UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PENNSYLVANIA 19406-1415

March 20, 1997

Michael Elliott
Environmental Manager
Texas Instruments, Inc.
34 Forest Street
Attleboro, Massachusetts 02703

SUBJECT: INSPECTION NO. 070-00033/97-001

Dear Mr. Elliott:

On February 3-6, 1997, Anthony Dimitriadis and Mark Roberts of this office conducted a safety inspection at the Texas Instruments, Inc. facility in Attleboro, Massachusetts of activities authorized by the NRC license listed below. The inspection was limited to observations by the inspectors, interviews with personnel, selective examination of records and confirmatory surveys inside Buildings 4, 5, and 10 and in exterior areas of the site. A copy of the NRC inspection report is enclosed. In addition, our inspection examined the activities covered in survey reports dated May 1995, August 1996, two from October 1996, January 1997, February 1997, February 11, 1997, February 24, 1997, and March 10, 1997. The findings of the inspection were discussed with James Armstrong, Francis Veale, Jr., your consultant Steve Shafer from Roy F. Weston, and you, at the conclusion of the inspection. Thomas O'Connell from the Commonwealth of Massachusetts, Department of Public Health - Radiation Control Program, assisted the inspectors and attended the exit meeting.

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

Please note that the enclosed inspection report does not constitute approval by the NRC for release of your facility for unrestricted use. The results of this inspection report, and all other applicable information available to the NRC, will be examined to determine if your facility may be released for unrestricted use by the reviewer who is responsible for amending your license.

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 will be placed in the Public Document Room. No reply to this letter is required.

A/32

ITEM # 32

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Your cooperation with us is appreciated.

Sincerely,

for Ronald R. Bellamy, Ph. D., Chief
Decommissioning and Laboratory Branch
Division of Nuclear Materials Safety

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

Enclosure:
Inspection Report No. 070-00033/97-001

cc w/enclosure:

Commonwealth of Massachusetts

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

INSPECTION REPORT

Report No. 070-00033/97-001

Docket No. 070-00033

License No. SNM-23

Licensee: Texas Instruments, Inc.
34 Forest Avenue
Attleboro, Massachusetts 02703

Inspection At: Texas Instruments, Inc.
Attleboro, Massachusetts

Inspection Conducted: February 3-6, 1997

Inspectors: _____ March 20, 1997
Anthony Dimitriadis date
Health Physicist

_____ March 20, 1997
Mark C. Roberts, CHP date
Senior Health Physicist

Approved By: _____ 3-20-97
for Ronald R. Bellamy, Ph. D., Chief date
Decommissioning and Laboratory Branch
Division of Nuclear Materials Safety

Inspection Summary: Announced, confirmatory survey at the licensee's Attleboro, Massachusetts facility (Inspection Report No. 070-00033/97-001)

Areas Inspected: Organization and scope of remediation project, confirmatory measurements in interior areas, confirmatory measurements in exterior areas, results of sample analysis, review of radiological survey and remediation documents.

Results: Radiological measurements did not identify any residual levels in excess of the criteria for release for unrestricted use. Sample results from 40 soil samples analyzed in the NRC regional laboratory confirmed the licensee's results. A small amount of contaminated soil or contamination on below-ground concrete surfaces was left in place in inaccessible areas that could not be further remediated because of their proximity to vital structures or utilities. Measurements in each of these areas were not different than ambient background measurements. Based on volume averaging, the inspectors determined that the average total uranium concentration in each of these areas is less than 30 picocuries per gram.

DETAILS

1. Individuals Contacted

* Michael Elliott, Environmental Manager, Texas Instruments, Inc. (TI)
* Francis Veale, Environmental Safety and Health Department Manager, TI
* James Armstrong, Operational Excellence Manager, TI
* Steve Shafer, Health Physicist (Exterior Remediation Project Manager), Roy F. Weston, Inc. (Weston)

Michael Madonia, Health Physicist (Interior Remediation Project Manager), Weston (via telephone on February 5, 1997)

* Thomas O'Connell, Health Physicist, Commonwealth of Massachusetts

* Denotes those present at exit meeting

2. Background

The TI facility is located in Attleboro, Massachusetts, approximately 16 kilometers (10 Miles) northeast of Providence, Rhode Island and 48 kilometers (30 miles) southwest of Boston. The site currently comprises eighteen buildings owned by TI on approximately 40 hectares (100 acres). Operations with radioactive material began at the site in 1952 when Metals and Controls, Inc. began to fabricate enriched uranium foils. Metals and Controls, Inc., merged with TI in 1959 and eventually was operated as a corporate division of TI. From 1952 through 1965, Metals and Controls (and later TI), under a variety of government contracts, fabricated enriched uranium fuel elements for the U.S. Naval Reactors Program, U.S. Air Force, other U.S. Government-funded research, and a few commercial customers. From 1965 through 1981, TI fabricated fuel for the High Flux Isotope Reactor at Oak Ridge National Laboratory and other government-owned research reactors. Depleted uranium and processed natural uranium were also used at the facility in research and development of the production methodologies. The facility remains operational in a variety of metallurgical production activities; however, radioactive material is no longer used in the company's manufacturing operations.

