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CONFIRMATORY SURVEY OF PHASE II DECOMMISSIONING FORMER WASTE PROCESSING FACILITY GA TECHNOLOGIES SAN DIEGO, CALIFORNIA

P. R. COTTEN

Radiological Site Assessment Program
Manpower Education, Research, and Training Division

FINAL REPORT
MARCH 1988

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OF
PHASE II DECOMMISSIONING
FORMER WASTE PROCESSING FACILITY
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Final Report

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INTRODUCTION AND SITE HISTORY

In mid 1984, GA Technologies (GA) of San Diego, California, initiated decommissioning activities for the purpose of releasing portions of its facilities from Nuclear Regulatory Commission (NRC) licensing restrictions. Potential radiological contaminants at GA have been identified as enriched uranium, thorium, and longer half-life fission and activation products. Decommissioning of these facilities was separated into three phases. Phase I activities, which encompassed the Solar Evaporation Pond Area, the areas immediately surrounding the former Waste Processing Facility and the Incinerator Pad, a previous burial site for contaminated asphalt, the hillside and canyon below the waste handling facilities, and undeveloped land surrounding the waste processing facilities, were completed in late 1985. A confirmatory survey, performed by Oak Ridge Associated Universities in December 1985, identified small isolated areas in need of additional remedial action.[1] These areas have been addressed and discussed in a separate report.[2] Phase II consists of two major areas, the former Waste Processing Facility and the Incinerator Pad. Phase III consists of approximately 87 hectares (215 acres) of primarily undeveloped land, surrounding the main GA Technologies plant site: survey findings of these areas have also been described in a separate report.[3]

During July and August 1987, GA conducted decommissioning activities of the Phase II facilities. A report of GA's findings, issued in August 1987, indicates that the post-decontamination radiological conditions satisfy the NRC guidelines for decommissioning.[4]

At the request of the NRC, Region V Office, the Radiological Site Assessment Program of Oak Ridge Associated Universities (ORAU) conducted a radiological survey in September, 1987 to confirm the status of the Phase II area, relative to the NRC criteria for release for unrestricted use.

SITE DESCRIPTION

The GA Technologies facilities are located near the intersections of Interstate 5 and Genesee Road, approximately 20 km north of San Diego, CA (Figures 1 and 2). Site activities include a wide variety of research and development programs. The Phase II area, shown in Figure 3, is reached via the main access road from the plant entrance gate. This area includes the Waste Processing Facility, consisting of the upper and lower storage yards, and the Incinerator Pad site (Figure 4). Much of this area is paved with asphalt; also included are a truck scale and several concrete pads or foundations. Some of the original paving and pads have been removed during the decontamination operations. Located in the lower storage yard are two small buildings - the By-Products Storage Building and the Garage/Office Building. The By-Products Storage Building was utilized for sample preparation and storage before and during decommissioning activities. The garage area of the other building was also used for short-term storage of radioactive materials. The buildings are of simple construction; the By-Products Storage Building is constructed of corrugated metal and the Garage/Office Building is of wood frame. Both buildings have concrete floors.

PROCEDURES

A survey of the Phase II Decommissioning area was performed by the Radiological Site Assessment Program of ORAU during September 9-28, 1987. This survey was in accordance with a survey plan submitted to the Region V Office of the NRC.[5] Methods and procedures utilized in the survey are presented in this section.

Objectives

The objectives of the survey were to confirm that the radiological condition of the Phase II area was as presented in the GA Technologies report and to provide information and data for evaluation of the site status, relative to NRC guidelines for release for unrestricted use. Radiological information collected included gamma exposure rates; location of elevated direct radiation levels; concentrations of radionuclides in surface soil; and surface contamination levels.

Procedures

Document Review

The licensee's final survey report for the release of the Phase II area for unrestricted use and supporting documents were reviewed by ORAU. Data presented in these reports were compared to the established release guidelines.

Building Survey

Gridding

An alphanumeric 6 ft (1.8 m) x 6 ft (1.8 m) reference grid was established on the floor and lower walls (up to 6 ft (1.8) in each building. The grid baseline coordinates (A,0) were located in the southwest corner of each building. Figures 5 and 6 show the building layouts and reference grid systems used for this survey. Measurements on the upper walls and ceilings were referenced to the floor grid designation.

