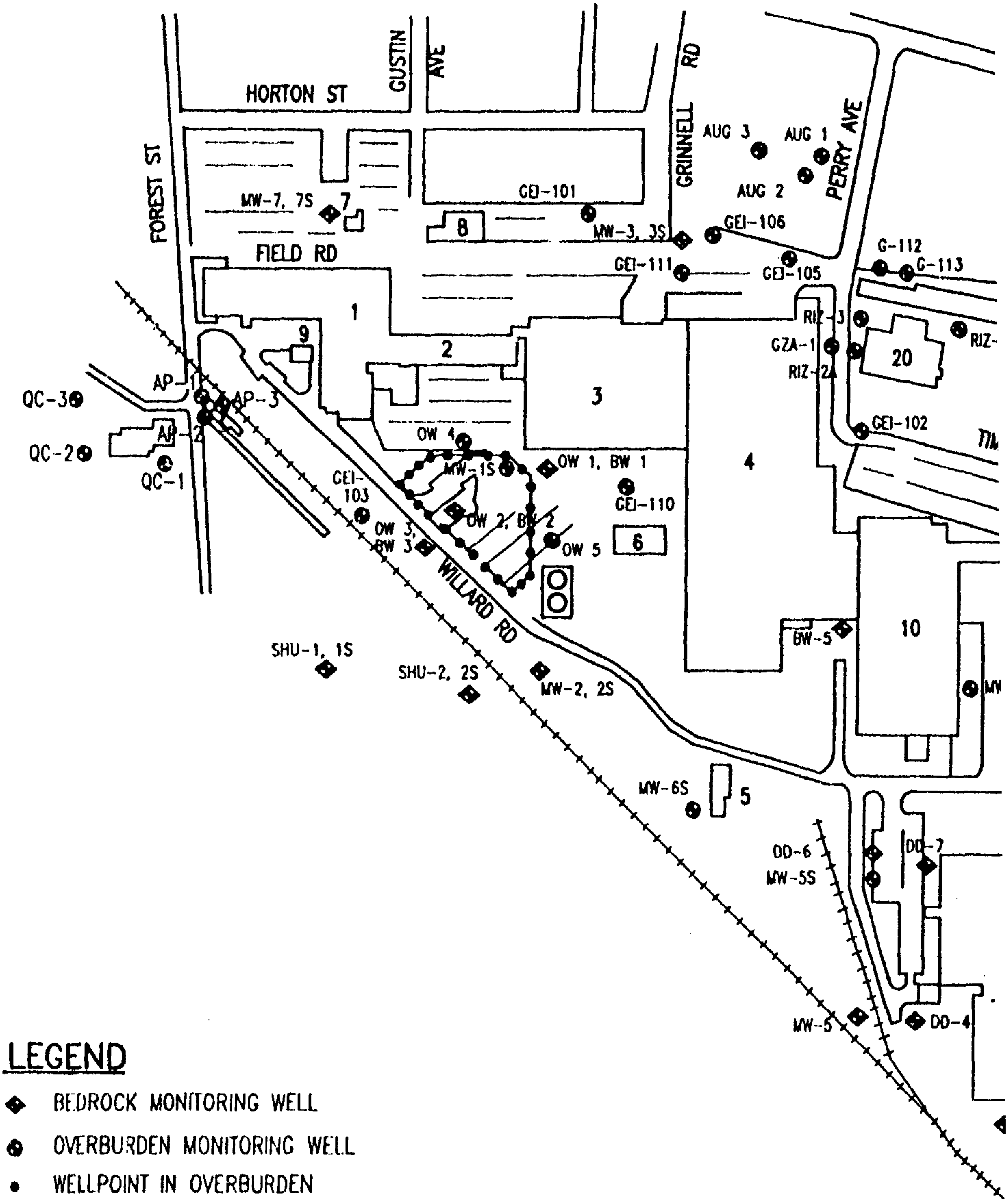
The purpose of this workplan is to describe the methodology and logic of the monitoring program to ascertain the presence of radionuclides in the groundwater at each RA. The results of this investigation are intended to be used in support of the completion of decommissioning efforts at the Site and termination of TI's Special Nuclear Materials License No. 23.

1.2 SITE HYDROGEOLOGY

The following description of Site hydrogeology was summarized from Appendix F, Site Hydrogeology in the 1993 Burial Site Final Report submitted by TI to the NRC in September 1993. The site is located within the bounds of the Narraganset basin. Bedrock consists of folded metasediments of the Rhode Island Formation containing fractures parallel to the northeast-southwest trending folds.

Bedrock is overlain by 10 to 40 feet of unconsolidated overburden which includes glacio-alluvial sediments consisting of a poorly sorted basal till (hydraulic conductivity 10E-5 to 10E-6 cm/s) overlain by interbedded silts, sands, and gravels (hydraulic conductivity 10E-2 to 10E-5 cm/s), with peat and other organic deposits near the surface representing a pre-development wetland in some locations.

Both the bedrock and overburden are waterbearing zones with some degree of hydraulic connection between them as indicated by pump test results. The water table is generally 4 to 5 feet below grade and a northwest-southeast trending divide is observed in the overburden aquifer. Shallow groundwater to the west of the divide flows towards the Ten Mile River Watershed and shallow groundwater east of the divide flows towards Cooper's Pond and the Taunton River Watershed.

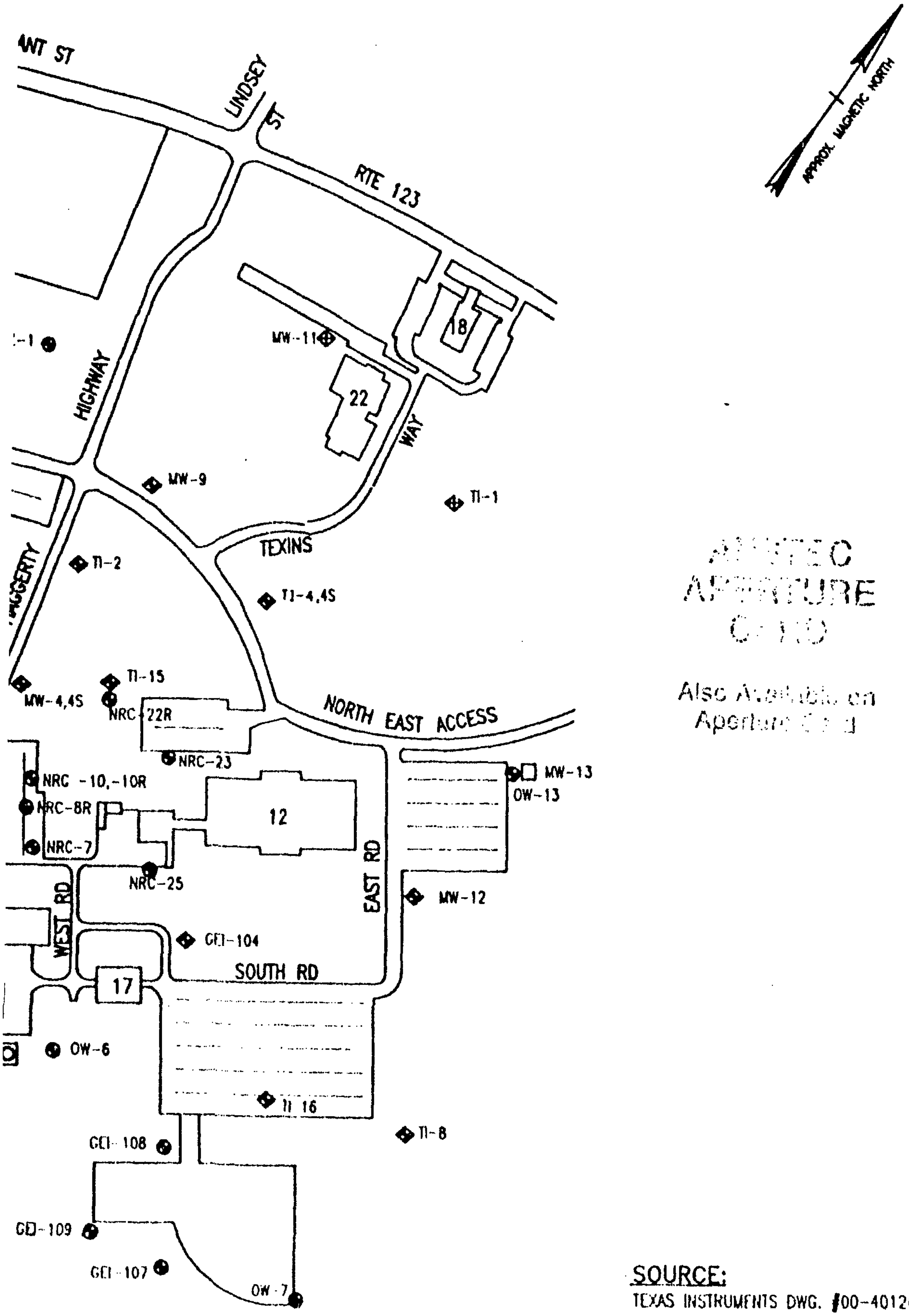


LEGEND

- BEDROCK MONITORING WELL
- OVERBURDEN MONITORING WELL
- WELLPOINT IN OVERBURDEN
- BEDROCK PRODUCTION WELL
- ABANDONED MONITOR WELL (CEMENT BACKFILL)

NOTE:

WHERE BOTH A SHALLOW AND A DEEP WELL EXIST TOGETHER AS A CLUSTER, THE DEEP WELL DIAMOND SYMBOL IS EMPLOYED.



APERTURE CARD

Also Available on Aperture Card

SOURCE:

TEXAS INSTRUMENTS DWG. #00-40126
MONITORING WELL LOCATIONS, SITE PLAN
DATED 2/89, REV. E 9/93

DOCUMENT CONTROL NO.	
REVISION NO.	
PROJECT	TEXAS INSTRUMENTS ATTLEBORO, MA
DRAWING	MONITOR WELL LOCATIONS SITE PLAN

INTEGRATED ENVIRONMENTAL SERVICES
A DIVISION OF NES, INC.

PROJECT # 2276-102	
FILENAME: 2276102A	
SCALE: 1" = 400'	DATE: 11/4/94
BY: AD	CK:
FIGURE # 1	

2. GROUNDWATER MONITORING PROGRAM

The following sampling program is designed to investigate the potential presence of radionuclides in groundwater at each of the RAs utilizing the existing groundwater monitoring network to the greatest extent possible. NES/IES proposes to sample the existing monitoring wells located in the immediate vicinity and on the downgradient side of each RA, if possible. If no overburden wells are immediately adjacent to and downgradient from the RA, an overburden well will be installed within a short distance downgradient of the area. Bedrock wells in the immediate vicinity will also be sampled to provide information on this aquifer; however, no additional bedrock wells are proposed in this scope of work.

2.1 EXISTING MONITORING WELL NETWORK

According to information provided by TI, there are a total of 63 monitoring wells that currently exist on-site and one that has been abandoned. In addition, there are 13 monitoring wells off-site North and South of the Western half of the Site (See Figure 1). Twenty five of these wells extend into the bedrock, two of which are production wells used for the on-site manufacturing and two are located off-site, to the South of the Site. The balance of the wells, a total of 51, are completed in the overburden and 11 of these are located off-site. A potentiometric map, generated in May 1990, of the overburden aquifer was provided by TI (TI, 1990), and shows the hydraulic gradient of the Site (See Figure 2).

TI is presently conducting a groundwater remediation program in the area where 24 wellpoints have been completed in the overburden South of Building #3. However, that program is not relevant to this investigation, since that area is not an RA.

2.2 INVESTIGATION PROCEDURES, METHODS AND PROTOCOLS

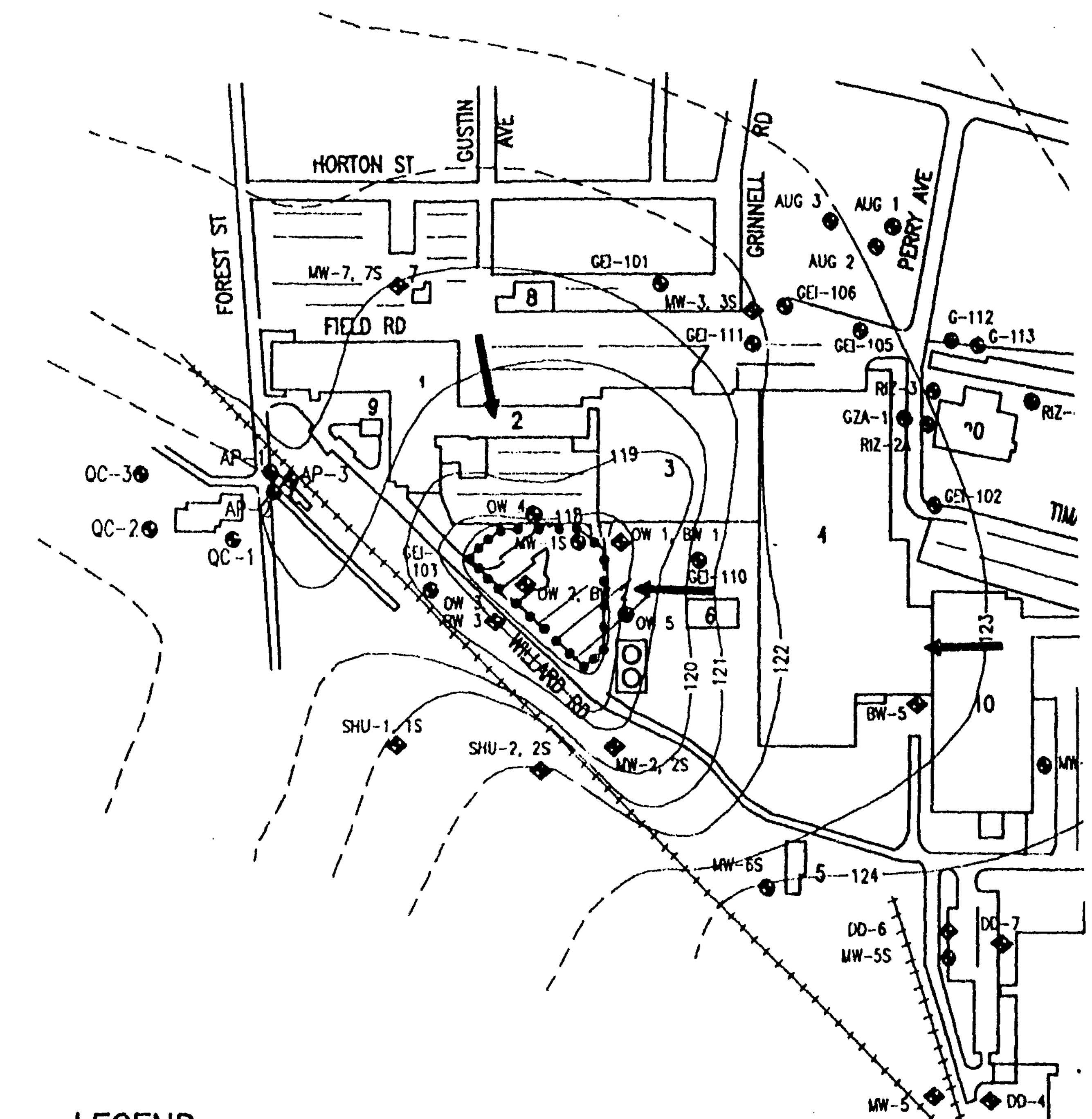
2.2.1 Groundwater Flow Mapping

Prior to beginning the well installation and sampling activities in any individual RA, NES/IES proposes to measure the groundwater elevations of all wells and use this information to generate a current groundwater flow map. This information will then be used to confirm the location or to re-position the proposed wells in the downgradient direction.