Operations with radioactive materials were initially conducted in portions of what is now Building 4, with very limited operations conducted in Building 3. In 1956, Metals and Controls constructed Building 10 on the site to house all work with radioactive materials. By 1957, all manufacturing operations were moved to Building 10. Waste handling, processing of scrap metal and residues, and treatment of waste acids and water were conducted in Building 5 and outside Building 5 in areas known as the Metals Recovery Area and the Stockade. A waste evaporator and an incinerator were operated in Building 5/Metals Recovery Area. Scrap and waste generated in the manufacturing processes were returned to the U. S. Government; however, some materials contaminated with low levels of radioactivity were disposed in a burial site adjacent to Building 11.
Following cessation of operations with radioactive materials in 1981, TI initiated remediation of uranium contamination in the buildings and surrounding exterior locations. Remediation and final surveys of contaminated portions of Buildings 4

and 10 were completed in 1985 and the NRC staff approved release of these buildings for unrestricted use. Residual radioactive contamination remained in the burial area east of Building 11 and west of the recently constructed Building 12. In 1990, the NRC listed the TI Attleboro, Massachusetts facility on the NRC Site Decommissioning Management Plan (SDMP) because of the presence of the residual contamination in the burial area. Region I staff approved a remediation plan for the burial area in 1992 and initial remediation was completed in December 1992. A confirmatory survey conducted by the Oak Ridge Institute for Science and Education (ORISE) in December 1992 identified some remaining contamination on the walls of the excavation. In July 1993, the licensee completed additional remediation activities. An ORISE confirmatory survey performed in December 1993 did not identify any remaining residual contamination in this burial area in excess of the current criteria for release for unrestricted use.

After completion of the remediation and survey of the burial area, TI identified soil contamination in three locations within the Metals Recovery Area. Remediation and sampling in this area during 1994 led to the determination that the three distinct contaminated areas were actually part of a single, larger contaminated area. Remediation of this area was completed in November 1994. After identification of the additional contamination in the Metals Recovery Area, Region I staff requested that TI perform a comprehensive survey of all potentially affected areas on the site. These comprehensive radiological surveys, performed in 1994 and 1995, and discussions with long-term employees, led to the identification of additional contaminated soil, primarily in the Stockade and Building 12 south lawn area. The contamination in the stockade area was likely due to the past handling and storage operations in the area. Contamination on the lawn of Building 12 was likely the result of intrusion into the burial area and the spread of contamination during final grading around the building. Residual contamination was identified in Buildings 4, 5, and 10, primarily where unclad uranium operations had been conducted. The contamination was primarily limited to cracks and joints in the concrete floor, areas around equipment installed in the concrete floor, and drain lines buried in or beneath the concrete floor. Remediation was performed in accordance with the 1992 plan for remediation of the burial area and a 1994 addendum.

Also, in approximately 1978, NRC confirmed the presence of radioactive contamination at the Shpack landfill in nearby Norton, Massachusetts. The source of this contamination may have been the result of work performed at the TI Attleboro facility, but the company has not acknowledged that its facility was the source of the material in the landfill. Although some residual radioactive material was removed from the closed landfill, further remediation for both radiological and chemical contaminants may still be required. In 1980, the landfill was listed on the U.S. Department of Energy (DOE) Formerly Utilized Site Remedial Action Program (FUSRAP), which will manage any remediation of radioactive materials. In addition, TI and several other companies have entered into a consent order with the U.S. Environmental Protection Agency (EPA) regarding the landfill.

3. Organization and Scope of Remediation Project

The site remediation project was coordinated by the Environmental Manager. This individual reports to the Environmental Safety and Health Manager who reports to the Site Manager. The remediation of the Metals Recovery Area was handled as one separate project and the remediation of the remainder of the exterior areas and all of the interior areas was handled as a second separate project. CPS Environmental, Inc. provided contractor health physics technical support and directed the excavation and drilling contractors based on the results of the radiation surveys and sample analysis. CPS, Environmental also performed the radiological characterization of the site. Roy F. Weston, Inc. provided project management for the remainder of the exterior remediation and the interior remediation. Two Weston project managers provided direct supervision of the support services including health physics, construction, transportation, and analytical services.

No safety concerns were identified.