Surface Scans

Alpha, beta-gamma, and gamma scans were performed on floors, using an alpha/beta gas-proportional floor monitor and NaI(Tl) gamma scintillation detectors with audible indicating scaler/ratemeters. Scans of surfaces not accessible to the floor monitor, i.e., walls, ceilings, and overhead areas such as ledges, beams, piping, fixtures, and equipment were performed using portable ZnS alpha scintillation detectors and "Pancake" GM beta-gamma detectors. Areas indicating elevated radiation levels were marked for additional decontamination and for further measurements.

Measurement of Surface Contamination Levels

Approximately 20% of the grid blocks on the floor and lower walls of each building were randomly selected for surface contamination measurements. Blocks selected for these measurements are indicated on Figures 5 and 6. In each grid block surveyed, direct measurements of alpha and beta-gamma contamination levels were systematically performed at the center and four equidistant points, midway between the center and block corners. Smears for removable alpha and beta

contamination were performed at that location in each grid block, where the highest direct level was obtained.

Seven locations on upper walls, ceilings, fixtures, and equipment were selected for single-point measurements of total and removable alpha and beta-gamma contamination levels. These locations are identified on Figures 7 and 8. Direct measurements and/or smears were also obtained from elevated locations identified by surface scans.

Outside Area Survey

Gridding

In the upper and lower storage yards the licensee's 10 ft (3.0 m) grid system was reestablished at 30 ft (9.1 m) intervals (Figure 9) and the licensee's 3 ft (0.9 m) grid was used on the Incinerator Pad.

Surface Scans

Walkover gamma surface scans were conducted at 1 to 2 m intervals in the upper and lower storage yard and on the Incinerator Pad, using portable NaI(Tl) gamma scintillation detectors and ratemeters. The exposed surface of the wall; separating the upper and lower storage yards, was scanned using a "Pancake" GM detector coupled to a ratemeter. Scans of concrete pads and some larger areas of asphalt paving were performed using the alpha/beta gas proportional floor monitor. Locations of elevated radiation identified by the scans, were brought to the licensee's attention and marked for further evaluation.

Exposure Rate Measurements

Exposure rate measurements were made at the surface and at 1 m above surface at 30 ft (9.1 m) intervals in unpaved areas of the former Waste Processing Facility, at seven locations in the Incinerator Pad area, and at locations of elevated direct radiation, identified by the surface scans. Portable gamma scintillation detectors, calibrated onsite against a pressurized ionization chamber, were used for these measurements.

Measurement of Surface Contamination Levels

Total and removable alpha and beta-gamma contamination levels were measured at nine locations, on the concrete pads (Figure 10).

Sampling

Surface (0-15 cm) samples were collected from areas of exposed soil at 30 ft grid intervals throughout the area and at locations identified by surface scans. Following further cleanup by the licensee, followup soil samples were obtained.

Concrete coring was performed at the location on each concrete pad, where the highest direct measurement was obtained. These locations are indicated on Figure 10. Gamma monitoring of the soil beneath the removed core was performed to identify the presence of elevated radiation levels and soil samples were collected from the exposed surface. A sample of residue was also collected from a drain near the By-Products Storage Building (Figure 10).

Background and Baseline Measurements

During a previous site visit, measurements and soil samples were obtained in the vicinity of the GA Technologies plant to determine area background levels and baseline radionuclide concentrations for comparison purposes. Locations of the background measurements and baseline samples are shown on Figure 11. Tables 1 and 2 present the background exposure rates and baseline radionuclide concentrations, respectively.

Sample Analyses and Interpretation of Results

Samples were returned to laboratories in Oak Ridge, Tennessee, for analyses. All soil and residue samples were analyzed by gamma spectrometry. The major radionuclides of interests were Cs-137, Co-60, U-235, U-238, Th-228, Th-232, and Ra-226; however, spectra were reviewed for the presence of other significant photopeaks. Selected individual samples and composite samples were also analyzed for Sr-90 and isotopic uranium. Smears for the determination of removable contamination were analyzed for gross alpha and beta concentrations.

Additional information concerning analytical equipment and procedures is contained in Appendices A and B. Results of this survey were compared to the guidelines, established by the NRC, for decommissioning of the GA Technologies Waste Processing Facility. These guidelines are presented in Appendices C and D.