2.2.2 Sample Collection Procedures

Groundwater samples will be collected from identified wells adjacent to each individual RA according to the following procedures, as stated in the NES/IES SOP-017-010, Sampling a Well. Groundwater will be sampled as remediation of each RA is completed. The following equipment will be used for well sampling:

Disposable Teflon™ Bailer	Electric submersible pump
Appropriate discharge tubing	Non-absorbent cord

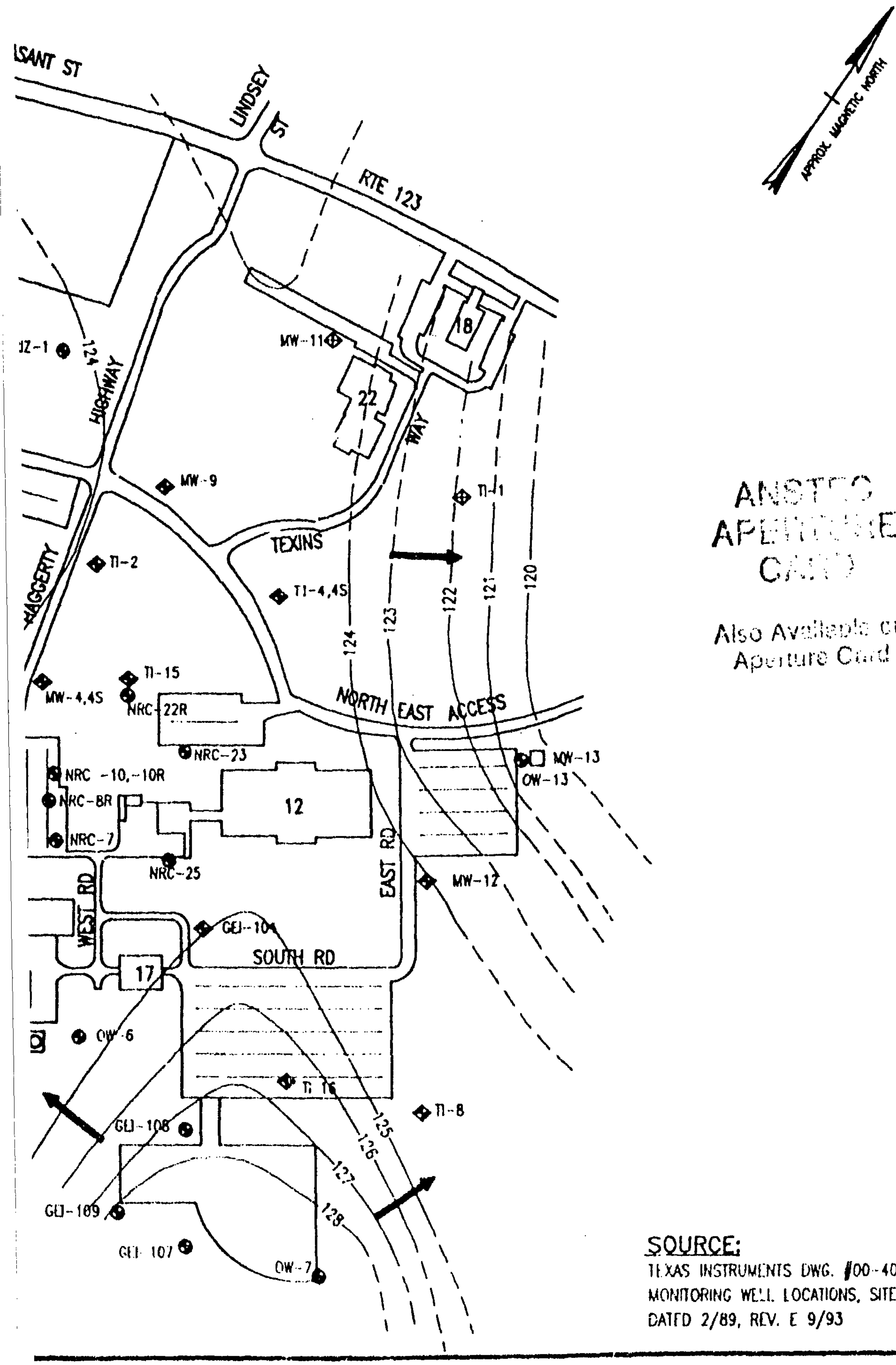


LEGEND

- BEDROCK MONITORING WELL
- OVERBURDEN MONITORING WELL
- WELLPOINT IN OVERBURDEN
- BEDROCK PRODUCTION WELL
- ABANDONED MONITOR WELL (CEMENT BACKFILL)
- DIRECTION OF GROUNDWATER FLOW

NOTE:

WHERE BOTH A SHALLOW AND A DEEP WELL EXIST TOGETHER AS A CLUSTER, THE DEEP WELL DIAMOND SYMBOL IS EMPLOYED.



SOURCE:
TEXAS INSTRUMENTS DWG. #00-40126
MONITORING WELL LOCATIONS, SITE PLAN
DATED 2/89, REV. E 9/93

DOCUMENT CONTROL NO.

REVISION NO.

PROJECT: TEXAS INSTRUMENTS
ATTLEBORO, MA

DRAWING: POTENTIOMETRIC MAP
OVERBURDEN AQUIFER – MAY 1990

IES
INTEGRATED ENVIRONMENTAL SERVICES
A DIVISION OF NES, INC.

PROJECT # 2276-102	
FILENAME 2276102A	
SCALE: 1" = 400'	DATE: 11/4/94
BY: AD	CK: JB
FIGURE # 2	

IES' field forms
Well location and site map
Stop watch or equivalent
Misc. tools
Appropriate Health and Safety Equipment (as specified in the H&S Plan)
Site Sampling Plan and Site Health and Safety Plan (H&S Plan)

Equipment decontamination will be according to the procedures stated in Section 2.3.5 - Quality Assurance/Quality Control. The depth of standing water will be measured as described in SOP-017-003 or SOP-017-004. At this time there is no indication that explosive gases would be present in the well; however, the well gases will be screened for organic contamination with a photoionization detector (PID).

The volume of water standing in the well will be calculated and three to five well volumes of water will be purged prior to sampling to ensure the collection of a representative groundwater sample. The purging of the well will be according to the procedures specified in SOP-017-012 - Standard Operating Procedure for Purging a Well. All purge water will be containerized until receipt of the analytical data. Upon receipt of the data, a determination will be made regarding the disposal of the purge water.

Any new monitoring wells will be installed according to NES/IES SOP-017-017, Construction, Development and Abandonment of Monitoring Wells in Unconsolidated Formations.

2.2.3 Sample Identification, Documentation and Handling

Each sample will be assigned a unique alpha-numeric identifier which is consistent with previous sample identification schemes used at the site. Each sample will be logged in a field notebook at the time of collection along with the following information: date sample was collected; weather conditions; unique sample identification number; field screening results; sample location and depth; verbal description of sample (matrix, color, texture, odor, etc.); and any unusual conditions or incidents during sampling.

Samples sent off-site for laboratory analysis will be accompanied by a Chain of Custody (COC) form completed by sampling personnel which includes the following information: sample identification number, number and volume of containers, preservative, analysis requested, and the date and time samples were relinquished to the laboratory.

2.2.4 Analytical Program

All samples collected are to be analyzed for gross Alpha and gross Beta radioactivity. The USEPA drinking water regulations (40 CFR 141), provide maximum contaminant levels (MCLs) for drinking water. These regulations state that the MCL for gross Alpha is 15 pCi/L and the MCL for gross beta is 50 pCi/L. In the event that any sample exceeds the MCL, isotopic analysis for uranium and thorium will be performed for that sample.

2.2.5 Quality Assurance/Quality Control

All sample containers will be laboratory supplied, pre-cleaned and traceable. Shipping containers will remain closed and sealed until sample containers are needed. Sample containers will remain closed until ready for use and then closed immediately after filling with the sample.

Hand held sampling equipment will be constructed of inert materials (e.g. stainless steel) and will be decontaminated prior to each sampling event according to the protocols stated in NES/IES SOP-017-008, Decontamination of Field Sampling Equipment. Disposable sampling equipment will be dedicated to one well and properly disposed of after use. Decontamination of non-disposable sampling equipment will be as follows: potable water rinse; scrubbing with a potable water soap solution; potable water rinse, and deionized water rinse.

Field blanks will be collected at the rate of one per day and will be generated by passing laboratory supplied analyte-free water through decontaminated sampling equipment into empty sample containers. The blanks will be analyzed according to the same analytical protocols selected for this investigation.

Relevant NES/IES SOPs to be used in this program are listed in Attachment 1 at the end of this report.

2.3 INVESTIGATION RESULTS REPORT

Analytical data will be received from the laboratory approximately 3-4 weeks from the date of sample collection. Once the laboratory data are received, a draft results report will be submitted to TI for review and approval. This report will include a site plan showing monitoring well locations, a current potentiometric map, the analytical results summarized in tables and discussion of the analytical data relative to the applicable MCLs, including the results of any isotopic analyses that were performed.

3. REFERENCES

NUREG/CR-1383. Guidance on the Application of Quality Assurance for Characterizing a Low-Level Waste Disposal Site, NUREG/CR-1383, October 1990.

NUREG/CR-5849. Guidance Manual for Conducting Radiological Surveys in Support of License Termination, draft, NUREG/CR-5849, June 1992.

ORAU, 1990a. Laboratory Procedures Manual for the Environmental Survey and Site Assessment Program, Revision 5, ORAU, February 1990.

ORAU, 1990b. Quality Assurance Manual for the Oak Ridge Associated Universities' Environmental Survey and Site Assessment Program, Revision 3, ORAU, February 1990.

ORAU, 1990c. Survey Procedures Manual for the Oak Ridge Associated Universities' Environmental Survey and Site Assessment Program, Oak Ridge Associated Universities (ORAU), March 1990.

NRC, 1994. Draft Branch Technical Position on Site Characterization for Decommissioning, Division of Waste Management, Office of Nuclear Material, Safety and Safeguards, U.S. Nuclear Regulatory Commission, Nov. 17, 1994.

TI, 1993. Monitoring Well Locations Site Plan, Texas Instruments Facility, Attleboro, Massachusetts, Texas Instruments, September 1993.

TI, 1993. Appendix F, Site Hydrogeology of 1993 Burial Site Final Report, Texas Instruments Facility, Attleboro, Massachusetts, Texas Instruments, September 1993.

TI, 1990. Potentiometric Map, Overburden Aquifer, May 1990, Texas Instruments Complex, Attleboro, Massachusetts, Texas Instruments, May 1990.

Veal, F.J. 1983. Environmental Report: Radiological Survey and Review of the Texas Instruments Complex, Attleboro, Massachuetts, Texas Instruments, 17 January 1983.

Veal, F.J. 1982. Environmental Report: Radiological Survey of the Texas Instruments Complex, Texas Instruments, 20 July 1982.

ATTACHMENT 1

List of Relevant NES/IES Standard Operating Procedures

SOP-017-001	Checking Data Tables
SOP-017-003	Measuring Water Levels and Sounding a Well with a Steel Tape
SOP-017-004	Measuring Water Levels and Sounding a Well with and Electronic Indicator
SOP-017-008	Decontamination of Field Sampling Equipment
SOP-017-010	Sampling a Well
SOP-017-017	Construction, Development and Abandonment of Monitoring Wells in Unconsolidated Formations
SOP-017-012	Standard Operating Procedure for Purging a Well.

Appendix C:
Radiological Health and Safety Plan

Texas Instruments Incorporated
Materials & Controls Group
Environmental, Safety & Health Department
P.O. Box 2964
34 Forest Street
Attleboro, MA 02703-0964

APPENDIX C

RADIOLOGICAL HEALTH AND SAFETY PLAN

TEXAS INSTRUMENTS FACILITY
ATTLEBORO, MASSACHUSETTS

Prepared for:

TEXAS INSTRUMENTS INCORPORATED
MATERIALS & CONTROLS GROUP
ENVIRONMENTAL, SAEFTY AND HEALTH DEPARTMENT
P.O. BOX 2964
34 FOREST STREET
ATTLEBORO, MASSACHUSETTS 02703-0964

Prepared by:

Creative Pollution Sollutions, Inc.

November 1994
Version 3.0

RADIOLOGICAL HEALTH AND SAFETY PLAN

TABLE OF CONTENTS

I. Scope

This health and safety plan is established for the radiological health and safety aspects of any future decommissioning work, associated with USNRC license SNM-23, to be performed at the Texas Instruments Incorporated facility in Attleboro, Massachusetts. In part, this plan will be based, when applicable, to the USNRC license SNM-23 Health and Safety Plan. If additional remediation activities are necessary, a general health and safety plan will be developed which will address all aspects of health and safety including any physical or chemical hazards.

This radiation health and safety plan details the site specific requirements for radiation protection purposes only. Since the anticipated radiation hazards are believed to be similar throughout the Texas Instruments site, this plan should require few modifications for any future remediation work. This plan, and the radiation protocols outlined within this plan, will also be applicable during all supplemental radiological surveys (drilling, walkover surveys, etc.).

II. Site Description

The Texas Instruments Incorporated, Materials and Control Group, Attleboro, MA, site is located in Attleboro, approximately 48 kilometers south of Boston on Route 123. The site covers approximately 250 acres (see Attachment A "Site Maps"). Attachment A also includes maps identifying the affected land areas and the affected buidling interior areas. These areas are described in detail within the main body of this report.

III. Responsible Organizations and Key Personnel

Individuals specified within the organizations shall be identified by the site access log detailed in appendix B.

A. Organizations

1. Texas Instruments Incorporated

Texas Instruments Incorporated by virtue of ownership is responsible for all aspects of the project scope Departments involved include: Environmental,

Health and Safety, Security, Facilities, Purchasing, Human Resources, Transportation, and affected bussiness operations.

2. Remediation Contractor(s)

The remediation contractor is responsible for the physical excavation and/or decontamination of the identified areas and the preparation and packaging of materials for disposition. Personnel involved include operations and health and safety.

3. Creative Pollution Solutions, Inc.

Creative Pollution Solutions, Inc. will provide the Site Specific Radiological Health and Safety Plan, radiation protection and controls during site activity, and recommendations to Texas Instruments Incorporated regarding radiation protection.

B. Key Personnel

1. Texas Instruments Incorporated

Environmental
Health and Safety
Site Security
Facilities
Transportation
Medical
Human Resources
Purchasing
Affected Bussiness Operations personnel

2. Remediation Contractor(s)
   - Operations Manager
   - Satety and Compliance Officer
   - Machine Operator(s)
   - Laborers

3. Creative Pollution Solutions, Inc.
   - Field Supervisor
   - Health Physicist
   - Health Physics Technicians
   - Health Physics Analytical Support

A telephone contact list of key personnel will be included within this plan and made available on site during remediation operations.

IV. Work Stop Authority

Any individual or organization has the right to shut down the operations on the site. In the event of a disagreement, the most conservative approach shall be taken. A meeting shall be convened by identified representatives of each organization to assess the decision at hand.

V. Site Radiological Characteristics

Radiological hazards associated with this site are the result of previous NRC licesenced activities which involved the manufacturing and processing of uranium. Hence, site radiological hazards are those associated with this material. The supplemental radiological surveys will allow for more precise determination of the level of contamination however, previous surveys indicate that the levels which may be encountered will most likely be consistent with the profile shown below. Modifications will be made to this plan as necessary based on future radiological surveys.

Concentrations of Radionuclides in Surface Soil

The concentration of U-238 in soil ranges from < 0.38 - 250 pCi/g. U-235 concentrations ranged from < 0.11 to 230 pCi/g.