4. Instrumentation Used in Confirmatory Surveys

The inspectors used a series of portable radiation survey meters and laboratory equipment to make confirmatory measurements. Ambient gamma radiation levels were measured with Ludlum Micro-R meters (NRC # 033513 and NRC # 019634, calibrated on December 5, 1996 and March 14, 1996, respectively). Unless otherwise indicated, these measurements were made at a distance of one meter above the ground or from the surface that was measured. Ambient exterior gamma radiation in the vicinity of the site ranged from 8 - 12 μR/hour. Background measurements inside Building 10 in unaffected areas ranged from 10 - 15 μR/hour. The higher range of values was generally measured in locations with newer concrete. Direct measurements for radioactive contamination were made at near contact with floor and wall surfaces using Ludlum Model 43-68 100 cm^2 gas-flow proportional detectors (NRC # 054810 and NRC # 057023) with Ludlum Model 18 rate-meters (NRC # 054822 and NRC # 054825, both calibrated March 4, 1996). Floor surfaces were scanned with Ludlum Model 239-1F floor monitors (NRC # 054976 and NRC # 054975 equipped with Ludlum Model 2221 scaler/rate-meters (NRC # 054826 and NRC # 054828, both calibrated March 14, 1996). The inspectors determined the operating voltages and detector efficiencies prior to the inspection and confirmed the efficiency and measured the background, for each detector, daily prior to initiating confirmatory measurements. The inspectors also measured higher background counts with the gas proportional detectors on the newer concrete. A 2" x 2" sodium iodide detector (Ludlum Model 44-10), coupled to one of the Ludlum Model 18 rate-meters, was used to make gross gamma measurements.

Soil samples from interior and exterior remediated areas were selected from archived samples in storage. Two additional soil samples were obtained directly from areas where characterization measurements indicated that the total uranium

concentration did not exceed the NRC guidelines for release for unrestricted use. Each soil sample was prepared for analysis in the Region I radioanalytical laboratory by drying and then milling the dried sample. An aliquot of each sample was weighed and transferred into a Marinelli beaker for gamma counting. Gamma counting was performed using a high-purity germanium detector (HpGe) that can quantify specific gamma emission energies from the sample. Analysis of the gamma spectrum and identification of radioactive isotopes is performed with a commercial software program. Results of the analysis of the soil samples were reported in units of picocuries/gram (pCi/g) with an uncertainty of one standard deviation for each radionuclide reported.

5. Confirmatory Measurements in Interior Areas

5.1. Measurements in Building 4

Building 4 is the largest of the manufacturing buildings on the site. A small portion of the building was used for uranium milling prior to the construction of Building 10. Approximately 12,000 ft^2 of this 295,000 ft^2 building required remediation. Gamma exposure rate measurements in the remediated area and in the area adjacent to the remediated area ranged from 6 - 12 μR/hour. With the exception of one area, these values were not distinguishable from background measurements in the building. The exposure rate measured along a stone walkway adjacent to the remediated area was as high as 18 μR/hour. The source of these slightly elevated readings appeared to be the natural stone used in the walkway. Scanning and direct measurements were performed with the gas-proportional detectors over approximately 100 percent of the accessible floor area in the remediated area. A large portion of the area adjacent to the remediated area was also scanned with the same instrumentation. With the exception of the stone walkway, all results were less than approximately 2000 dpm/100 cm^2. The area of the walkway exhibited elevated surface measurements, but appeared to be caused by naturally-occurring radioactive material in the rock.

The inspectors also performed gamma exposure rate measurements directly above drain pipes buried in or beneath the floor. These pipes had either been remediated by pressure washing or characterization readings indicated that contamination levels met the NRC guidance for release. All measurements were not different than the background measurements.

No safety concerns were identified.

5.2. Measurements in Building 5

Building 5 is a small building adjacent to the Metals Recovery Area. Remediation in Building 5 consisted of removal of approximately one third of the concrete floor of the building and removing contaminated soil

beneath the floor. Gamma exposure rate measurements in Building 5 ranged from 12 - 16 μR/hour. All scanning and direct measurements on the floor and lower wall surfaces were not distinguishable from background. Areas that had been remediated and areas where characterization data indicated that the surface criteria for release for unrestricted use was met were both included in the survey of this building. Because this is a small building, the entire floor surface was subject to the scanning measurements.

No safety concerns were identified.

5.3. Measurements in Building 10

Building 10 was the primary location for work with both clad and unclad licensed materials. The principle area within the building where the unclad material was used was the northern end of the building. Licensed material use in the remainder of the building was limited to storage and transportation support for the finished products. Following the remediation of contamination in 1981 and 1982, the building was converted to a number of other manufacturing uses. The recent decommissioning activities required remediation of approximately 40,000 ft^2 of the 168,000 ft^2 building. Most of the remediation performed required the removal and replacement of portions of the concrete slab, excavation and disposal of contaminated soil, and pressure washing or removal of contaminated drain lines.

Gamma exposure rates measured throughout the building ranged from 6 - 16 μR/hour. The higher values were generally measured in areas where there was newer concrete. The inspectors made scanning measurements throughout the remediated area and in the areas bordering the remediated area with the floor monitor. All areas were well below the release criterion of 5000 dpm/100 cm^2. The inspectors also performed gamma exposure rate measurements above the concrete slab where drain pipes are buried in the floor. The pipes had either been cleaned or characterization measurements indicated that remediation was not required. The gamma exposure rate measurements in these areas were not different than those measured throughout the remainder of the building.