RESULTS

Document Review

ORAU's review of the survey report submitted by GA to the NRC, indicates that the procedures and instrumentation used were consistent with industry accepted practices. Sampling conducted by GA was primarily from the waste processing area, where contaminated soil was stored awaiting shipment, and in several locations where the potential for contamination was the highest, based on previous facility use history. The data developed by GA are within the NRC guidelines established for this decommissioning activity.

Building Survey

Surface Scans

Surface scans identified an area of residual contamination on the floor of the By-Products Storage Building. This location is indicated on Figure 12. According to site personnel a spill had occurred at this location during facility operations. No additional areas of elevated radiation were noted inside the buildings.

Surface Contamination Measurements

Table 3 summarizes the results of surface contamination measurements in the two buildings. The total contamination data presented in this table are direct measurements which include removable and non-removable activity. Total contamination levels in the By-Products Storage Building were higher than in the Garage/Office Building because the building had been used for sample preparation before and during decommissioning. At the floor location in the By-Products Storage Building identified by the surface scan, the highest total alpha and beta-gamma levels were 10,600 dpm/100 cm^2 and 17,800 dpm/100 cm^2, respectively.

These levels were reduced to <27 alpha dpm/100 cm^2 and 820 beta-gamma dpm/100 cm^2, after additional remedial actions by the licensee. At other locations in this building the individual alpha measurements ranged from <27 to 890 dpm/100 cm^2 and the individual beta-gamma measurements ranged from <470 to 3600 dpm/100 cm^2. Total alpha and beta-gamma contamination levels in the Garage/Office Building were generally less than the detection sensitivity of the instruments. Levels for alpha and beta-gamma ranged from <27 dpm/100 cm^2 to 130 dpm/100 cm^2 and <470 dpm/100 cm^2 to 2550 dpm/100 cm^2, respectively.

Removable alpha and beta contamination levels were also generally less than the measurement sensitivity. The highest level of removable alpha activity detected was 27 dpm/100 cm^2, on the floor in By-Products Storage Building; the highest beta level was 12 dpm/100 cm^2, on the floor in the Garage/Office Building.

Outside Area Survey

Surface Scans

Eight areas of elevated direct gamma radiation were identified by the surface scans. These areas are shown on Figure 13. The licensee performed additional remedial action at these locations and follow-up scanning indicated that cleanup of these locations had been effective in removing the contaminant.

Exposure Rate Measurements

Table 4 presents the results of exposure rate measurements at 30 ft (9.1 m) grid intervals. Levels ranged from 11 to 16 µR/h at 1 m above the surface and from 11 to 21 µR/h at surface contact. The highest levels were at grid coordinate 7300N, 9560E. Levels in the area of the Incinerator Pad ranged from 15 to 20 µR/h at 1 m above the surface and from 16 to 28 µR/h at surface contact. The highest levels were at grid coordinate 7585N, 9722E. Results are presented in Table 5. Exposure rates on the concrete pads ranged from 13 to 16 µR/h at 1 m above the surface and from 15 to 18 µR/h at contact (Table 6).

After further remediation of areas identified by surface scans, exposure rates were measured at each location. The maximum exposure rate measured was 20 µR/h at 1 m and 21 µR/h at the surface. The results of these measurements are presented in Table 7.

Surface Contamination Measurements

Table 8 summarizes surface contamination measurements on concrete pad foundations. Total contamination levels for alpha and beta-gamma ranged from <27 dpm/100 cm^2 to 1550 dpm/100 cm^2 and from 1240 dpm/100 cm^2 to 5390 dpm/100 cm^2, respectively. Removable contamination levels were generally less than the detection sensitivity of the instrument.

Radionuclide Concentrations in Soil

Concentrations of gamma emitting radionuclides, measured in surface soil samples from 30 ft (9.1 m) grid intervals, are presented in Table 9. Ranges of concentrations were: Co-60, <0.03 to 0.90 pCi/g; Cs-137, <0.02 to 9.54 pCi/g; Ra-226, 0.44 to 2.23 pCi/g; U-235, 0.05 to 1.26 pCi/g; U-238, 0.3 to 3.9 pCi/g; Th-228, 0.47 to 2.80 pCi/g; and Th-232, 0.41 to 2.70 pCi/g. Radionuclide concentrations in samples from the Incinerator Pad area are presented in Table 10. The highest levels of gamma emitting radionuclides measured in these samples were: Co-60, 1.37 pCi/g; Cs-137, 19.28 pCi/g; Ra-226, 1.74 pCi/g; U-235, 0.66 pCi/g; U-238, 1.31 pCi/g; Th-228, 2.11 pCi/g, and Th-232, 2.26 pCi/g. Radionuclide concentrations in soil samples obtained from beneath concrete pads (Table 11) were in the ranges of concentrations in baseline soil.