Concentrations of Radionuclides Surface Soil

The concentration of U-238 in sub-surface soil ranged from < .38 - 410 pCi/g; U-235 ranged from <.11 - 440 pCi/g.

External Exposure Rates

External Exposure Rates ranged from 12 - 20 μR/h.

VI. Personnel Training Requirements

All site personnel will have received training consistent with that required under the general health and safety plan developed by the remediation contractor. Site specific training regarding radiation protection and control will be conducted by CPS. An outline of the radiolgocial control training is as follows:

1. Organization
2. Health and Safety Plan
3. Responsibilities
4. Site Characterization
5. Radiation Properties (site specific)
6. Contamination Controls
7. Frisking Procedures
8. Dose Control
9. Personnel Access
10. Work Stop Authority

A training log will be established to keep a record of the site specific radiation training (see Attachment D).

VII. Site Control

Site Controls will be established in accordance with standard practices for hazardous waste activities. Generally work zones will be established and broken down into three primary zones: the Exclusion Zone, the Contamination Reduction Zone and the Support Zone. These zones are all to be considered part of the larger Restricted Area. Only authorized personnel will be allowed within the Restricted Area.

Exclusion Zone -- Exclusion zone is the area within the Restricted Area where remediation activities will be performed. The exclusion zone will require level D protective clothing unless characterization data dictates an upgrade in protective equipment.

Contamination Reduction Zone -- Within the contamination reduction zone a control point will be established to control access to the Exclusion Zone. A personnel decontamination area and an equipment decontamination area will be established within this zone.

Support Zone --- The support zone will include a command center and a field radiation laboratory.

Security check points may be necessary in order to control access to the Restricted Area.

VIII. Personnel Protective Equipment

Personnel in the Exclusion Area will maintain, as a minimum, level D protective equipment. The minimum protective equipment required includes: hard hat and steel toed safety shoes. In many situations shoe covers and gloves will be required. Additional protective equipment may be required as conditions warrant. Decisions to upgrade or downgrade protective equipment at any time during the site operation will be made jointly by Texas Instruments Incorporated, Materials and Control Group personnel and Creative Pollution Solutions, Inc. personnel.

IX. Monitoring and Sampling

This section describes the radiological sampling and monitoring to be performed during site operations in order to protect site personnel and the community. Action Levels have been established for certain aspects of sampling and monitoring (Attachment D).

Area Air Sampling

Area air sampling will be performed, as needed, during site operations at perimeter locations and work areas. Perimeter locations will be based on prevailing conditions.

Personnel Breathing Zone Air Samples

Personnel BZA's may be provided to a representative number of workers based on job task.

Bioassay Measurements

In-vitro bioassay monitoring consisting of baseline and post-work urinalysis will be performed on all personnel working in the exclusion zone. Urinalysis samples will be analyzed for total uranium via flourometric techniques by an identified outside laboratory.

Personnel Contamination Monitoring

Frisking of personnel and equipment shall be performed prior to exit from the contamination reduction zone. Frisking will be done to assure personnel and equipment are not contaminated.

X. Decontamination

Personnel Decontamination

Personnel decontamination will be performed in accordance with standard decontamination practices as outlined in the "Occupational Safety and Health Manual for Hazardous Waste Site Activities". In addition to standard waste site procedures frisking out of all personnel will take place prior to exiting the exclusion zone.

Equipment Decontamination

All equipment shall be surveyed to determine disposition. Disposition shall include decontamination for free release (see Appendix C) or disposed of as appropriate.

XI. Medical Surveillance

Medical surveillance shall be performed for all personnel working in the exclusion zone. Medical surveillance shall be in accordance with the general health and safety plan developed by the remediation contractor. In addition, for this site, a bioassay analysis for the assessment of intakes of radionuclides shall be performed pre and post site work.

XII. Informational Programs

Informational programs are the responsibility of Texas Instruments Incorporated, Materials and Control Group. These programs will inform TI employees and the community of the site work as necessary.

XIII. Record Keeping

Site records will be kept including but not limited to : Site log, site training records, air sampling results, site sampling and monitoring results, and bioassay results.

XIV. Emergency Response Contingency Plan

Emergency procedures will be consistent with those outlined in the general health and safety plan developed by the remediation contractor and Texas Instruments Incorporated, Materials and Control Group Disaster Emergency Management Plan.

Attachment A

Site Maps

Figure A1
Map of Open Land Areas Depicting Undeveloped and Unaffected Land Areas

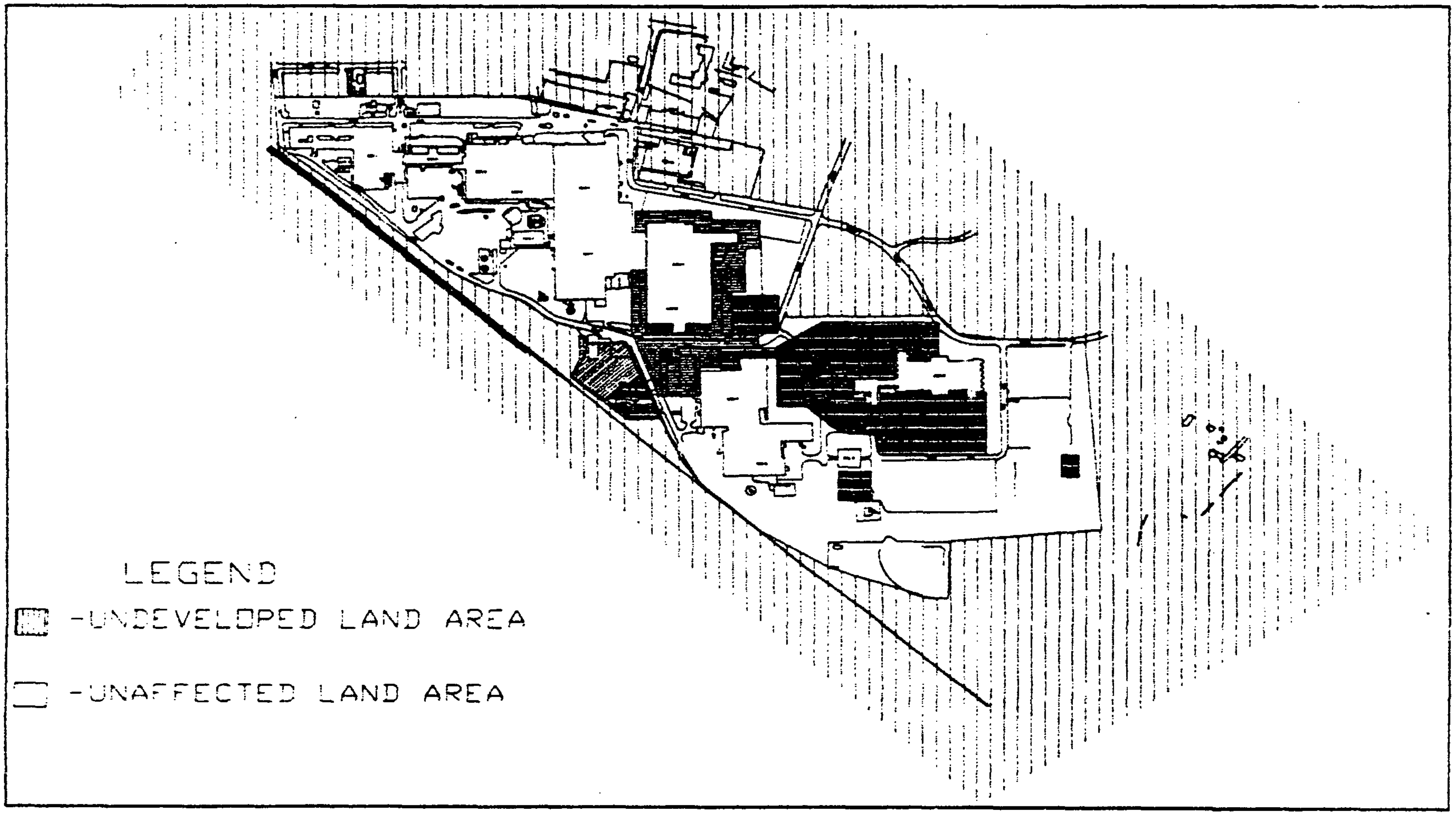
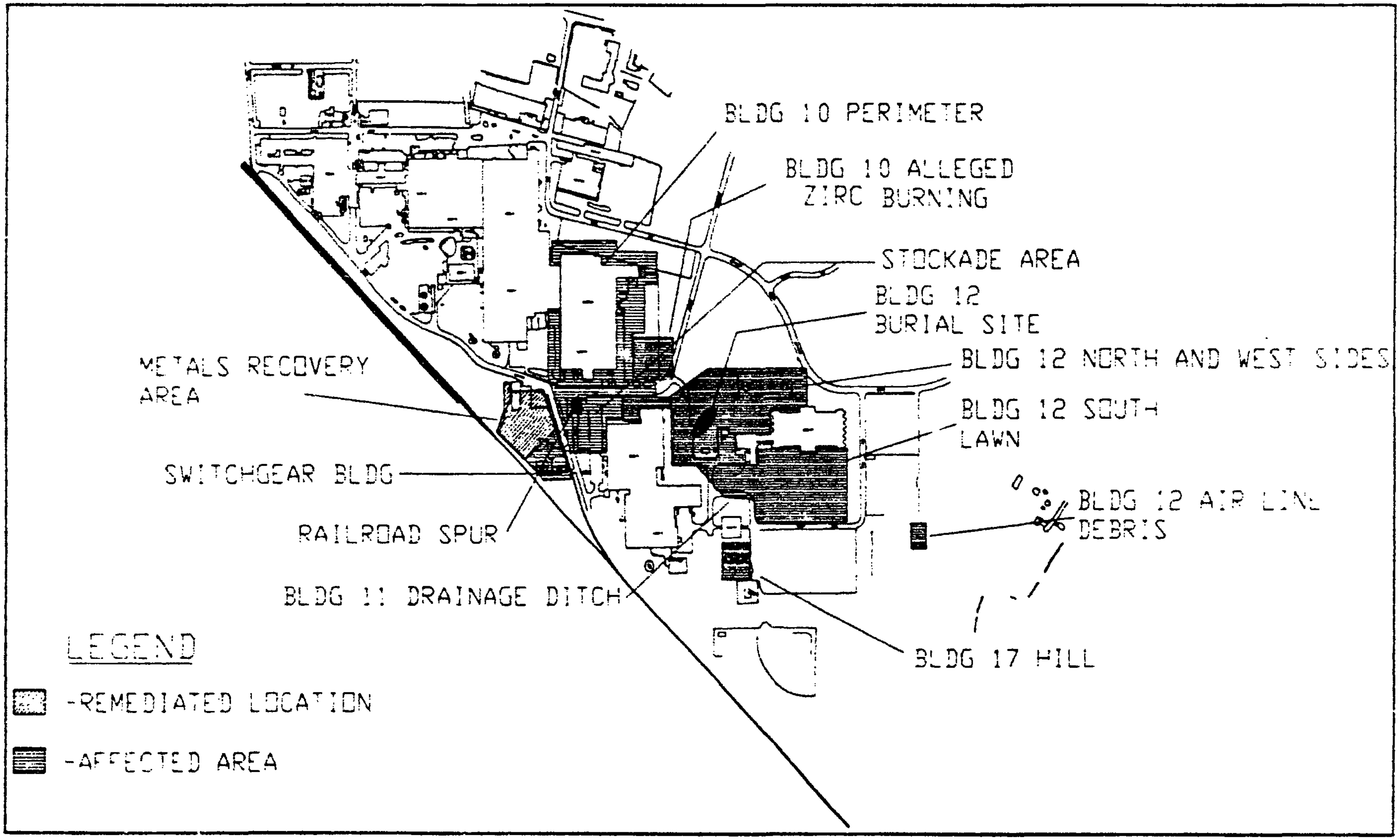


Figure A2
Map of Open Land Areas Depicting Affected and Previously Remediated Areas



Attachment B

Site Access Log

Site Access Log

Name	Date	Company	Position/Purpose

Attachment C

Action Limits

Air Sample (General Area)

General Area Air Sampling is performed to assess airborne concentrations of radionuclides. Action Limits are established in accordance with NRC published concentration limits (Derived Air Concentrations, DACs).

Concentration	Action
< 25%	No Action
25% < X < 75 %	Investigate and notify radiation protection supervision
75% < X < 100%	Stop work. Notify radiation protection supervision.

Personnel Exposure

External Dose

Thermoluminescent Dosimetry (TLDs) shall be the dose of record for those issued. Self reading pocket dosimeters are for exposure control purposes, dose of record for those not issued TLDs, and to serve as a backup to TLDs. Action limits are established for dose control purposes using the self reading pocket dosimeters.

SRD Reading	Action
< 20 mR	No Action
20 mR < X < 100 mR	Notify Radiation Protection Supervision for Investigation
> 100 mR	Remove worker from area and notify a..: notify Radiation Protection Supervision.

Breathing Zone Air Samples (BZA)

BZAs are worn by a representative group of workers based on job function. BZAs are used to assess potential intakes of radionuclides. Action Limits are as follows:

< 150 dpm	No action
> 150 dpm	Investigation level. Verify by bioassay

Bioassay (Urine analysis)

Urine samples are obtained to assess intakes and verify the effectiveness of the respiratory protection. Bioassay results are reported in the units of g/l. The results are compared to baseline values and to Investigation/Action levels.

Bioassay results	Action
< 5 g/l	No action
> 5 g/l	Investigation

Contamination Levels

In accordance with USNRC guidelines for "Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material", Dated April 1993, the following is established:

Acceptable Surface Contamination Levels

Nuclide (Note a)	Average (Note b,c,f)	Maximum (Note b,d,f)	Removable (note b,e,f)
U-Natural, ^{235}U, ^{238}U, and associated decay products	5,000 dpm /100 cm^2	15,000 dpm /100cm^2	1,000 dpm /100cm^2
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	100 dpm/100cm^2	300 dpm/100cm^2	20 dpm/100cm^2
Th-nat., ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{131}I, ^{133}I	1,000 dpm/100cm^2	3,000 dpm/100cm^2	200 dpm/100cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr and others noted above. Includes mixed fission products containing ^{90}Sr and others noted above.	5,000 dpm /100cm^2	15,000 dpm /100cm^2	1,000 dpm /100cm^2

Notes:

a. Where surface contamination by both alpha and beta-gamma emitting nuclides exists, the limits established for alpha and beta-gamma emitting nuclides should apply independently.

b. As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrument.

c. Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

d. The maximum contamination level applies to an area of not more than 100 cm^2.

e. The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbant paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface area should be wiped.

f. The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h at 1 cm and 1.0 mrad at 1 cm, respectively, measured through not more than 7 mg/100 cm^2 of total absorber.

Exposure Rates

Action Limits for external exposure rates are specified as follows:

Exposure Rate	Action
Background < X < 1 mR/h	No Action
1 mR/h < X < 10mR/h	Stop work and Radiation Protection Supervision Notified for Investigation
10 mR/h < X < 100 mR/h	Stop Work. Personnel retire to area of exposure rate less than 1 mR/h. Radiation protection supervision notified for investigation.
> 100 mR/h	Stop work. evacuate to control point and exit to command center. Radiation Protection supervision notified.