The licensee left residual contamination in place in eight inaccessible locations within the building. These areas are under or adjacent to vital structures or heavy equipment and consist of either contaminated soil or contamination on concrete surfaces. The depth of these locations ranges from one to 2.5 meters beneath the floor surface. Direct gamma measurements with the 2" x 2" NaI detector at the soil surface and exposure rate measurements with the Micro R-meter in each of these areas were also indistinguishable from background measurements.

Because Building 10 required the most significant remediation, the inspectors selected a number of archived, post-remediation samples for analysis in the NRC regional laboratory. The results of these analyses are discussed in section 7 of this inspection report.

No safety concerns were identified.

6. Confirmatory Measurements in Exterior Areas

The inspectors reviewed the characterization and post-remediation radiological survey data for the exterior areas of the TI site. The affected exterior area of the site was divided into approximately 300 grid cells, 10 meters x 10 meters. A total of 93 of the grid cells required remediation by removal of uranium contaminated soil in excess of the NRC criteria for release for unrestricted use. The inspectors made measurements with the 2" x 2" NaI gamma detector and the micro-R meter throughout the remediated area and in areas where the characterization data indicated that no remediation was required. All readings were not different than the background measurements on the site.

In thirteen of the remediated grid cells, at least one post-remediation sample from the grid cell exceeds the NRC unrestricted use criterion of 30 pCi/g total uranium. In all cases, the residual contamination is inaccessible due to the presence of critical utilities or structures that prevented complete removal of contaminated soil. This residual contamination is located from one to three meters below the surface of the soil. The inspectors made measurements with the 2" x 2" NaI gamma detector and the micro-R meter in each of these grid cells. Measured exposure rates ranged from 10 to 17 μR/hour. The highest reading was measured in the vicinity of a large sub-surface concrete structure which appeared to have contributed to the exposure rate. All other readings were not significantly different than local background levels.

No safety concerns were identified.

7. Results of Sample Analyses

As discussed in section 4 of this report, selected soil samples, primarily post-remediation samples, were analyzed by gamma spectrometry in the Region I analytical laboratory. Concentrations of uranium-235 and U-238 (reported as the concentrations of the thorium-234 and protactinium-234m decay progeny) for the forty soil samples are presented in Table 1. Because the gamma spectrometry analysis can not be used to quantify the uranium-234 concentration in a sample, some of the soil samples were submitted to ORISE, the NRC's contractor laboratory, for alpha spectrometry analysis. The alpha spectrometry analysis provided a quantitative measure of the U-235 and U-238 concentrations, as well as, the U-234 concentration. Results of the nine alpha spectrometry analyses are presented in Table 2. Licensee contractor data for these samples is also presented in Table 2.

The results of the gamma spectrometry analyses confirm that the facility meets the criteria for release for unrestricted use. The average total uranium concentration of the thirty-nine post remediation samples is approximately 11 pCi/g. The inspectors estimated the U-234 concentrations using ratios of U-238 to U-235 for each sample. One pre-remediation sample indicated a total uranium concentration of approximately 180 pCi/g. This value was in good agreement with the licensee contractor value of approximately 200 pCi/g. The area was later remediated to levels less than 30 pCi/g. Only two samples indicated estimated total uranium concentrations above 30 pCi/g. One sample from the Metals Recovery Area was approximately 31 pCi/g and appeared to be depleted uranium (the NRC guideline for depleted uranium is 35 pCi/g). A sample from the stockade area indicated an estimated concentration of 38 pCi/g. This value was in good agreement with the licensee's contractor values of 36, 15 and 45 pCi/g for this location. Although this value exceeded 30 pCi/g, volume averaging indicates that the total uranium concentration in this area meets the 30 pCi/g guideline.

The alpha spectrometry results in Table 2 show very good agreement with data from the licensee's contractors. Except for one sample from the Metals Recovery Area, the data also show very good agreement with the gamma spectrometry data. The disagreement in the sample data from the Metals Recovery Area was likely caused by a non-homogenous sample, because neither the U-235 nor the U-238 results are in agreement, and the alpha spectrometry analysis use a very small sample compared to the gamma spectrometry analysis. One sample from the Stockade Area slightly exceeded 30 pCi/g; however, this area also meets the NRC criteria based upon volume averaging for the grid cell.

No safety concerns were identified.

8. Review of Radiological Survey and Remediation Documents

8.1 Surveys of Open Land Areas

Because of the discovery of soil contamination in the burial area between Buildings 11 and 12 and the subsequent identification of soil contamination in the Metals Recovery Area adjacent to Building 5, TI conducted a comprehensive survey of exterior areas of the site. This systematic characterization survey of the affected and unaffected exterior areas of the site was conducted from July through September 1994 and was documented in a May 1995 report (Radiological Surveys of Open Land Areas, Texas Instruments Incorporated, Attleboro, Massachusetts). The survey included a 100 percent walkover survey of both the affected and unaffected areas of the site using a 2" x 2" NaI detector and rate-meter. The surveys were conducted by CPS, a contractor for TI. Undeveloped portions of the site were not surveyed.