Table 12 presents the concentrations in samples from locations identified by surface scans, collected following further remedial action by the licensee. Maximum concentrations in these samples were Co-60, 1.77 pCi/g; Cs-137, 15.62 pCi/g; Ra-226, 1.32 pCi/g; U-235, 0.88 pCi/g; U-238, 2.1 pCi/g; Th-228, 2.64 pCi/g; and Th-232, 2.53 pCi/g.

Results of Sr-90 and isotopic uranium analyses performed on three composite samples, are presented in Table 13. The highest concentration of Sr-90 was 1.46 pCi/g in composite sample B. Isotopic uranium concentrations were 1.53 to 3.83 pCi/g of U-234; 0.05 to 0.16 pCi/g of U-235; and 1.04 to 2.19 pCi/g of U-238.

A soil sample, collected from beneath the concrete floor of the By-Products Storage, contained concentrations in the ranges of baseline soil. Data are presented in Table 14.

Miscellaneous Samples

Table 14 also presents the results of analyses on samples of drain residue and a piece of asphalt from the location on the Incinerator Pad, exhibiting an elevated gamma level. The Cs-137 level in the drain residue (2.41 pCi/g) was slightly elevated above baseline concentrations. Other radionuclide concentrations in the two samples did not differ from typical baseline levels.

COMPARISON OF SURVEY RESULTS WITH GUIDELINES

Guidelines for decommissioning the Former Waste Processing Facilities of GA Technologies are presented in Appendices C and D. Surface contamination limits, based on primary contaminants of Uranium, Cs-137, and Co-60, identified on this site, are:

Alpha

5000 dpm/100 cm^2, averaged over 1 m^2
15000 dpm/100 cm^2, maximum in 100 cm^2
1000 dpm/100 cm^2, removable

Beta-Gamma

5000 dpm/100 cm^2, averaged over 1 m^2
15000 dpm/100 cm^2, maximum in 100 cm^2
1000 dpm/100 cm^2, removable

Surveys of the two remaining buildings and concrete pads indicate that the surfaces satisfied these guidelines, with the exception of one small area on the floor of the By-Products Storage Building. Additional remedial action reduced this location to within the guideline levels.

Exposure rate guidelines limit the level at 1 m above the surface to 10 μR/h, above background, over an area of 30 ft (9.1 m) x 30 ft (9.1 m) or greater; the guideline level for smaller areas is 20 μR/h above background. At the GA Technologies Site, the total exposure rate guidelines are 19.7 μR/h and 29.7 μR/h, i.e., 10 μR/h and 20 μR/h, respectively, plus the average background level of

9.7 μR/h (from Table 1). One area, at the Incinerator Pad had an associated exposure rate of 20 μR/h at 1 m above the surface. Although this is slightly above the 19.7 μR/h average for areas in excess of 30 ft x 30 ft, this radiation was limited to a small isolated area and the exposure rate was less than 20 μR/h above background. All other measurements were well below 19.7 μR/h. The external exposure rate target guideline has therefore been satisfied.

Most samples collected from the site had radionuclide concentrations in the ranges of typical baseline soils from the La Jolla area. Only two samples contained radionuclide levels in excess of the guideline. One of these was a sample of soil from grid coordinate 7270N, 9543E; this sample, from an area of elevated direct radiation identified by surface scans, contained 15.62 pCi/g of Cs-137, as compared to the guideline level of 15 pCi/g. The other sample containing a concentration above guideline levels was from the Incinerator Pad area; this sample contained 19.28 pCi/g of Cs-137. At both of these locations the extent of contamination is limited to small isolated areas, based on results of surface gamma scans. Also, the exposure route from Cs-137 in surface soil is direct radiation; exposure rates measured at these locations were within guideline limits. The elevated Cs-137 concentrations, when averaged across adjacent land areas would be well within the 15 pCi/g guideline. Radionuclide concentrations in the soil therefore satisfy the guidelines established for this decommissioning project.