Attachment D

Training Log

Training Log

Description of Training:

Date:

Attendees:

MAR 1 5 1995

Docket No. 070-00033 License No. SNM-23

Mr. Michael Elliott
Environmental Manager
Texas Instruments, Inc.
34 Forest Street
Attleboro, MA 02703

SUBJECT: SPECIAL INSPECTION NO. 94-002/070-00033

Dear Mr. Elliott:

On August 24, 1994, Mark C. Roberts of this office conducted a special, announced safety inspection at the above address and at an area along Holden Street, in Attleboro, of activities authorized by the above listed NRC license. The inspection was limited to a review of the possible disposal of licensed material in the fill area along Holden Street. The inspection consisted of observations by the inspector, interviews with personnel, independent measurements by the inspector, and an examination of selected aerial photographs.

The inspector also gathered information during telephone conversations on February 15, 1995 with James Mooney of the Attleboro Health Department, and February 22, 1995 with Paul Jost of your office. The preliminary findings of the inspection were discussed with Jay Eidson and Mary McGarigle of CDM Federal Programs Corporation and you on August 24, 1994. A copy of the NRC inspection report is enclosed.

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

As agreed during the inspection, you conducted various radiation surveys and provided the results with your letter dated January 12, 1995.

In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and the enclosed report will be placed in the Public Document Room. No reply to this letter is required.

Your cooperation with us is appreciated.

Sincerely,

Original Signed By:
John D. Kinneman
John D. Kinneman, Chief
Site Decommissioning Section
Division of Radiation Safety
and Safeguards

280017

Docket No. 070-00033
License No. SNM-23

Enclosure:
Inspection Report No. 070-00033/94-002

cc w/encl:
Commonwealth of Massachusetts

Carl Dorrance
Treasurer
Dorrance Excavating Contractor
283 West Main Street
Norton, MA 02766

Nancy Smith
Massachusetts Site Assessment Manager
U.S. Environmental Protection Agency
Region I
JFK Federal Building
Boston, MA 02203-2211

<u>Distribution w/encl</u>:
Region I Docket Room (w/concurrences)
PUBLIC
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OFFICE	RI:DRSS E	RI:DRSS E			
NAME	Roberts	Kinneman			
DATE	3/14/95	3/14/95			

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U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 070-00033/94-002

Docket No. 070-00033

License No. SNM-23

Licensee: Texas Instruments, Inc.
34 Forest Avenue
Attleboro, Massachusetts 02703

Facility Name: Texas Instruments, Inc.

Inspection At: Texas Instruments, Inc.
Attleboro, Massachusetts

Fill area along Holden Street
Attleboro, Massachusetts

Inspection Conducted: August 24, 1994

Inspector: Mark C. Roberts, Senior Health Physicist — 3-14-95 Date

Approved by: John D. Kinneman, Chief, Site Decommissioning Section — 3-14-95 Date

Areas Inspected: Announced special inspection to review possibility that licensed material was transferred to an area on Holden Street including a visit to Holden Street fill area in Attleboro; radiation measurements in the Holden Street fill area; site visit to Texas Instruments facility in Attleboro, review of aerial photographs and radiological survey data (radiological survey data provided in letter dated January 12. 1995); contact with the Attleboro Health Department to identify well water use. Final information for this report was received on February 22, 1995.

Results: It is unlikely that licensed radioactive material originating at the Texas Instruments, Attleboro, Massachusetts facility was transferred to the Holden Street fill area. No violations were identified.

DETAILS

1.0 Persons Contacted

*Michael Elliott, Environmental Manager, Texas Instruments, Inc.
*Jay Eidson, Site Management Consultant, CDM Federal Programs Corporation
*Mary McGarigle, Environmental Scientist, CDM Federal Programs Corporation
Carl Dorrance, Treasurer, Dorrance Excavating Contractor, Inc.
Emily Brunkhurst, Massachusetts Audubon Society (via telephone on September 12, 1994)
James P. Mooney, Health Agent Director, Attleboro Health Department (via telephone on February 15, 1995)
Paul Jost, Facilities Department, Texas Instruments, Inc. (via telephone on February 22, 1995)

*Denotes those present at exit interview.

2.0 Background

The Texas Instruments, Inc. (TI) facility is located in Attleboro, Massachusetts, 48 kilometers (30 miles) south of Boston. The site is approximately 40 hectares (100 acres) with twelve major buildings. Operations with radioactive materials commenced at the site in 1952 when the General Plate Division of Metals and Controls, Inc. began to fabricate enriched uranium foils. That company merged with TI in 1959. Texas Instruments fabricated enriched uranium fuel elements for the U.S. Navy and commercial customers from 1959 through 1983. Depleted uranium was also used at the facility for research and development.

During the time period that the licensee conducted activities with licensed material on the site, scrap material and equipment contaminated with uranium were buried in a disposal area between Building 11 and what is now Building 12. This area was the subject of remediation and final surveys which were completed in October 1993. A confirmatory survey in this area, conducted by the Oak Ridge Institute for Science and Education (ORISE) in December 1993, did not identify residual contamination in excess of the current criteria for release for unrestricted use. Other exterior locations on the site were also contaminated with uranium as a result of the licensed operations. In particular, an area near Building 5, where zirconium chips contaminated with uranium were incinerated, has recently been remediated. The licensee is in the process of performing a radiological survey of the entire site to determine if there is any remaining uranium contamination.

From the 1960's through the 1980's, TI conducted several major construction projects on the site which required the excavation of soil in the area of the construction. These included the construction of Building 12, additions to Building 11 and addition of a railroad spur west of Buildings 10 and 11. Some of the excess soil generated by these projects was removed from the site and was disposed at other locations. NRC Region I and EPA Region I are reviewing the disposal of excavated

soil at a site along the Bungay River near Holden Street in Attleboro to determine whether that site was contaminated with licensed material (depleted and/or enriched uranium). Metallic debris of industrial origin has apparently been identified in fill material in the Holden Street area. The metallic debris apparently includes items that were manufactured by TI. Based on newspaper accounts and a conversation with a representative from the Massachusetts Audubon Society, a portion of this area is being considered for a nature preserve/park.

Since the TI Attleboro, Massachusetts facility is currently licensed by the NRC, EPA Region I has deferred jurisdiction to the NRC and does not plan further investigation under the EPA Superfund Site Assessment program.

3.0 Visit to Holden Street Fill Area

The inspector met with representatives from CDM Federal Programs (an EPA Region I contractor), Texas Instruments Inc., and Dorrance Excavating Contractor, Inc (Dorrance Excavating) at the Holden Street fill area. Dorrance Excavating is a family owned and operated company in nearby Norton, Massachusetts. The fill area, a parcel of land approximately 4 acres in area, is owned by a member of the Dorrance family. The fill area has been used since approximately 1957 to receive fill from various excavation jobs of the company. Use of the area to receive fill stopped in approximately 1977. Fill material, consisting of miscellaneous soils, rocks and tree trunks, was placed in this marshland area with the consideration that the land could be used for future residential development. From discussions with Mr. Dorrance, the source of the fill material was primarily excavation work done at school construction projects in and around the city of Attleboro. A newspaper article from the October 26, 1966 issue of the Attleboro Sun (Attachment 1) also describes the type and source of material that had been placed in the fill area.

The fill area is bordered by the Bungay River to the west, Holden Street to the north, Benefit Street to the east and to the south by the extension of Oak Street. The area is overgrown with dense vegetation and not readily accessible. With the permission of Mr. C. Dorrance, the group gained access to the fill area from the east by cutting down some of the vegetation to create a path to the fill area. Due to the significant vegetation, the terrain in the fill area was difficult to assess. However, the area appeared to be relatively level with some gentle undulations and a few small hillocks. The western edge of the parcel slopes toward the Bungay River. Numerous marshy areas were encountered during the walk around the property.

Mr. Dorrance estimated that the depth of the fill ranged from 0 to approximately 10 feet thick with a total volume of approximately 10,000 yd^3. The additions of fill were not documented nor was documentation required. Although the successive dumpings of fill were generally spread to maintain a relatively flat terrain, there was no apparent attempt to ensure that the fill was graded. A requirement that fill not

be dumped in the river was incorporated into later dumping permits that authorized the use of the area for the placement of fill. Mr. Dorrance stated that he was not aware of any dumping of fill into the Bungay River and that he thought such dumping unlikely since the area immediately adjacent to the river was too soft to allow for trucks or other equipment to drive without becoming stuck.

Mr. Dorrance also stated that soil from construction activities on the TI site in Attleboro was placed in the fill area. The soil removal activities were conducted in approximately 1976. At that time, Mr. Dorrance worked in the family business as a dump truck driver and he worked on that excavation project. Mr. Dorrance offered to identify the location at the TI Attleboro site where the soil was excavated and removed to the Holden Street fill area.

No safety concerns were identified.

4.0 Site Visit to Texas Instruments facility in Attleboro

The inspector requested and received permission from the Texas Instruments' representative for the group to meet at the TI site to examine possible locations where soil was removed from the TI site and transported to the fill area along Holden Street. Mr. Dorrance accompanied the group and identified the addition to Building 11 that lies south and east of the original building as the area that was excavated and from which the soil removed and placed in the Holden Street fill area. He stated that the excavation of the area was accomplished using a dragline; a large volume construction bucket suspended from a tall boom and dragged via a cable through the area to be excavated. The material captured by the bucket was then loaded into trucks for transport. This method is apparently useful for soft soil and shallow excavation depths. Mr. Dorrance stated that the excavated material that was removed appeared to be a dark soil, similar to the indigenous peat soil present in the area. The methodology used for soil removal and the appearance of the excavated material was independently confirmed through discussions with another representative from TI who was familiar with the project. He confirmed that the excavation was performed in approximately September 1976 through examination of construction drawings. Mr. Dorrance stated that this was the only location that he was aware on the TI Attleboro site where soil was removed and dumped at the Holden Street fill area.

No safety concerns were identified.

5.0 Radiation Measurements in the Holden Street Fill Area

The inspector made measurements of the exposure rate during the traverse of the Holden Street fill area using a Ludlum Model 19 Micro R Meter (NRC Serial No. 33513, calibration expires June 9, 1995). The exposure rates measured along Holden and Benefit Streets were approximately 11

μR/hour at one meter above the ground. The measured exposure rates throughout the Holden Street fill area were not distinguishable from this measured background exposure rate.

No safety concerns were identified.

6.0 Review of Aerial Photographs and Radiological Survey Data

An aerial photograph of the TI Attleboro site from April 15, 1966 and a second aerial photograph from approximately 1987 or 1988 (Attachments 2 and 3) were examined by the inspector. The 1966 photograph was taken prior to the construction of Building 12 and the additions to Building 11 since these structures do not appear in the photograph. The railroad spur is shown on the 1966 photograph. Discussions with TI representatives indicate that excavation of the railroad spur commenced in approximately November 1965. The burial area that lies between Building 11 and what is now Building 12 is also shown in the 1966 photograph. Construction on Building 12 commenced in the summer or fall of 1966.

From an examination of the 1966 photograph and a comparison to the 1987/88 photograph, it appears that the land where the southeast addition to Building 11 was constructed is undisturbed. This supports the information provided by Mr. Dorrance and the TI representative that the excavated material from this area in 1976 was the indigenous peat soil of the area.

Following the remediation of the burial area, between Buildings 11 and 12, confirmatory surveys including soil sampling and analyses were performed by ORISE (Oak Ridge Institute for Science and Education) in February 1994. The inspector reviewed the data from that survey. Total uranium concentrations in soil from the borings (typically taken at the surface and depths of 1 meter and 2 meters) beyond the southern and eastern perimeters of the burial area are all less than or equal to 10 pCi/gram. The data indicates that the burial area between Buildings 11 and 12 on the TI Attleboro site did not extend into the area that was excavated for the additions to Building 11.

The TI Environmental Manager stated that TI would perform walkover radiological survey of the entire site. The inspector requested that TI provide information concerning radiological measurements performed south and east of Building 11. This information was provided to Region 1 in a letter dated January 12, 1995. These surveys did not identify any locations in excess of 1.5 times the background exposure rate and thus no further sampling was performed.

No safety concerns were identified.

7.0 Contact with the Attleboro Health Department to Identify Well Water Use

The inspector contacted a representative from the Attleboro City Health Department for information concerning well water use in the vicinity of the Holden Street fill area. The Health Department representative stated that a city water well is immediately downstream of the Holden Street fill area, but that the well has not been used in approximately seven years and was recently capped. The well supplied potable water; however, the high iron content of the water causes the water to be undesirable to consume. The well was always a secondary source of water and was only used for short durations during peak demand in late summer. The entire community around the Holden Street fill area is served by the municipal water supply which obtains water from a different watershed area than the Bungay River area. The representative was not aware of any private wells in the area supplying drinking water.

No safety concerns were identified.

8.0 Conclusions Concerning Buried Licensed Material at Holden Street

Fill material consisting primarily of soil, rocks and tree trunks from numerous excavation projects, including one major construction project at the TI Attleboro site, was dumped by the property owner at a privately-owned parcel of land along Holden Street and the Bungay River in Attleboro. Discussions with a representative of Dorrance Excavating who performed these activities indicated that the material removed from the TI site was dumped at Holden Street in approximately 1976 and consisted of material that appeared to be similar to the indigenous peat-like soil found in the area. Neither this excavating company representative nor a TI representative were aware of any other movements of fill from the TI Attleboro site to Holden Street.

Inspection of the Holden Street fill area did not reveal the presence of any radioactive material or debris. Radiation exposure rates measured in the Holden Street fill area were not different than background radiation exposure rates made nearby the fill area. Metallic items reported to have been found at the Holden Street fill area ("Klixon" thermostatic disks manufactured by TI) do not contain radioactive material.

A review of available photographs and radiological survey data from the vicinity of the excavated area of the TI Attleboro site where soils were removed to the Holden Street fill area indicate that the area did not likely contain any significant quantity of licensed material.

All available information indicates that the soil removed from the TI Attleboro site and placed at the Holden Street fill area does not contain licensed radioactive material.

9.0 Exit Interview

The results of the inspection were discussed with the licensee representative identified in Section 1.0.

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Views Mixed On Plan To Fill Marshland

Voices of proponents and opponents were strong last night before a mayor's public hearing as to whether Melvin G. Dorrance, 17 Dorrance St., should be allowed to dump fill into marshland next to the Bungay River, off of Holden Street.

Because of the Hatch Act — a state law relative to the preservation of wetlands, marshlands and inland water ways — which went into effect a year ago Dorrance asked for the hearing before the city executive, as now required by law, in order to continue dumping fill in the marsh land, now owned by his wife, Annie.

Atty. John P. Lee of Attleboro, representing Mrs. Dorrance, told Mayor Thomas A. Piggott that the purpose of filling the lowland was to prepare it for future residential development.

Official Opposition

Raymond A. Moreau, chairman of the Attleboro Conservation Commission, opposed strongly by expressing fear that the heavy fill on the peat moss ground would force the soft river bed to rise and obstruct the river's course. He also noted that a marshland is Nature's way of supplying water to the wells "and we would be cutting our own throats to allow that land to be filled."

Mrs. Roger K. Richardson, 275 Wilmarth St., reported concern over sewage disposal if a housing development was placed there.

"It's not practical to have cesspools in a peat bog," said Leslie R. Gage, 52 Crossman Ave., indicating that the cesspools there would run into the Bungay River.

John A. Siddell Jr., 151 Holden St., supported Moreau's opposition. John C. Oliver, 33 Crossman St., said the fill being dumped by Dorrance in the area is "too soft" to build cellar holes.

Fill Too High

Arthur P. Schneider, 82 Benefit St., whose land abuts the marshland, expressed concern that the fill was higher than his land, therefore feared that rain water would not follow a natural course into the river but remain stagnant on his property.

Richard H. Sweet, 4 Crossman Ave., complained of the dust created by the Dorrance trucks traveling to and from the marshland.