Systematic surface and sub-surface soil samples were taken by a split spoon sampling apparatus and drill rig. Sampling was conducted at 1600

locations resulting in the collection of 5865 surface and sub-surface soil samples. Sample locations in affected areas were defined on a 10 meter x 10 meter (100 m^2) grid plan to ensure complete coverage of the affected area. Sampling in the Stockade Area was complicated by the presence of numerous underground electrical, communication, and water utilities and concrete supports for overhead structures. Designated sample points within some of the grid cells were moved short distances to avoid these obstacles. Unaffected areas were not sampled on a defined grid; however, thirty random sub-surface samples were collected in the unaffected areas. Samples were evaluated by the gross alpha soil analysis technique to identify total uranium concentrations. The soil sampling in the affected area identified eighty-five 100 $meter^2$ grid cells where soil contamination exceeded NRC guidelines for release for unrestricted use. One additional contaminated area was found in the unaffected area survey. This area, which bordered the Stockade Area, was remediated as part of the exterior remediation project in the Stockade Area.

Based on a review of the data in the characterization report, knowledge of the physical layout of the site obtained in previous inspections, and a prior review of the gross alpha counting technique (including the analysis of samples split with the NRC), the site was adequately characterized to identify locations where licensed material was used or may have been inadvertently disposed. TI's contractors and environmental staff interviewed a number of long-time employees to assist in determining the areas that were defined as affected.

No safety concerns were identified.

8.2 Remediation of the Metals Recovery Area

Radiological surveys in late 1993 and early 1994 identified soil contamination in the Metals Recovery Area. This area was formerly a waste handling area where an incinerator and a liquid waste evaporator were operated. Three initial areas were identified in this area and the contaminated soil volume was estimated to be approximately 425 m^3 (15,000 ft^3). The remediation activities conducted in this area led eventually to the disposal of 3300 m^3 (115,000 ft^3) of contaminated soil. Contamination was primarily limited to the top 15 cm of soil; however, excavation of contaminated soil down to approximately 2 meters was required in the area immediately adjacent to Building 5. The highest concentration of uranium identified in characterization and remediation samples was 17,000 pCi/g. Remediation activities were conducted from April 1994 through November 1994. A report summarizing the results of the remediation of the Metals Recovery Area was transmitted to the NRC in October 1996 (Texas Instruments Incorporated, Attleboro, Massachusetts - Remediation of the Metals Recovery Area, Final Report).

The results from the analysis of systematic surface and sub-surface soil samples from the excavated area and the perimeter of the excavated area; and exposure rate measurements indicate that the criterion for residual uranium concentration in soil (30 pCi/g) and the exposure rate criterion were both met. In one 9 meter x 9 meter grid cell, contaminated soil averaging 49 pCi/g total uranium was left in place around an electrical duct bank. Using a volumetric averaging method, the inspectors determined that this area was below the 30 pCi/g total uranium criterion when averaged over a one-meter thick vertical plain. Rain water that collected in the excavation was confirmed to be well below effluent criteria and was released. Contaminated soil was disposed at the Envirocare facility in Utah.

No safety concerns were identified.

8.3 Remediation of Exterior Areas Adjacent to Buildings 11 & 12

TI's contractor, Weston, coordinated the remediation of the exterior areas adjacent to Buildings 11 and 12 that were identified in the report on the Survey of the Open Land Areas. The burial area between Buildings 11 and 12 and the Metals Recovery Area were not included in this remediation project because they had been previously remediated by CPS and the results provided to Region I. Characterization data generated by CPS was used to identify the initial 77, 10 meter x 10 meter grid cells, requiring remediation. An additional 16 cells, adjacent to remediated cells, were eventually included in the remediation. The depth of the contaminated material ranged from the surface to approximately three meters (ten feet). Remediation activities on these exterior areas were conducted from June 1995 through December 1995. The results of the remediation activities were documented in an August 1996 report (Texas Instruments Incorporated, Attleboro, Massachusetts - Remediation of Exterior Areas Adjacent to Buildings 11 and 12, Final Report).

Remediation of contaminated soil in grid cells was accomplished by removing soil in approximately 30-centimeter (one-foot) sections within the grid cell. In areas where the surface soil was less than the criteria for release for unrestricted use, the soil was reserved for backfilling excavated areas where contaminated soil was removed. Contaminated soil was excavated and segregated for eventual disposal. Excavation continued until field measurements indicated that the unrestricted guidelines had been met. Thirteen check samples were then analyzed using a gross alpha screening technique. If the results of those analyses were acceptable, five verification samples (one from each quadrant of the cell and one from the center of the cell) were collected and analyzed and reported as the final verification sample. A composite of these samples was then sent to an off-site vendor for alpha spectrometry analysis.

Contaminated soil in excess of the NRC guidelines for release for unrestricted use was left in place in a few inaccessible locations. These areas are beneath vital structures or utilities and can not be further remediated without adversely affecting the structures. In all but three areas, the average total uranium soil concentration on the surface of the excavation met the averaging criteria for unrestricted use. In the other three locations, using a volumetric averaging method, the inspectors determined that these areas also met the 30 pCi/g release criteria.