SUMMARY

At the request of the NRC Region V Office, on September 7-28, 1988, Oak Ridge Associated Universities performed a confirmatory survey of Phase II Decommissioning at GA Technologies, Inc. in San Diego, California. The survey included gamma, beta-gamma, and alpha scans; exposure rate measurements; measurements of total and removable surface contamination; and measurements of radionuclide concentrations in soil. The survey identified several small areas of residual contamination, which were promptly recleaned by the licensee and resurveyed by ORAU. Although there are several isolated locations of residual low-level soil contamination, the size of the involved areas and the associated levels are such that the concentrations can be averaged and the guidelines satisfied. It is therefore ORAU's opinion that the decontamination efforts by the licensee have been effective in meeting the radiological conditions established for release of this site for unrestricted use.

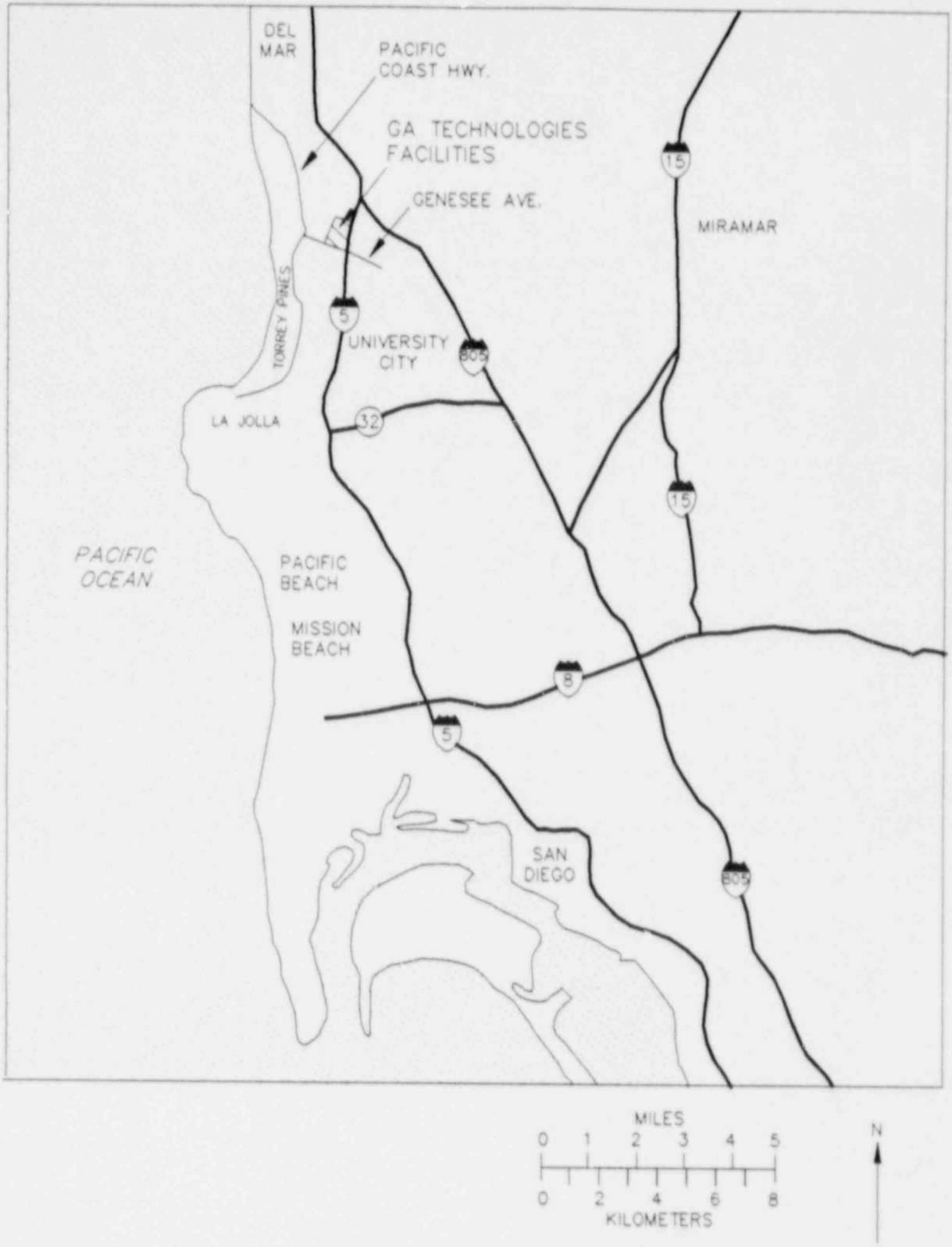


FIGURE 1: Map of San Diego Area, Indicating the Location of the GA Technologies Facilities