"We live in the middle of a dust bowl," he said. "Aren't those trucks supposed to be covered or wetted down?"

Mrs. Lucia B. Smith, 139 Holden St., asked how cellars for homes over a fill could be dug when some of the fill is tree trunks "bigger than your trunks."

"We'll just build split level houses in those places," Dorrance replied.

Contours Controlled

James A. Freeman of Attleboro, a private civil engineer hired by Dorrance, told Mayor Piggott that he has attempted to develop the contours of the land ... so that the water would always shed toward the river.

"To the best of my knowledge these contours have not interfered with the lands of abutting home owners," Freeman said. He did not that the contour next to the Schneider property was about two feet higher but assured Schneider that an adjustment would be made so that water would run off of his property toward the river.

The engineer said that the filled area would make a "fine" residential development "if up to the grades of the contours I present" and that it would work well toward the best interests of the city.

Dorrance noted that the area is four acres, one and one half of which still has to be filled. He estimated that "about 25,000 square yards of fill will be needed to do the job. Rough estimates by Freeman placed the amount at about 40,000. Dorrance estimated the area would be completely filled, his attorney indicated it would take another three years.

Sewer System

As to sewage disposal for a possible development, Dorrance said he would install a complete sewer system to be hooked onto the city's system and would install the necessary pumping facilities if necessary. As to the soft fill being dumped, he said, "I admit it's soft when it is dumped, but when it dries out it's ok for cellar holes."

The contractor said he has been dumping fill in the marsh land since 1956. The fill has included black soil, rocks and tree stumps. Most of the waste has come from excavation work he has done at schools in the city, he said.

Dorrance said he didn't believe the fill would force the soft river bottom to rise. Freeman said, however, that if that should happen he was sure that Dorrance would clear the river.

Offers To Sell

Moreau also indicated that marshlands were valuable in obstructing flash floods going down a river. The discussion between him and Dorrance became somewhat heated over that point.

"If you're so concerned about that, then why doesn't the city buy that land?" Dorrance asked.

"If the land is for sale, then we're interested," replied Moreau.

Lee requested Mayor Piggott to do much study and discussion with state officials and local persons involved before making his decision.

The mayor said, after the hearing, that he would study the verbatim notes, obtained by a stenographer, and discuss the situation with the Attleboro Board of Health, the state Conservation Commission and the Department of Public Works before making a decision on Mrs. Dorrance's petition to continue dumping fill into the marshland.

Home Owners' Hopes Hinge On 'Yes 5', Taxpayers Told

The most important vote to be case by any citizen in the upcoming election will be a "Yes" vote on Referenda Question No. Five, James Zora, Attleboro chairman of the Mass. Committee for Cities, Towns and Schools told members of the Attleboro Association for Fair Taxes last night.

Rep. Donald Bliss warned the assembly that there is grave danger that the sales tax now sustaining the hopes of people who are small home owners, most of them with children in school, for keeping their tax rate within reason, may be defeated on Nov. 8.

If a "No" vote prevails there will be almost chaos in the government of the Commonwealth for the balance of the year or until some emergency provision is made by the legislature to provide means of bringing revenue to keep the cities, towns and schools operating, both Bliss and Zora told the group meeting in the high school cafeteria.

Both speakers urged listeners to constitute themselves a determined committee of one to urge every neighbor, relative and friend to be sure to vote on Question Five — and favorably — Nov. 8. The too-often seen ... continuance of the sales tax, the speakers pointed out.

Loss of the income from the sales tax could mean an increase in real property and personal taxes, a rise in the state income tax, and for those who may be rent payers rather than property owners, a sharp jump in the cost of living quarters, Zora pointed out.

Rep. Bliss said that the majority of the members of the House of Representatives strongly favor retention of the sales tax. Democratic representatives strongly supported the governor in his call for the sales tax, and will again if they are called upon, Bliss said. The question of Senate support is precarious though so the surest way is to vote continuance on the referenda, he added.

A central headquarters for workers in behalf of the sales tax continuance will be established at 40 South Main St. within hours, Zora announced. He invited all to come in and join the group which is planning a strong drive to ... a full note on the quest...

MME. CHIANG HOME

TAIPEI, Formosa ... Mme. Chiang Kai-shek

Passes Away

Matthias C. Galligan, 81, husband of Catherine A. (Lahey) Galligan of 70 Dunham St., died yesterday following an extended illness.

Mr. Galligan, long a sulky racer in the New England area, was born in Norton, a son of the late Michael and Julia (Leddy) Galligan, and had worked at the Marathon Co.

Surviving besides his widow are four daughters, Sister Catherine Agnes, SUSC, of Sacred Heart Convent, Fall River, Mrs. Albert A. (Helen) Robinson and Miss Angela Galligan, both of this city, and Mrs. Ruth Lang of Woodsville, N. H.; two sons, Edward F. and Charles Galligan, a sister, Miss Mary F. Galligan, all of this city, 13 grand and three great grandchildren.

The funeral will be conducted Friday morning from the Foley Funeral Home, with a requiem Mass at 9 o'clock in St. John the Evangelist Church and interment in St. John Cemetery.

William L. Sweetland Dies

PAWTUCKET — William L. Sweetland, 34, of 85 Hanover Ave., died yesterday at home following a long illness.

Born in Pawtucket, son of the late George T. and Mary (Whorton) Sweetland, he had been employed by the Jarvis Tap Co., North Attleboro, for 15 years and was a member of the Pawtucket Lodge of Elks. He was a communicant of St. Leo Church and a member of the parish bowling league.

He is survived by four sisters, Mrs. Walter Shawinski of Plainville, Mrs. Thomas Carberry of Torrence, Calif., Mrs. Thomas Dineen of Cumberland and Mrs. William Gray Jr. of Pawtucket; a brother, George P. Sweetland of Pawtucket.

The funeral will be held Friday from the Manning-Heffern Funeral Home, with a solemn requiem Mass at 9 a.m. in St. Leo Church and burial in Mt. St. Mary Cemetery.

Rites Held For Mrs. A. B. Curry

SOUTH ATTLEBORO — A requiem Mass for Mrs. Annie B. (Ryan) Curry was celebrated this morning in St. Theresa Church by the Rev. Gerard Chabot. The Rev. Rene Gagne conducted the committal service in St. Francis Cemetery, Pawtucket. Serving as bearers were Frederick Gordon, Leo Fontaine, Ronald F. Dennis, Fred Jr. and Fred Clarke Sr.

Mrs. Curry, formerly of 143 Cumberland Ave. and widow of Edwin F. Curry, died Sunday.

Mass Sung For

In Attleboro

Tuberculosis is present in Attleboro, and its potential of spreading is becoming greater. "Many people with the inactive germ are failing to take care of themselves," said Miss Dorothy McManus, public health nurse.

She noted that as of next week, there will be four Attleboreans confined to the T... hospital in Norfolk with the active disease.

Miss McManus said th... thought that TB had been wiped out in Attleboro due to new medicines, and the closing of the Bristol County TB Sanitorium in January 1963, "is false."

"A TB germ can be confined within a body through the use of the new medicines, and the person must not abuse his body," she said.

A germ can become active again if the person doesn't get the proper amount of food and sleep, drinks too much, smokes too much. Then the person has to be confined in the sanitorium until the germ is arrested.

Of the four with the active germ, two are being covered by insurance policies, another is paid by the family, and the city pays the tab on the fourth one. It costs $27.78 per day per person to stay at the sanitorium. Most patients have to remain there about a year, depending on how they respond to the treatment. The Commonwealth pays half of the daily rate, leaving $13.89 per day to be paid by the family, insurance or city.

There are 81 persons presently in Attleboro who have histories of tuberculosis. Most are required to have an annual TB X-ray, others more often depending upon a doctor's orders. Each January, Miss McManus conducts a survey of these persons for the Central Tuberculosis Case Register, Boston, ...

In Wall Street

NEW YORK (AP) — Steels led the stock market to a vigorous rally with trading heavy early this afternoon.

The top steelmakers advanced more than 2 points each in response to the U.S. Steel dividend boost and Bethlehem's report of its biggest third-quarter profits in history.

As trading warmed up, the pace was the fastest of the week.

Analysts interpreted "Big Steel's" dividend hike as meaning that the company expected profits to rise in future quarters.

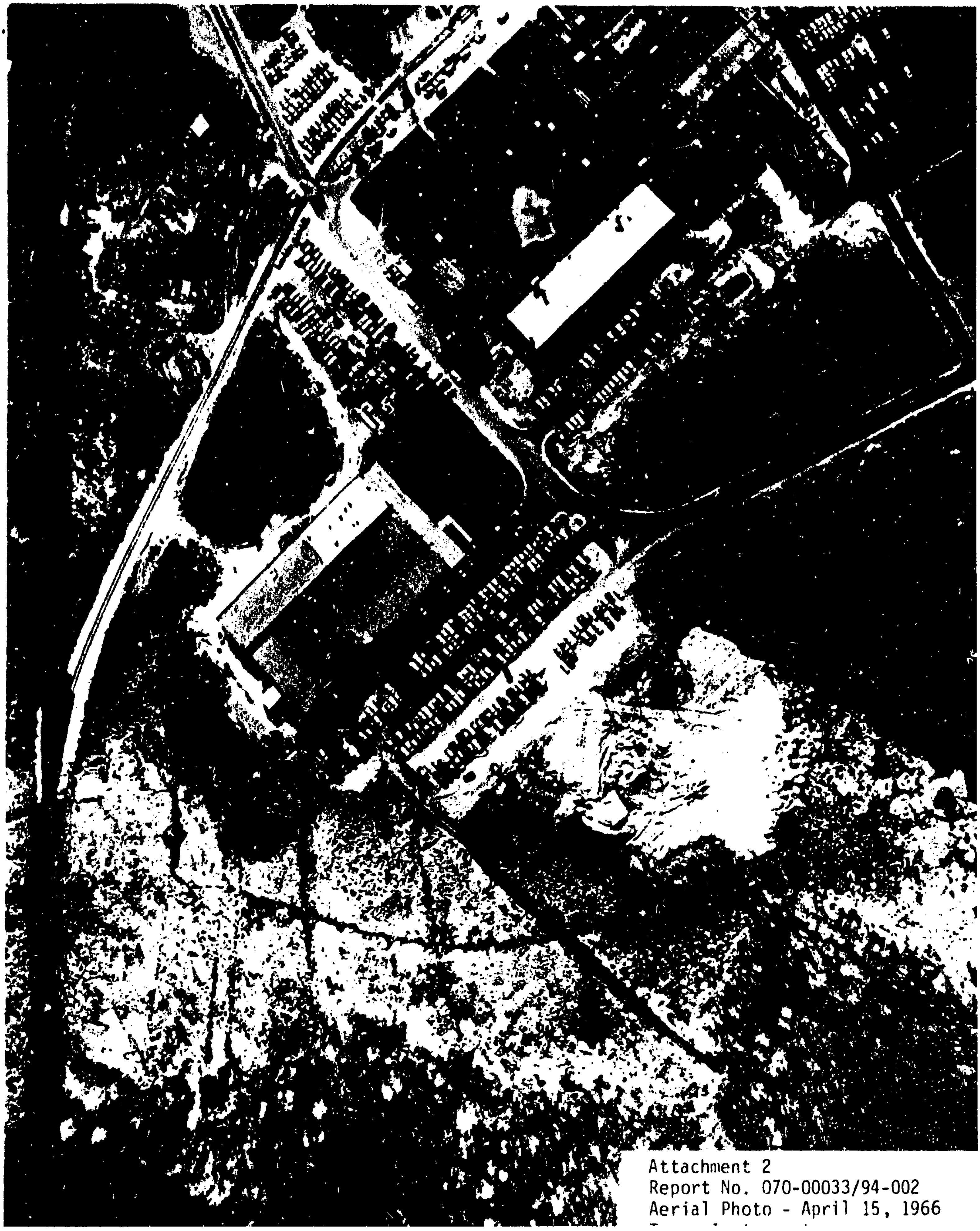
Big Three autos, which suffered Tuesday from a report of dropping sales in mid October firmed up, all showing fractional gains.

The Dow Jones industrial average at noon was up 8.41 at 801.50.

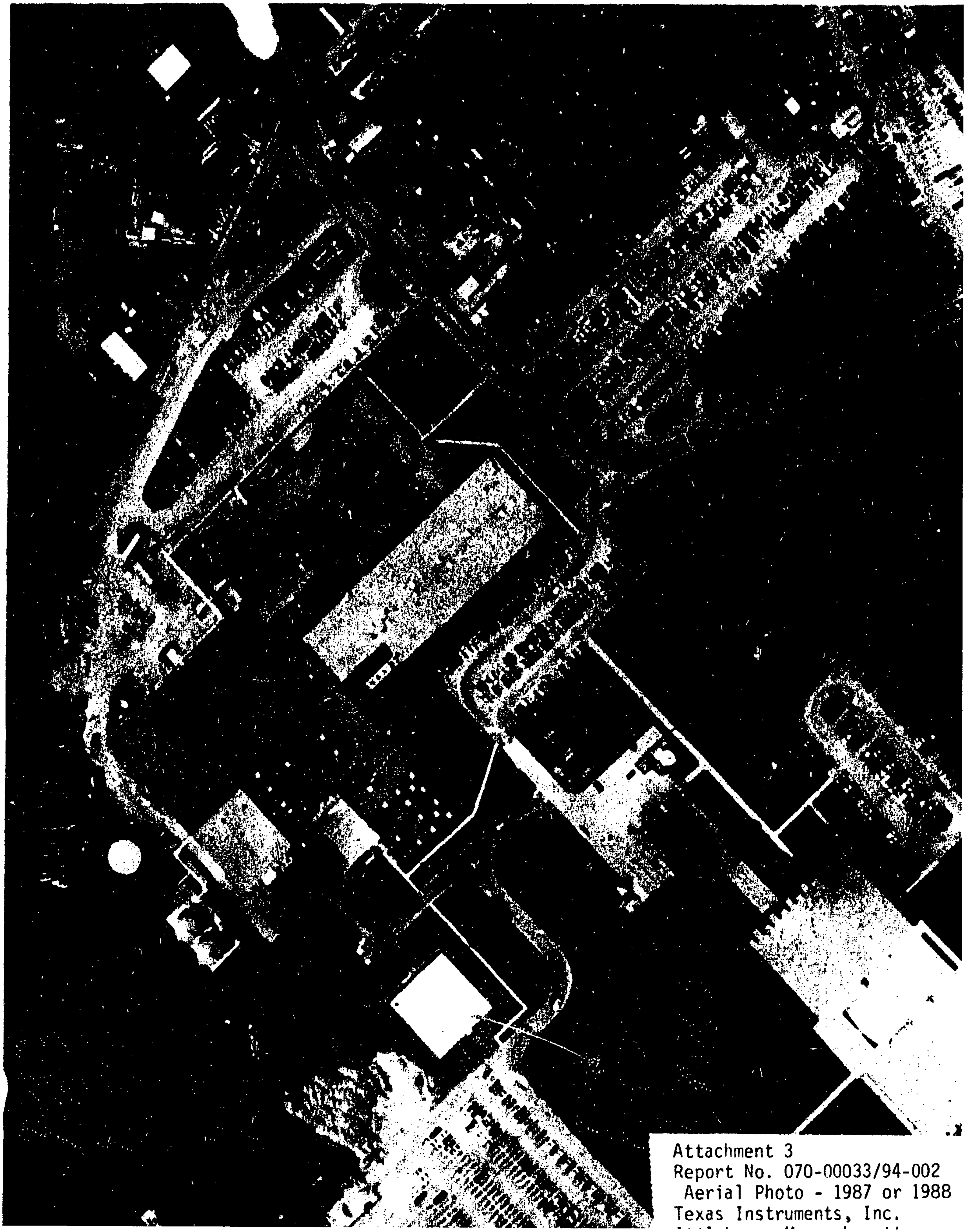
The Associated Press average of 60 stocks at noon was up 2.5 at 288.4 with industrials up 4.0, rails up 1.0 and utilities up 1.2.