No safety concerns were identified.

8.4 Surveys of Interior Areas in Buildings 4, 5, and 10

TI's contractor, Weston, also coordinated the remediation of the contaminated interior portions of Buildings 4, 5, and 10. Remediation activities on these interior areas were conducted from June 1995 through September 1996. The results of the remediation activities are documented in an October 1996 report (Texas Instruments Incorporated, Attleboro, Massachusetts - Remediation of Building Interiors, Buildings 4, 5, and 10).

The contaminated portions of the buildings were divided into eighteen (decontamination) areas based upon physical barriers and historical operations. The decontamination areas were further divided into 100 m^2 grids. A contaminated portion of the roof was similarly divided. Remediation activities primarily included scabbling contaminated concrete floors and removing portions of the concrete slab to excavate contaminated soil and remove contaminated drain lines. The total volume of waste disposed from the interior remediation project was 980 m^3 (34,600 ft^3). Final remediation soil samples were analyzed by an off-site laboratory for total uranium or isotopic uranium. Surface contamination measurements were performed with properly calibrated detectors with sufficient sensitivity to meet the NRC guidelines for surface contamination measurements.

Contaminated soil or surface contamination in excess of the NRC guidelines for release for unrestricted use was left in place in a few inaccessible locations. These areas are beneath structural column footings or under vital machinery and can not be further remediated without adversely affecting the building structure or some of the machinery in the building. In these locations, using a volumetric averaging method, the inspectors determined that these areas meet the 30 pCi/g release criteria. All other areas were also sufficiently remediated to meet the NRC criteria for release for unrestricted use.

Based on their review of this document, the inspectors requested additional information concerning the remediation activities for pipes left in

place and the evaluation of residual contamination. The inspector also requested that the licensee perform a dose evaluation of the residual contamination in the remediated drain lines. Based on the review of three documents prepared by Weston (Texas Instruments Incorporated Attleboro Facility - Building Interiors Remediation, Drainage System Characterization, January 1996; Drainage System Unrestricted Release Information - Supplemental Analyses, February 11, 1997; and SNM License Termination Hypothetical Radiological Dose and Exposure Rate Assessment, Priority 2 Drain Lines), the inspectors concluded that the residual activity in the priority 2 drain lines (drain lines that were cleaned by pressure washing) met the NRC guidelines for release for unrestricted use.

No safety concerns were identified.

8.5 Surveys of Building Interiors, Overhead Structures, and Upper Walls

As part of the characterization of the affected buildings, surveys of the building interiors, overhead structures, and upper walls were performed. Although data from these surveys were recorded, the surveys were not initially documented in a report. The results of the surveys were used to guide the remediation of contaminated portions of Buildings 4 and 10. The surveys were subsequently documented in a February 1997 report (Texas Instruments Incorporated, Attleboro, Massachusetts - Supplemental Surveys of Building Interiors, Overhead Structures and Upper Walls). Measurements included both direct measurements to evaluate non-removable contamination and smears to evaluate removable contamination. A review of this document confirmed that the upper portions of Buildings 3, 4, 10, and 11 meet the NRC guidelines for release for unrestricted use.

No safety concerns were identified.

8.6 Groundwater Radiological Monitoring Data Report

The chemical forms of uranium used at the site were primarily uranium oxides, uranium metal, and uranium metal alloys. These forms of uranium are generally not soluble. Groundwater monitoring data for the Texas Instrument site is summarized in a letter report (February 24, 1997 letter and four attachments to M. Roberts, NRC Region I from M. Elliott, Texas Instruments). Groundwater samples were collected from a series of representative monitoring wells on the site during January-March 1993, August-September 1995, and December-February 1996-1997. Gross alpha concentrations for the most recent samples ranged from less than detectable to 11 pCi/liter and gross beta concentrations ranged from less than detectable to 25 pCi/liter. These values are below the EPA groundwater screening criteria for gross alpha and gross beta activity of 15 and 50 pCi/liter, respectively. Results from the earlier samples were

less than the most recent samples. A specific uranium analysis was performed on selected samples in the recent sampling period. Measured total uranium concentrations ranged from 0.22 to 0.39 pCi/liter. These concentrations are below the EPA proposed primary drinking water limit of 30 pCi/liter for uranium, and are acceptable for releasing the site for unrestricted use.

No safety concerns were identified.

8.7 Dose Assessment

As discussed in sections 8.4 and 8.5, residual contamination was left in place in areas that were inaccessible because the remaining material was beneath critical utilities and structures. In order to conclude that there is no significant dose impact in leaving this material in place, and in order to satisfy the Commonwealth of Massachusetts requirement that the residual dose impact be less than 10 millirem per year, TI's contractor (Weston) performed a supplementary Radiological Dose Assessment of the interior and exterior areas. The results of this assessment are reported in a February 20, 1997 report (Texas Instruments, Incorporated - SNM License Termination, Radiological Dose Assessment). The assessment considered both a current exposure scenario and a future exposure scenario for members of the public. In each case, a maximum population group is considered.