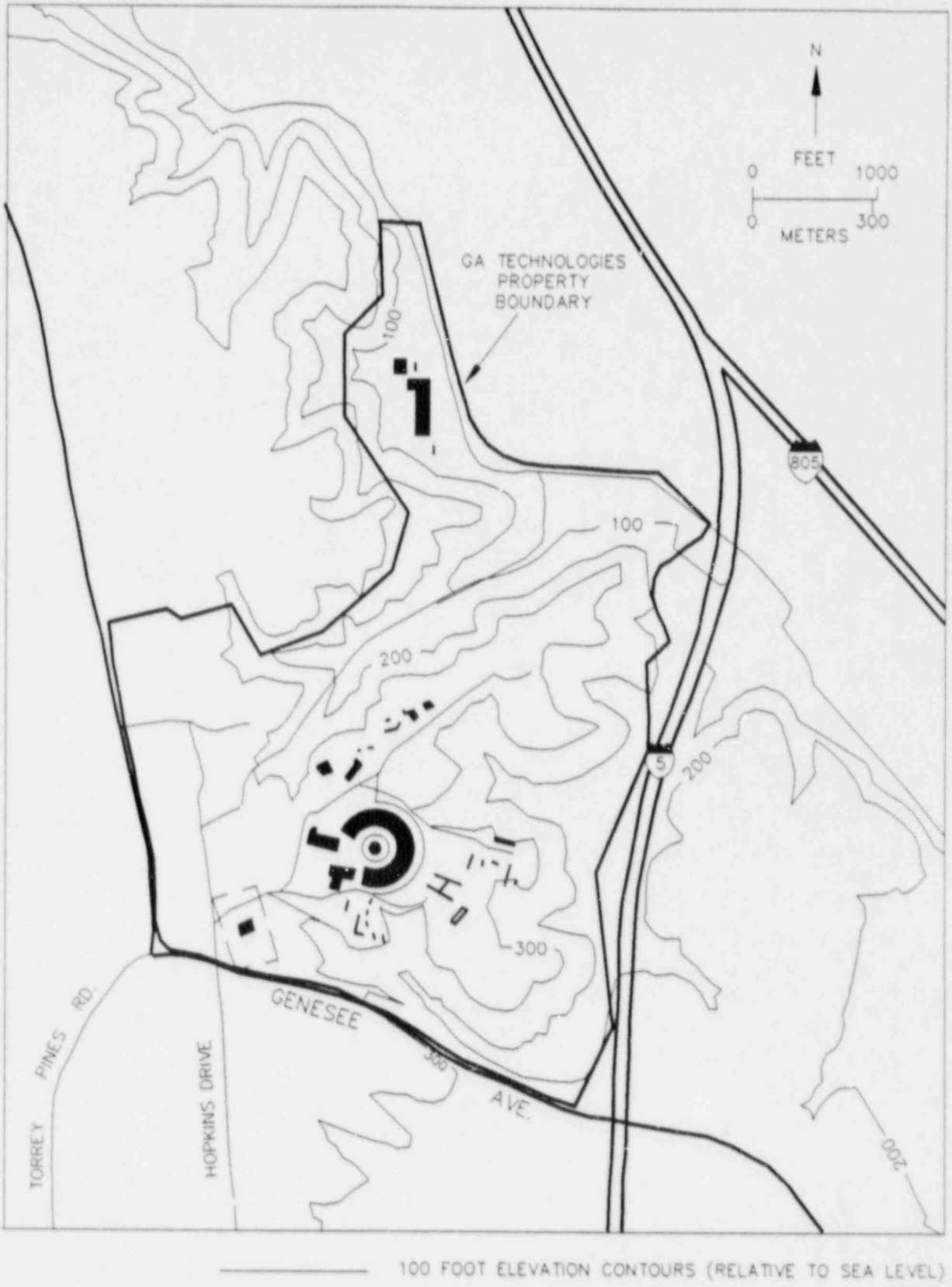


FIGURE 2: GA Techologies