Steels were ahead from the

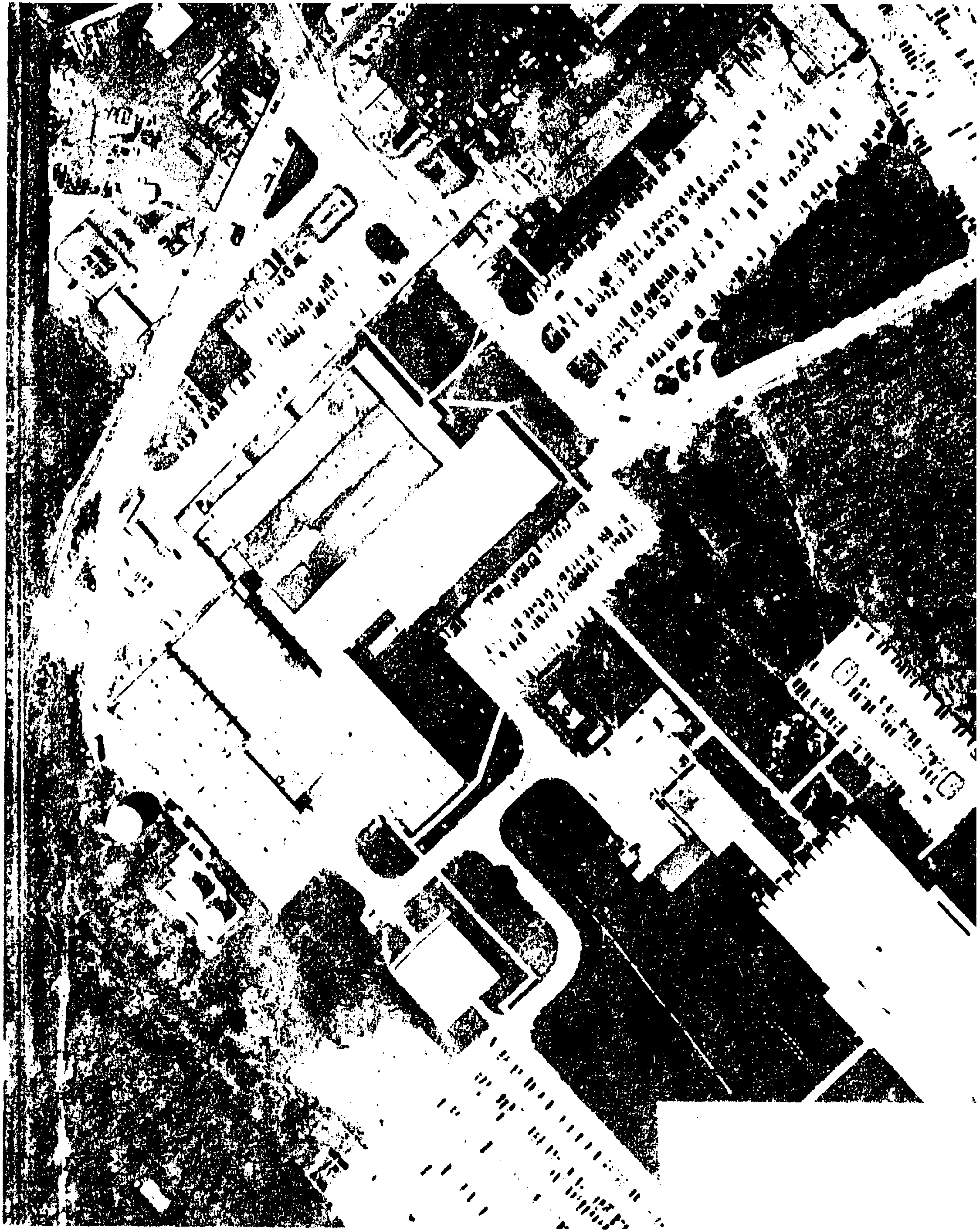
Attachment 1
Report No. 070-00033/94-002
Newspaper Article
... 26, 1966



Attachment 2
Report No. 070-00033/94-002
Aerial Photo - April 15, 1966



Attachment 3
Report No. 070-00033/94-002
Aerial Photo - 1987 or 1988
Texas Instruments, Inc.



U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 070-00033/94-002

Docket No. 070-00033

License No. SNM-23

Licensee: Texas Instruments, Inc.
34 Forest Avenue
Attleboro, Massachusetts 02703

Facility Name: Texas Instruments, Inc.

Inspection At: Texas Instruments, Inc.
Attleboro, Massachusetts

Fill area along Holden Street
Attleboro, Massachusetts

Inspection Conducted: August 24, 1994

Inspector: Mark C. Roberts 3-14-95
Mark C. Roberts, Senior Health Physicist Date

Approved by: John D. Kinneman 3-14-95
John D. Kinneman, Chief Date
Site Decommissioning Section

Areas Inspected: Announced special inspection to review possibility that licensed material was transferred to an area on Holden Street including a visit to Holden Street fill area in Attleboro; radiation measurements in the Holden Street fill area; site visit to Texas Instruments facility in Attleboro, review of aerial photographs and radiological survey data (radiological survey data provided in letter dated January 12. 1995); contact with the Attleboro Health Department to identify well water use. Final information for this report was received on February 22, 1995.

Results: It is unlikely that licensed radioactive material originating at the Texas Instruments, Attleboro, Massachusetts facility was transferred to the Holden Street fill area. No violations were identified.

DETAILS

1.0 Persons Contacted

*Michael Elliott, Environmental Manager, Texas Instruments, Inc.
*Jay Eidson, Site Management Consultant, CDM Federal Programs Corporation
*Mary McGarigle, Environmental Scientist, CDM Federal Programs Corporation
Carl Dorrance, Treasurer, Dorrance Excavating Contractor, Inc.
Emily Brunkhurst, Massachusetts Audubon Society (via telephone on September 12, 1994)
James P. Mooney, Health Agent Director, Attleboro Health Department (via telephone on February 15, 1995)
Paul Jost, Facilities Department, Texas Instruments, Inc. (via telephone on February 22, 1995)

*Denotes those present at exit interview.

2.0 Background

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The fill area is bordered by the Bungay River to the west, Holden Street to the north, Benefit Street to the east and to the south by the extension of Oak Street. The area is overgrown with dense vegetation and not readily accessible. With the permission of Mr. C. Dorrance, the group gained access to the fill area from the east by cutting down some of the vegetation to create a path to the fill area. Due to the significant vegetation, the terrain in the fill area was difficult to assess. However, the area appeared to be relatively level with some gentle undulations and a few small hillocks. The western edge of the parcel slopes toward the Bungay River. Numerous marshy areas were encountered during the walk around the property.

Mr. Dorrance estimated that the depth of the fill ranged from 0 to approximately 10 feet thick with a total volume of approximately 10,000 yd^3. The additions of fill were not documented nor was documentation required. Although the successive dumpings of fill were generally spread to maintain a relatively flat terrain, there was no apparent attempt to ensure that the fill was graded. A requirement that fill not

be dumped in the river was incorporated into later dumping permits that authorized the use of the area for the placement of fill. Mr. Dorrance stated that he was not aware of any dumping of fill into the Bungay River and that he thought such dumping unlikely since the area immediately adjacent to the river was too soft to allow for trucks or other equipment to drive without becoming stuck.

Mr. Dorrance also stated that soil from construction activities on the TI site in Attleboro was placed in the fill area. The soil removal activities were conducted in approximately 1976. At that time, Mr. Dorrance worked in the family business as a dump truck driver and he worked on that excavation project. Mr. Dorrance offered to identify the location at the TI Attleboro site where the soil was excavated and removed to the Holden Street fill area.

No safety concerns were identified.

4.0 Site Visit to Texas Instruments facility in Attleboro

The inspector requested and received permission from the Texas Instruments' representative for the group to meet at the TI site to examine possible locations where soil was removed from the TI site and transported to the fill area along Holden Street. Mr. Dorrance accompanied the group and identified the addition to Building 11 that lies south and east of the original building as the area that was excavated and from which the soil removed and placed in the Holden Street fill area. He stated that the excavation of the area was accomplished using a dragline; a large volume construction bucket suspended from a tall boom and dragged via a cable through the area to be excavated. The material captured by the bucket was then loaded into trucks for transport. This method is apparently useful for soft soil and shallow excavation depths. Mr. Dorrance stated that the excavated material that was removed appeared to be a dark soil, similar to the indigenous peat soil present in the area. The methodology used for soil removal and the appearance of the excavated material was independently confirmed through discussions with another representative from TI who was familiar with the project. He confirmed that the excavation was performed in approximately September 1976 through examination of construction drawings. Mr. Dorrance stated that this was the only location that he was aware on the TI Attleboro site where soil was removed and dumped at the Holden Street fill area.

No safety concerns were identified.

5.0 Radiation Measurements in the Holden Street Fill Area

The inspector made measurements of the exposure rate during the traverse of the Holden Street fill area using a Ludlum Model 19 Micro R Meter (NRC Serial No. 33513, calibration expires June 9, 1995). The exposure rates measured along Holden and Benefit Streets were approximately 11

μR/hour at one meter above the ground. The measured exposure rates throughout the Holden Street fill area were not distinguishable from this measured background exposure rate.

No safety concerns were identified.

6.0 Review of Aerial Photographs and Radiological Survey Data

An aerial photograph of the TI Attleboro site from April 15, 1966 and a second aerial photograph from approximately 1987 or 1988 (Attachments 2 and 3) were examined by the inspector. The 1966 photograph was taken prior to the construction of Building 12 and the additions to Building 11 since these structures do not appear in the photograph. The railroad spur is shown on the 1966 photograph. Discussions with TI representatives indicate that excavation of the railroad spur commenced in approximately November 1965. The burial area that lies between Building 11 and what is now Building 12 is also shown in the 1966 photograph. Construction on Building 12 commenced in the summer or fall of 1966.

From an examination of the 1966 photograph and a comparison to the 1987/88 photograph, it appears that the land where the southeast addition to Building 11 was constructed is undisturbed. This supports the information provided by Mr. Dorrance and the TI representative that the excavated material from this area in 1976 was the indigenous peat soil of the area.

Following the remediation of the burial area, between Buildings 11 and 12, confirmatory surveys including soil sampling and analyses were performed by ORISE (Oak Ridge Institute for Science and Education) in February 1994. The inspector reviewed the data from that survey. Total uranium concentrations in soil from the borings (typically taken at the surface and depths of 1 meter and 2 meters) beyond the southern and eastern perimeters of the burial area are all less than or equal to 10 pCi/gram. The data indicates that the burial area between Buildings 11 and 12 on the TI Attleboro site did not extend into the area that was excavated for the additions to Building 11.

The TI Environmental Manager stated that TI would perform walkover radiological survey of the entire site. The inspector requested that TI provide information concerning radiological measurements performed south and east of Building 11. This information was provided to Region 1 in a letter dated January 12, 1995. These surveys did not identify any locations in excess of 1.5 times the background exposure rate and thus no further sampling was performed.

No safety concerns were identified.

7.0 Contact with the Attleboro Health Department to Identify Well Water Use

The inspector contacted a representative from the Attleboro City Health Department for information concerning well water use in the vicinity of the Holden Street fill area. The Health Department representative stated that a city water well is immediately downstream of the Holden Street fill area, but that the well has not been used in approximately seven years and was recently capped. The well supplied potable water; however, the high iron content of the water causes the water to be undesirable to consume. The well was always a secondary source of water and was only used for short durations during peak demand in late summer. The entire community around the Holden Street fill area is served by the municipal water supply which obtains water from a different watershed area than the Bungay River area. The representative was not aware of any private wells in the area supplying drinking water.

No safety concerns were identified.

8.0 Conclusions Concerning Buried Licensed Material at Holden Street

Fill material consisting primarily of soil, rocks and tree trunks from numerous excavation projects, including one major construction project at the TI Attleboro site, was dumped by the property owner at a privately-owned parcel of land along Holden Street and the Bungay River in Attleboro. Discussions with a representative of Dorrance Excavating who performed these activities indicated that the material removed from the TI site was dumped at Holden Street in approximately 1976 and consisted of material that appeared to be similar to the indigenous peat-like soil found in the area. Neither this excavating company representative nor a TI representative were aware of any other movements of fill from the TI Attleboro site to Holden Street.

Inspection of the Holden Street fill area did not reveal the presence of any radioactive material or debris. Radiation exposure rates measured in the Holden Street fill area were not different than background radiation exposure rates made nearby the fill area. Metallic items reported to have been found at the Holden Street fill area ("Klixon" thermostatic disks manufactured by TI) do not contain radioactive material.

A review of available photographs and radiological survey data from the vicinity of the excavated area of the TI Attleboro site where soils were removed to the Holden Street fill area indicate that the area did not likely contain any significant quantity of licensed material.

All available information indicates that the soil removed from the TI Attleboro site and placed at the Holden Street fill area does not contain licensed radioactive material.

9.0 Exit Interview

The results of the inspection were discussed with the licensee representative identified in Section 1.0.

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...V. LaPointe, 26, of ...rt Ave., Pawtucket, ...ced to one year in ... of correction and ...fter being found guil... ...arge of operating to...

... appealed the find... ...ail was set at $100 ... F. Williams of 437 ... North Attleboro, had ...mplaint against him ... Nov. 29.

...s of speeding, op... ...out a license, oper... registered and unin... ... vehicle and carry... without a permit ...gory W. Carter of ...ry St., Boston were ... Nov. 15.

...ICT, TAUNTON

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... Patrolman Herbert ...d the two had tak... ...t later was involved ...ent on Pine Street, ...ct. 8.

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... suffered a crip... ...ttack in 1955 but, ...ned to a wheel... ...action to a four... ...mayor in 1959 and ...ed in 1963. Last ...s defeated by for... ...dicott Peabody in ... Democratic nom... ...e U.S. Senate.

...und of Worcester, New England En... ...facturing Co., was ...ent of the society ... Paul Sonnabend, ...s president of Ho... America, who was ... board of trustees ...

...ing through the ...ll from the Al... Pacific travel west ...

Views Mixed On Plan To Fill Marshland

Voices of proponents and opponents were strong last night before a mayor's public hearing as to whether Melvin G. Dorrance, 17 Dorrance St., should be allowed to dump fill into marshland next to the Bungay River, off of Holden Street.

Because of the Hatch Act — a state law relative to the preservation of wetlands, marshlands and inland water ways — which went into effect a year ago Dorrance asked for the hearing before the city executive, as now required by law, in order to continue dumping fill in the marsh land, now owned by his wife, Annie.

Atty. John P. Lee of Attleboro, representing Mrs. Dorrance, told Mayor Thomas A. Piggott that the purpose of filling the lowland was to prepare it for future residential development.

Official Opposition

Raymond A. Moreau, chairman of the Attleboro Conservation Commission, opposed strongly by expressing fear that the heavy fill on the peat moss ground would force the soft river bed to rise and obstruct the river's course. He also noted that a marshland is Nature's way of supplying water to the wells "and we would be cutting our own throats to allow that land to be filled."

Mrs. Roger K. Richardson, 275 Wilmarth St., reported concern over sewage disposal if a housing development was placed there.

"It's not practical to have cesspools in a peat bog," said Leslie R. Gage, 52 Crossman Ave., indicating that the cesspools there would run into the Bungay River.