The current exposure scenario was intrusion of a Texas Instruments' maintenance worker into any of the five primary source areas to perform maintenance in a trench. This scenario considers multiple exposure pathways including direct radiation exposure, inhalation of resuspended dusts and ingestion of contaminated soils. For conservatism, the area of highest residual contamination was used as the source term. The maintenance worker intrusion scenario resulted in an annual total effective dose equivalent of 1.3 millirem. The dose calculation was performed using a series of hand calculations. The contractor considered using the RESRAD-BUILD computer code for the calculations, but determined that the program was not readily applicable to the scenario.

The future use scenario considered closure of the site, removal of the industrial buildings and construction of a residence. The computer code RESRAD (version 5.62) was used to model the exposure pathways and calculate the dose from the scenario. The area with the highest average residual activity was selected for the calculations. The annual total effective dose equivalent for the future use residential scenario is 7.3 millirem for the first year, with the projected dose declining in future years.

No safety concerns were identified.

9. Exit Meeting

The results of the inspection were discussed with the individuals identified in Section 1 of this report.

TABLE 1

GAMMA SPECTROMETRY RESULTS OF SELECTED TEXAS INSTRUMENTS, INC., SOIL SAMPLES

[Results in Units of pCi/g dry ± 1σ]

Sample Identification Number	Location Description	Th-234	Pa-234m	U-235
40S 130E 120195,VER-0092C	Building 11 West Lawn	1.33 ± 0.10	1.0 ± 0.6	0.38 ± 0.02
30S 130E 120195, VER-0077C	Building 11 West Lawn	1.45 ± 0.09	1.0 ± 0.6	1.13 ± 0.03
20S 40E 112995, VER-0103	Stockade Area	7.4 ± 0.3	9.1 ± 0.9	1.05 ± 0.04
0110-06-6C-SS-01-00 TI 287	Building 10, Area 6	2.0 ± 0.3	4.4 ± 1.0	0.43 ± 0.04
0110-06-SC-SS-02-06-00 TI-278	Building 10, Area 6	4.88 ± 0.12	5.0 ± 0.8	0.39 ± 0.02
1214-12-6D-BSS(substation) TI-359 [a]	Building 10, Area 12	101.8 ± 0.7	111 ± 2	3.21 ± 0.06
01222-13-2C-SS-01-06-00 TI-359	Building 4, Area 13	0.4 ± 0.3	< 2	< 0.1
0110-06-5C-SS-03-06-00 TI-279	Building 10, Area 6	5.99 ± 0.11	6.7 ± 0.6	0.58 ± 0.03
0110-06-60-SS-01-06-00 TI-289	Building 10, Area 6	<0.5	1.2 ± 0.7	0.04 ± 0.02
1026-08-6B-SS-02-06-00 TI-062	Stockade Area	0.67 ± 0.09	1.3 ± 0.8	0.12 ± 0.02
120N21OE-09089S-VER-0022C	Adjacent to Building 12, Loading Dock	3.0 ± 0.2	2.5 ± 0.7	0.13 ± 0.03
60S 70E-10209S-VER-0041-C	Stockade Area	11.55 ± 0.11	11.3 ± 0.8	0.29 ± 0.02
100N 150E-092695-VER-0015-Ca	Building 11, East Lawn	2.1 ± 0.3	3.6 ± 0.9	0.08 ± 0.03
2050-112195-VER-0076-C	Stockade Area, near metals p	2.16 ± 0.08	2.3 ± 0.6	0.73 ± 0.02
200N 150E-073195-VER-0001-C	Building 12, Northwest Lawn	10.7 ± 0.4	12.1 ± 0.8	0.49 ± 0.03
110N 270E-082845-VER-0019-C	Building 12, South Lawn	1.54 ± 0.11	1.3 ± 0.7	0.10 ± 0.02
60S 40E-112895-VER-0061-C	Stockade Area	4.3 ± 0.3	5.7 0.8	0.25 ± 0.03
40S 140E 120195-VER-0093-C	Building 11, Lawn	1.45 ± 0.14	2.0 ± 1.0	0.48 ± 0.03
30S 40E 111495-VER-0064-C	Stockade Area	1.1 ± 0.3	2.3 ± 0.6	0.14 ± 0.03
110N 220E-091295-VER-0027-C	Adjacent to Building 12 Loading Dock	5.55 ± 0.09	5.2 ± 0.7	0.26 ± 0.02
30S 90E 1200195-VER-0052	Stockade Area	17.61 ± 0.13	18.7 ± 0.8	0.64 ± 0.03
40S 130E-120492-VER-0092-C13	Building 11, West Lawn	1.0 ± 0.3	1.4 ± 0.7	0.16 ± 0.03
20S 90E-120295-VER-0053-C	Stockade Area	13.60 ± 0.12	13.7 ± 0.9	0.58 ± 0.03
FGS 20S X90W TI-B5-FGC-0719-1676	Metals Recovery Area	2.54 ± 0.10	2.3 ± 0.6	0.16 ± 0.02
FSG 75SX0 1' TI-B5-FGC-0805-1744	Metals Recovery Area	6.76 ± 0.13	4.6 ± 0.7	0.45 ± 0.03