John A. Siddall Jr., 151 Holden St., supported Moreau's opposition. John G. Oliver, 33 Crossman St., said the fill being dumped by Dorrance in the area is "too soft" to build cellar holes.

Fill Too High

Arthur P. Schneider, 82 Benefit St., whose land abuts the marshland, expressed concern that the fill was higher than his land; therefore feared that rain water would not follow a natural course into the river but remain stagnant on his property.

Richard H. Sweet, 4 Crossman Ave., complained of the dust created by the Dorrance trucks traveling to and from the marshland.

"We live in the middle of a dust bowl," he said. "Aren't those trucks supposed to be covered or wetted down?"

Mrs. Lucia B. Smith, 159 Holden St., asked how cellars for homes over a fill could be dug when some of the fill is tree trunks "bigger than your trunks."

"We'll just build split level houses in those places," Dorrance replied.

Contours Controlled

James A. Freeman of Attleboro, a private civil engineer hired by Dorrance, told Mayor Piggott that he has attempted to develop the contours of the land; fill ... so that the water would always shed toward the river.

"To the best of my knowledge these contours have not interfered with the lands of abutting home owners," Freeman said. He did not that the contour next to the Schneider property was about two feet higher but assured Schneider that an adjustment would be made so that water would run off of his property toward the river.

The engineer said that the filled area would make a "fine" residential development "if up to the grades of the contours I present" and that it would work well toward the best interests of the city.

Dorrance noted that the area is four acres, one and one-half of which still has to be filled. He estimated that "about 25,000 square yards of fill will be needed to do the job. Rough estimates by Freeman placed the amount at about 40,000. Dorrance estimated the area would be completely filled, his attorney indicated it would take another three years.

Sewer System

As to sewage disposal for a possible development, Dorrance said he would install a complete sewer system to be hooked onto the city's system and would install the necessary pumping facilities if necessary. As to the soft fill being dumped, he said, "I admit it's soft when it is dumped, but when it dries out it's ok for cellar holes."

The contractor said he has been dumping fill in the marsh land since 1956. The fill has included black soil, rocks and tree stumps. Most of the waste has come from excavation work he has done at schools in the city, he said.

Dorrance said he didn't believe the fill would force the soft river bottom to rise. Freeman said however, that if that should happen he was sure that Dorrance would celar the river.

Offers To Sell

Moreau also indicated that marshlands were valuable in obstructing flash floods going down a river. The discussion between him and Dorrance became somewhat heated over that point.

"If you're so concerned about that, then why doesn't the city buy that land?" Dorrance asked.

"If the land is for sale, then we're interested," replied Moreau.

Lee requested Mayor Piggott to do much study and discussion with state officials and local persons involved before making his decision.

The mayor said, after the hearing, that he would study the verbatim notes, obtained by a stenographer, and discuss the situation with the Attleboro Board of Health, the state Conservation Commission and the Department of Public Works before making a decision on Mrs. Dorrance's petition to continue dumping fill into the marshland.

Home Owners' Hopes Hinge On 'Yes 5', Taxpayers Told

The most important vote to be case by any citizen in the upcoming election will be a "Yes" vote on Referenda Question No. Five, James Zora, Attleboro chairman of the Mass. Committee for Cities, Towns and Schools told members of the Attleboro Association for Fair Taxes last night.

Rep. Donald Bliss warned the assembly that there is grave danger that the sales tax now sustaining the hopes of people who are small home owners, most of them with children in school, for keeping their tax rate within reason, may be defeated on Nov. 8.

If a "No" vote prevails there will be almost chaos in the government of the Commonwealth for the balance of the year or until some emergency provision is made by the legislature to provide means of bringing revenue to keep the cities, towns and schools operating, both Bliss and Zora told the group meeting in the high school cafeteria.

Both speakers urged listeners to constitute themselves a determined committee of one to urge every neighbor, relative and friend to be sure to vote on Question Five — and favorably — Nov. 8. The too-often seen ... continuance of the sales tax, the speakers pointed out.

Loss of the income from the sales tax could mean an increase in real property and personal taxes, a rise in the state income tax, and for those who may be rent payers rather than property owners, a sharp jump in the cost of living quarters, Zora pointed out.

Rep. Bliss said that the majority of the members of the House of Representatives strongly favor retention of the sales tax. Democratic representatives strongly supported the governor in his call for the sales tax, and will again if they are called upon, Bliss said. The question of Senate support is precarious though so the surest way is to vote continuance on the referenda, he added.

A central headquarters for workers in behalf of the sales tax continuance will be established at 40 South Main St. within hours, Zora announced. He invited all to come in and join the group which is planning a strong drive to ... a full vote on the quest...

MME. CHIANG HOME

TAIPEI, Formosa ... Mme. Chiang Kai-shek ...

... Passes Away

Matthias C. Galligan, 87, husband of Catherine A. (Lahey) Galligan of 70 Dunham St., died yesterday following an extended illness.

Mr. Galligan, long a sulky racer in the New England area, was born in Norton, a son of the late Michael and Julia (Leddy) Galligan and had worked at the Marathon Co.

Surviving besides his widow are four daughters, Sister Catherine Agnes, SUSC of Sacred Heart Convent, Fall River, Mrs. Albert A. (Helen) Robistow and Miss Angela Galligan, both of this city, and Mrs. Ruth Lang of Woodsville, N. H.; two sons, Edward F. and Charles Galligan, a sister, Miss Mary F. Galligan, all of this city, 13 grand and three great grandchildren.

The funeral will be conducted Friday morning from the Foley Funeral Home, with a requiem Mass at 9 o'clock in St. John the Evangelist Church and interment in St. John Cemetery.

William L. Sweetland Dies

PAWTUCKET — William L. Sweetland, 34, of 85 Hanover Ave., died yesterday at home following a long illness.

Born in Pawtucket, son of the late George T. and Mary (Wharton) Sweetland, he had been employed by the Jarvis Tap Co., North Attleboro, for 15 years and was a member of the Pawtucket Lodge of Elks. He was a communicant of St. Leo Church and a member of the parish bowling league.

He is survived by four sisters, Mrs. Walter Skawinski of Plainville, Mrs. Thomas Carberry of Torrence, Calif., Mrs. Thomas Dineen of Cumberland and Mrs. William Gray Jr. of Pawtucket; a brother, George P. Sweetland of Pawtucket.

The funeral will be held Friday from the Manning Heffern Funeral Home, with a solemn requiem Mass at 9 a.m. in St. Leo Church and burial in Mt. St. Mary Cemetery.

Rites Held For Mrs. A. B. Curry

SOUTH ATTLEBORO — A requiem Mass for Mrs. Annie B. (Ryan) Curry was celebrated this morning in St. Theresa Church by the Rev. Gerard Chabot. The Rev. Rene Gagne conducted the committal service in St. Francis Cemetery, Pawtucket. Serving as bearers were Frederick Gordon, Leo Fontaine, Ronald F., Dennis, Fred Jr. and Fred Clarke Sr.

Mrs. Curry, formerly of 143 Cumberland Ave. and widow of Edwin F. Curry, died Sunday.

Mass Sung For

In Attleboro

Tuberculosis is present in Attleboro, and its potential of spreading is becoming greater.

"Many people with the inactive germ are failing to take care of themselves," said Mrs. Dorothy McManus, public health nurse.

She noted that as of next week, there will be four Attleboreans confined to the T... hospital in Norfolk with the active disease.

Miss McManus said th... thought that TB had been wiped out in Attleboro due to new medicines, and the closing of the Bristol County TB Sanitorium in January 1963, "is false."

"A TB germ can be confined within a body through the use of the new medicines, and the person must not abuse his body," she said.

A germ can become active again if the person doesn't get the proper amount of food and sleep, drinks too much, smokes too much. Then the person has to be confined in the sanitorium until the germ is arrested.

Of the four with the active germ, two are being covered by insurance policies, another is paid by the family and the city pays the tab on the fourth one. It costs $27.78 per day per person to stay at the sanitorium. Most patients have to remain there about a year, depending on how they respond to the treatment. The Commonwealth pays half of the daily rate, leaving $13.89 per day to be paid by the family, insurance or city.

There are 81 persons presently in Attleboro who have histories of tuberculosis. Most are required to have an annual TB X-ray, others more often depending upon a doctor's orders. Each January, Miss McManus conducts a survey of these persons for the Central Tuberculosis Case Register, Boston, ...

In Wall Street

NEW YORK (AP) — Steel led the stock market to a vigorous rally with trading heavy early this afternoon.

The top steelmakers advanced more than 2 points each in response to the U.S. Steel dividend boost and Bethlehem's report of its biggest third quarter profits in history.

As trading warmed up the pace was the fastest of the week.

Analysts interpreted "Big Steel's" dividend hike as meaning that the company expected profits to rise in future quarters.

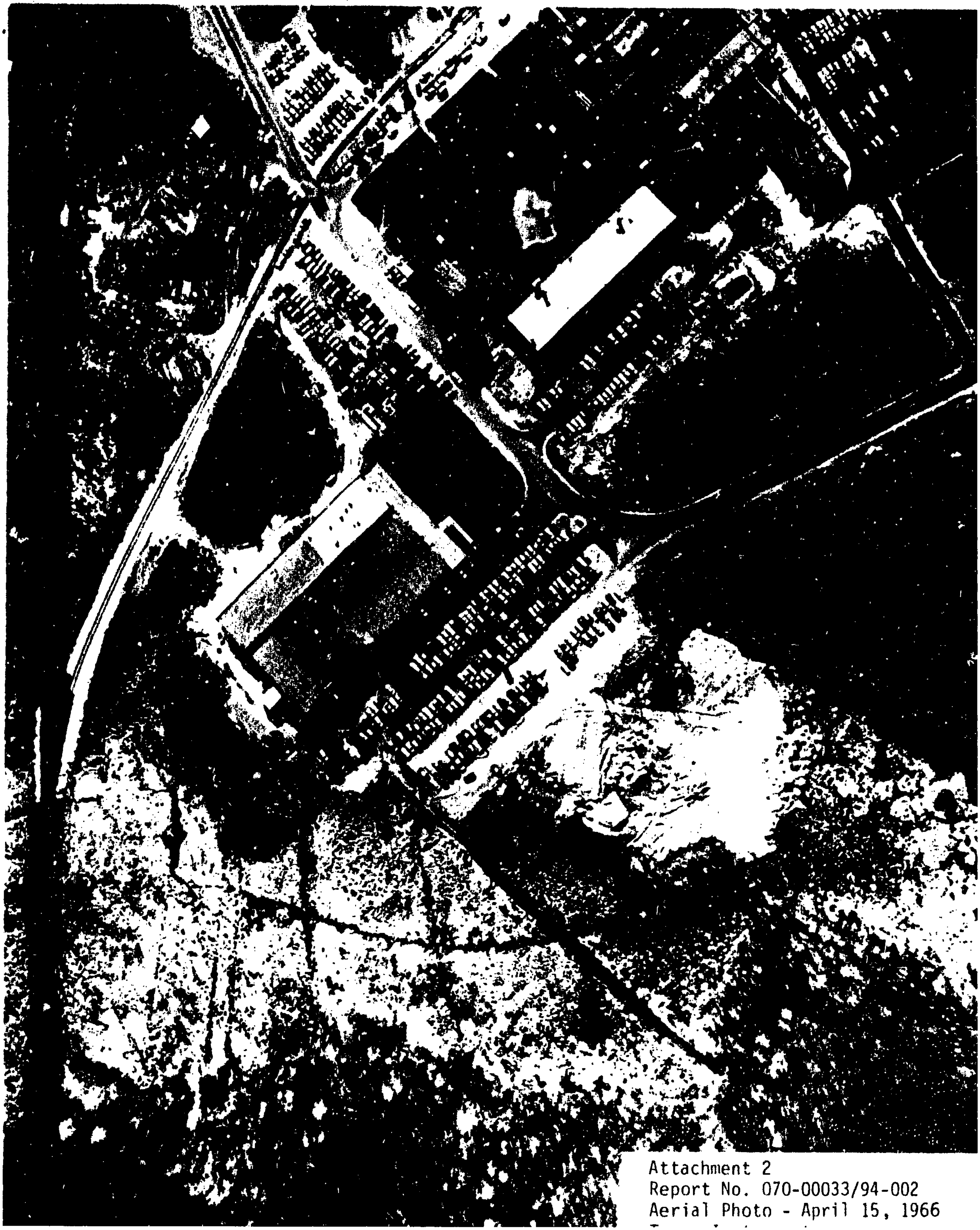
Big Three autos, which suffered Tuesday from a report of dropping sales in mid October, firmed up, all showing fractional gains.

The Dow Jones industrial average at noon was up 8.41 at 801.50.

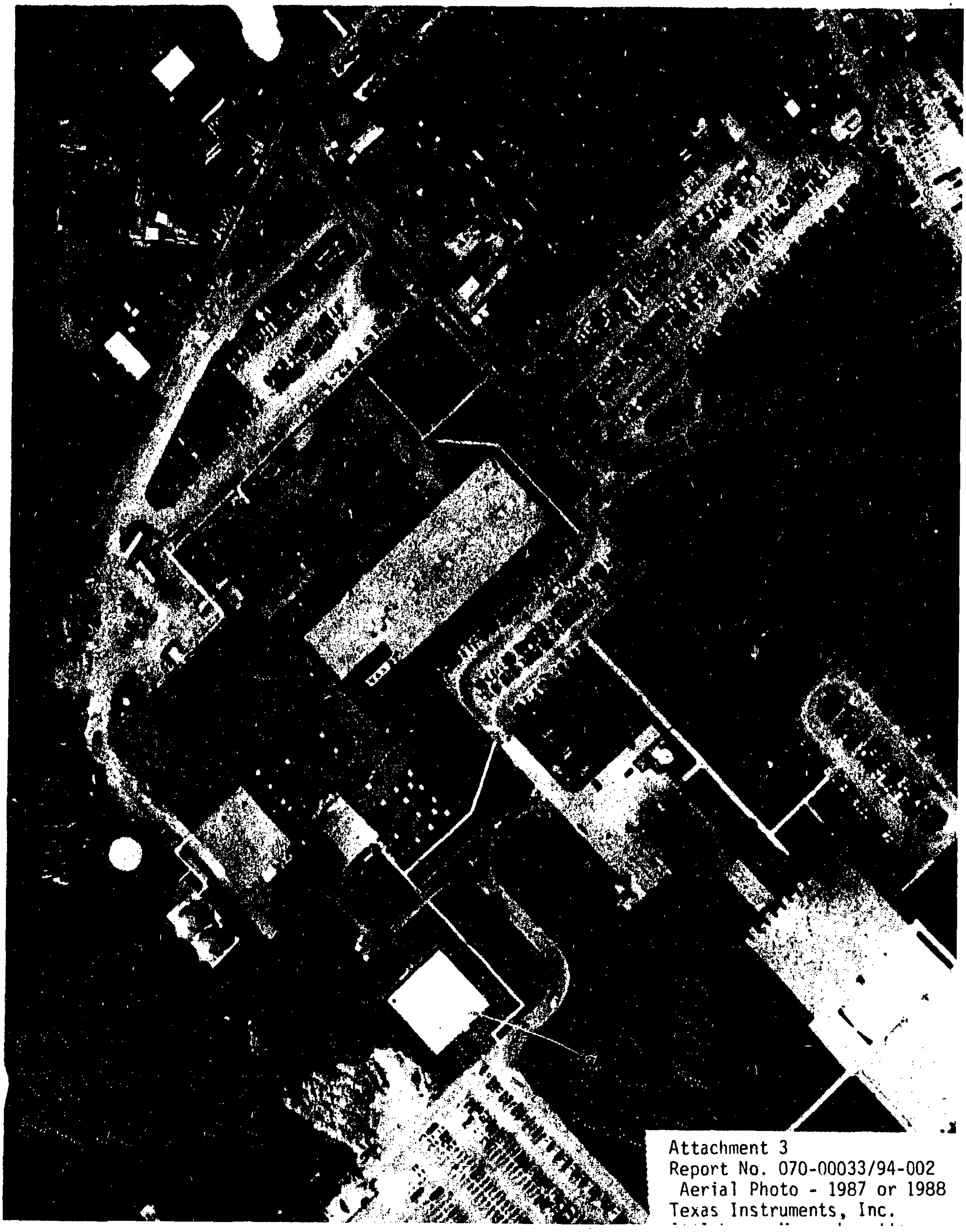
The Associated Press average of 60 stocks at noon was up 2.5 at 288.4 with industrials up 4.0, rails up 1.0 and utilities up 1.2.

Steels were ahead from the ...

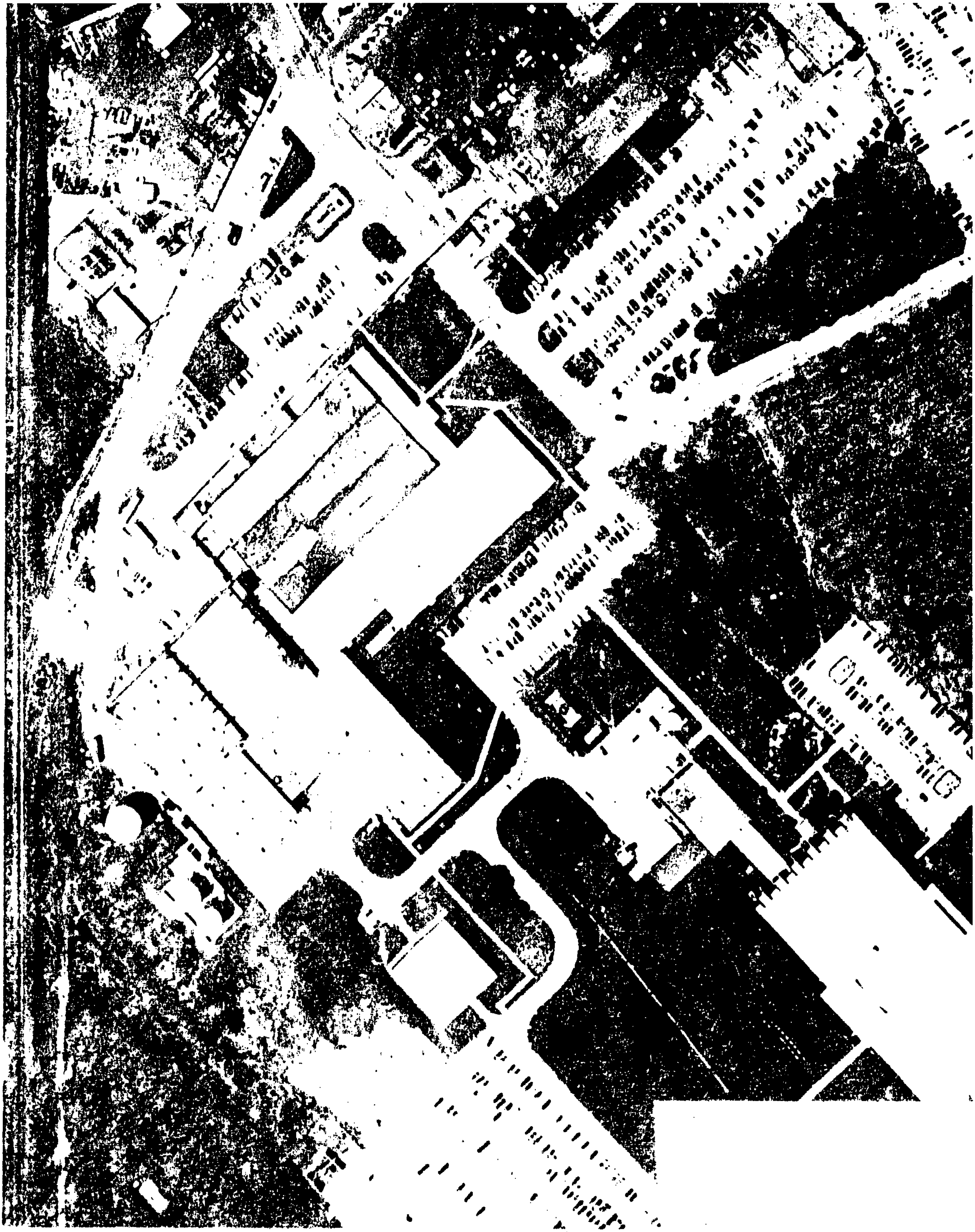
Attachment 1
Report No. 070-00033/94-002
Newspaper Article
... October 26, 1966



Attachment 2
Report No. 070-00033/94-002
Aerial Photo - April 15, 1966



Attachment 3
Report No. 070-00033/94-002
Aerial Photo - 1987 or 1988
Texas Instruments, Inc.



INAL TO

APR - 4 1995

Docket No. 070-00033 License No. SNM-23

Michael J. Elliott
Environmental Manager
Texas Instruments, Inc.
34 Forest Street
Attleboro, MA 02703

SUBJECT: ROUTINE INSPECTION NO. 070-00033/95-001

Dear Mr. Elliott:

On March 8 and 9, 1995, Mark C. Roberts of this office conducted a routine safety inspection at above address of activities authorized by the above listed NRC license. The inspection was an examination of your licensed activities as they relate to radiation safety and to compliance with the Commission's regulations and the license conditions. The inspection consisted of observations by the inspector and interviews with personnel. The findings of the inspection were discussed with you at the conclusion of the inspection. A copy of the NRC inspection report is enclosed.

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

In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and the enclosed report will be placed in the Public Document Room. No reply to this letter is required.

Your cooperation with us is appreciated.

Sincerely,

Original Signed By:
John D. Kinneman

John D. Kinneman, Chief
Site Decommissioning Section
Division of Radiation Safety
and Safeguards

Docket No. 070-00033
License No. SNM-23

Enclosure:
NRC Region I Inspection Report No. 070-00033/95-001

cc w/encl:
Commonwealth of Massachusetts

Distribution w/encl:
PUBLIC
Nuclear Safety Information Center (NSIC)
Region I Docket Room (w/concurrences)

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OFFICE	RI:DRSS	E	RI:DRSS							
NAME	Roberts/gxc/slj		Kinneman							
DATE	3/24/95		04/4/95							

OFFICIAL RECORD COPY

U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 070-00033/95-001

Docket No. 070-00033

License No. SNM-23

Licensee: Texas Instruments, Inc.
34 Forest Avenue
Attleboro, Massachusetts 02703

Facility Name: Texas Instruments, Inc.

Inspection At: Texas Instruments, Inc.
Attleboro, Massachusetts

Inspection Conducted: March 8-9, 1995

Inspector: Mark C. Roberts 3-31-95
Mark C. Roberts
Senior Health Physicist

Approved by: John D. Kinneman
John D. Kinneman, Chief
Site Decommissioning Section

Areas Inspected: Characterization and remediation of interior areas; characterization and remediation of exterior areas; ground water monitoring program.

Results: The licensee's characterization and remediation activities are proceeding in an effective fashion. No violations were identified.

DETAILS

1.0 Persons Contacted

*Michael Elliott, Environmental Manager, Texas Instruments, Inc.
Mark Griffon, CPS Environmental
Fred McWilliams, CPS Environmental

*Denotes those present at exit interview.

2.0 Background

The Texas Instruments, Inc. (TI) facility is located in Attleboro, Massachusetts, 48 kilometers (30 miles) south of Boston. The site is approximately 40 hectares (100 acres) with twelve major buildings. Operations with radioactive materials commenced at the site in 1952 when the General Plate Division of Metals and Controls, Inc. began to fabricate enriched uranium foils. That company merged with TI in 1959. Texas Instruments fabricated enriched uranium fuel elements for the U.S. Navy and commercial customers from 1959 through 1983. Depleted uranium was also used at the facility in research and development. The company no longer uses licensed radioactive material in its manufacturing operations.

Since 1985, TI has performed remediation on a number of areas of the site to remove residual radioactive contamination in buildings and surrounding exterior locations on the site. Remediation and final surveys of contaminated portions of Buildings 4 and 10 were completed in 1985 and are documented in various reports. The licensee has also completed a remediation project involving the removal of scrap material and equipment contaminated with uranium that was buried in a disposal area between Building 11 and what is now Building 12. Other exterior locations on the site were also contaminated with uranium as a result of the licensed operations. In particular, the metals recovery area near Building 5, where zirconium chips contaminated with uranium were incinerated, has recently been remediated. The licensee is in the process of completing the documentation of the final surveys performed in this area and expect to submit this report to Region I by the end of April 1995. The licensee has recently completed a radiological survey of the site, including interior areas, to determine if there is additional uranium contamination.

3.0 Characterization and Remediation of Interior Areas

Texas Instrument's radiological consultant, CPS Environmental, has performed radiological surveys in site buildings where licensed material had been previously used or stored. Although contamination in some of these buildings had been previously remediated, the licensee intends to survey all interior areas where licensed material was previously used. Buildings 10, 4 and 5 are the primary interior locations where licensed materials were used.

Building 10 previously housed the manufacturing operations for the production of uranium fuel elements for use by the U.S. Navy and for use in the High Flux Isotope Reactor (HFIR) Program. Since Building 10 is currently being used for manufacturing operations that do not involve licensed radioactive material, the licensee will clear a portion of the building (typically areas of approximately 100 m^2) and perform characterization, remediation and restoration of the discrete area. Once final surveys and restoration have been completed, the area will be returned to manufacturing use or will be used to receive material and equipment from another area where characterization must be performed. Characterization, remediation, final survey and restoration will be performed on each successive area until the Building is complete. The licensee intends to perform sufficiently detailed characterization measurements so that the results can serve as final surveys in areas that do not require remediation.

Manufacturing operations with licensed material were primarily carried out in the northeast and northwest corners of Building 10. Preliminary characterization measurements in the northeast corner of the building (the unclad manufacturing area) identified non-removable contamination levels as high as 50,000 - 60,000 dpm/100 cm^2 of enriched uranium. Activity was primarily associated with seams in the floor of adjoining slabs of concrete and a floor drain that was no longer in use. Lower levels of contamination were found in a pipe/utility trench running throughout the area. Characterization has been completed and remediation has commenced in the first of the cleared areas in the unclad manufacturing area. Remediation in this area has consisted of scabbling fixed surface contamination from a few square meters of the concrete floor, removing the contaminated concrete around a number of seams and cracks in the floor and removing an old floor drain and pipe elbow. In some locations beneath cracks or seams in the concrete, contaminated soil was also removed. Surveys in the drain line after the floor drain was removed did not identify any residual contamination. Based on the experience gained in this area, the licensee is investigating alternative remediation techniques that may include chemical decontamination or removal of contaminated concrete by a diamond wire cutting method.

Characterization measurements in the former HFIR fuel manufacturing section of Building 10 (northwest corner) also identified non-removable contamination in excess of the criteria for release for unrestricted use. The contamination in this area is generally of much lower levels and less widespread than in the unclad manufacturing area. A small area of contamination along the base of the connecting wall between Buildings 4 and 10 was also identified. This area is the site of a previous loading dock serving Building 4.

Building 4 was primarily used for research and development and a limited amount of manufacturing of uranium fuel prior to the construction of Building 10 in 1955. This building is also being used for manufacturing activities that do not involve licensed material. Characterization, remediation and restoration will also be done on small portions of the

building so that the routine operations are not significantly impacted. Licensed material was only used in a relatively small area of the building; therefore, not all of the building is being treated as an affected area. Preliminary characterization measurements indicate that contamination is very spotty and levels much lower than found in Building 10.

Building 5, a small building southeast of Building 4, previously housed a waste evaporator and collection tanks for contaminated waste water from Building 10. An incinerator for material contaminated with licensed material was also located in this building. The waste evaporator and incinerator were removed in approximately 1983. The entire building was surveyed and remediated during the remediation of the contaminated soil from the metals recovery area that is adjacent to this building. Contamination in excess of the criteria for release for unrestricted use was not found in Building 5; however, a portion of the floor of an addition to the building was removed to allow removal of contaminated soil associated with the remediation performed in the metals recovery area.

No safety concerns were identified.

4.0 Characterization and Remediation of Exterior Areas

As previously described in Inspection Report No. 070-00033/94-001, the licensee identified residual uranium contamination in soil in excess of the criteria for release for unrestricted use in the metals recovery area in the vicinity of Building 5. The contamination was apparently the result of the disposal of residue from the incineration of zirconium chips contaminated with uranium. This contamination was identified in late 1993. Characterization measurements during the first half of 1994 defined the extent of the contaminated soil. During 1994, approximately 100,000 ft^3 of contaminated soil was removed from this area and shipped to the Envirocare facility in Utah for disposal. The licensee has performed final survey measurements for the area and is preparing a final survey report. The licensee expects to transmit the report to Region I in April 1995.

Since the licensee had identified exterior soil contamination in the former burial area between Buildings 11 and 12 and in the metals recovery area, the licensee requested their radiological contractor to perform a walk-over radiation survey of the entire developed portion of the site. The licensee also interviewed current and former employees who were involved in early work involving licensed material at the facility. Based on the survey results and employee interviews, additional exterior areas were identified for further investigation to determine if contamination remained in the area. Sub-surface sampling and subsequent uranium analyses were performed to determine the extent and to quantify uranium soil contamination in the investigated areas.

An extensive area of soil contamination was identified in the stockade area, south of Building 10. The licensee estimates that the volume of contaminated soil in this area may exceed 50,000 ft^3. Remediation of this area will be complicated due to the presence of underground water and electrical utilities. Uranium contamination exceeds the criteria for release for unrestricted use in a smaller area on the south lawn of Building 12. The licensee expects to remediate these areas during the spring and summer of 1995.

Two small areas, a hill near Building 17 and a debris area east of Building 12; were also investigated and small volumes of contaminated soil were removed and disposed from each area. Soil was apparently placed in these areas during small construction projects in areas that were later found to have uranium contamination in excess of the criteria for release for unrestricted use. The area surrounding Building 10 was also identified as a suspect area since previous operations could have led to contamination of the soil outside the building. Analysis of surface and sub-surface soil samples from the perimeter of Building 10 did not identify soil contamination in excess of the criteria for release for unrestricted use.

No safety concerns were identified.

5.0 Ground Water Monitoring Program

Texas Instruments currently has 63 on-site monitoring wells and 13 off-site monitoring wells in place. The wells are not routinely sampled except for a group near Building 3 that are being sampled for non-radiological parameters. Most of the wells were last sampled and analyzed for radiological parameters in approximately 1983. However, wells surrounding the burial area between Buildings 11 and 12 were sampled and analyzed for gross alpha and gross beta activities in 1993. All 1993 results were less than the EPA drinking water criteria of 15 pCi/liter for gross alpha activity and 50 pCi/liter for gross beta activity.

Texas Instruments intends to sample the wells that are down-gradient of each remediated area. Water samples will be filtered prior to performing gross alpha and gross beta analyses. The sensitivity of the analyses will be sufficient to meet the EPA drinking water criteria described above. If the gross alpha or gross beta results exceed the above values, a specific analysis for uranium will be performed on the sample. Monitoring well sampling is expected to commence in the second quarter of 1995.

No safety concerns were identified.

6.0 Exit Interview

The results of the inspection were discussed with the licensee representative identified in Section 1.