Sample Identification Number	Location Description	Th-234	Pa-234m	U-235
70N X110W 7-2-94 TI-B5-FGC-0702-1670	Metals Recovery Area	0.16 ± 0.13	1.3 ± 1.2	0.44 ± 0.04
68N X105W 7/1/94 TI-B5-FGC-0701-1659	Metals Recovery Area	< 1	< 4	0.22 ± 0.08
40S X35W 6" FGS TI-B5-FGC-0805-1764	Metals Recovery Area	1.04 ± 0.11	2.2 ± 0.6	0.06 ± 0.02
0119-14A-3F-SS-03-06-00 TI-330	Building 4, Area 14	0.5±0.3	<2	0.07±0.03
1130-12-6E-SS-01-06-00 TI-191	Building 10, Area 12	0.9 ± 0.3	1.8 ± 0.7	0.10 ± 0.03
1211-12-5F-BSS South Composite	Building 10, Area 12	0.8 ± 0.3	< 2	0.11 ± 0.03
0227-BLDG5-SS-02-06-00 TI-465	Building 5	1.67±0.12	1.9±0.7	0.36±0.03
0111-05-5B-SS-03-06-00 TI-293	Building 10, Area 5	2.61 ± 0.11	2.2 ± 0.7	0.33 ± 0.02
0111-05-6B-SS-04-06-00 TI-292	Building 10, Area 5	5.9±0.3	6.9±0.9	1.10±0.04
0104-12-5D-SS-03-06-00 TI-273	Building 10, Area 12	4.34 ± 0.08	4.2 ± 0.7	0.42 ± 0.03
0104-12-5E-SS-02-06-00 TI-272	Building 10, Area 12	17.63±0.13	18.4±0.9	0.54±0.02
0110-06-6C-SS-04-06-00 TI-288	Building 10, Area 6	5.88±0.09	5.9±0.7	0.61±0.02
1026-08-7B-SS-01-06-00	Building 10, Area 8	0.4±0.3	< 2	0.08±0.03
Building 12	Building 12 Lawn	1.21±0.11	1.0±0.7	0.06±0.02
Site Background	East of Building 12	0.72±0.08	1.1±0.8	0.09±0.02

(1) Pre-remediation sample

TABLE 2

COMPARISON OF ALPHA SPECTROMETRY RESULTS OF SELECTED TEXAS INSTRUMENTS, INC., SAMPLES

[Results in Units of pCi/g dry ± 2σ]

Sample Identification No.	Texas Inst. In-house Results (Total Uranium)	Licensee Contractor Results			NRC Contractor Results		
		U-234	U-235	U-238	U-234	U-235	U-238
20S 40E 112995, VER-0103	24 (1)	27.71 ± 6.62	1.12 ± 0.46	7.16 ± 1.54	29.1 ± 2.1	1.3 ± 0.2	8.6 ± 0.7
0110-06-6C-SS-01-00 TI 287	(2)	5.79 ± 1.22	0.29 ± 0.20	2.69 ± 0.69	8.3 ± 0.5	0.3 ± 0.06	2.1 ± 0.2
0110-06-SC-SS-02-06-00 TI-278	(2)	4.97 ± 1.25	0.33 ± 0.27	2.76 ± 0.83	10.4 ± 0.6	0.52 ± 0.07	5.1 ± 0.3
0110-06-5C-SS-03-06-00 TI-279	(2)	10.34 ± 2.11	0.34 ± 0.21	6.06 ± 1.33	16.2 ± 0.9	0.67 ± 0.08	6.9 ± 0.4
60S 70E-102095-VER-0041-C	9	5.2 ± 1.6	0.51 ± 0.28	12.2 ± 3.4	5.2 ± 0.3	0.42 ± 0.07	13.3 ± 0.8
100N 150E-092695-VER-0015-Ca	26	2.5 ± 0.89	0.07 ± 0.10	2.10 ± 0.76	2.8 ± 0.2	0.14 ± 0.04	2.3 ± 0.2
20S0-112195-VER-0076-C	21	8.7 ± 0.33	0.40 ± 0.22	8.5 ± 0.32	14.3 ± 0.8	0.56 ± 0.08	1.6 ± 0.1
FSG 75SX0 1' TI-B5-FGC-0805-1744	30	(3)	(3)	(3)	16.7 ± 1.0	0.77 ± 0.09	8.1 ± 0.5
70N X110W 7-2-94 TI-B5-FGC-0702-1670	10	(3)	(3)	(3)	11.0 ± 0.7	0.42 ± 0.07	0.33 ± 0.06

(1) Uncertainty for In-house result not calculated
(2) Only alpha spectrometry analysis performed on these samples by the licensee
(3) Alpha spectrometry analysis not performed on these samples by the licensee contractor