Plant Layout

GAT7b

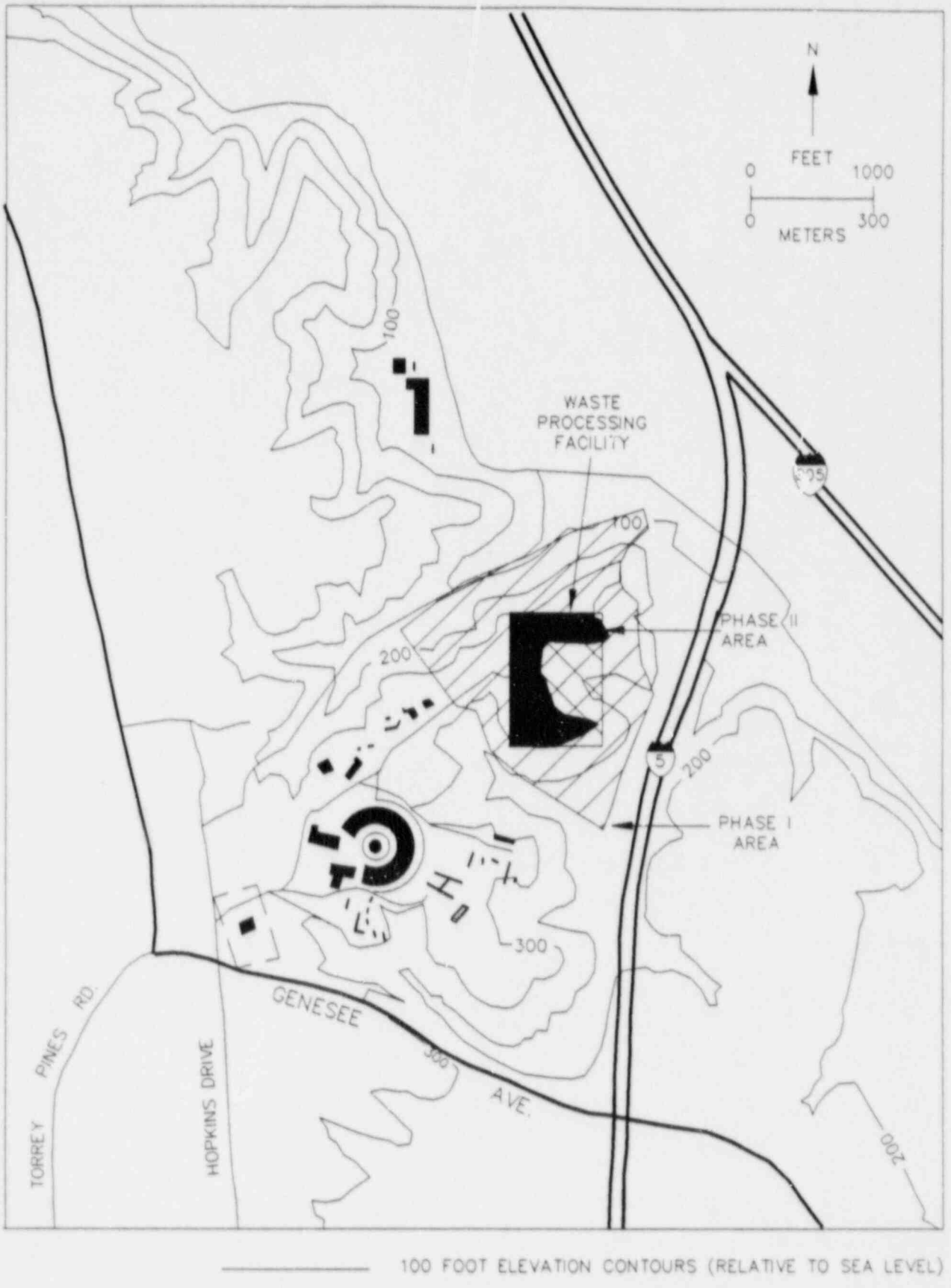
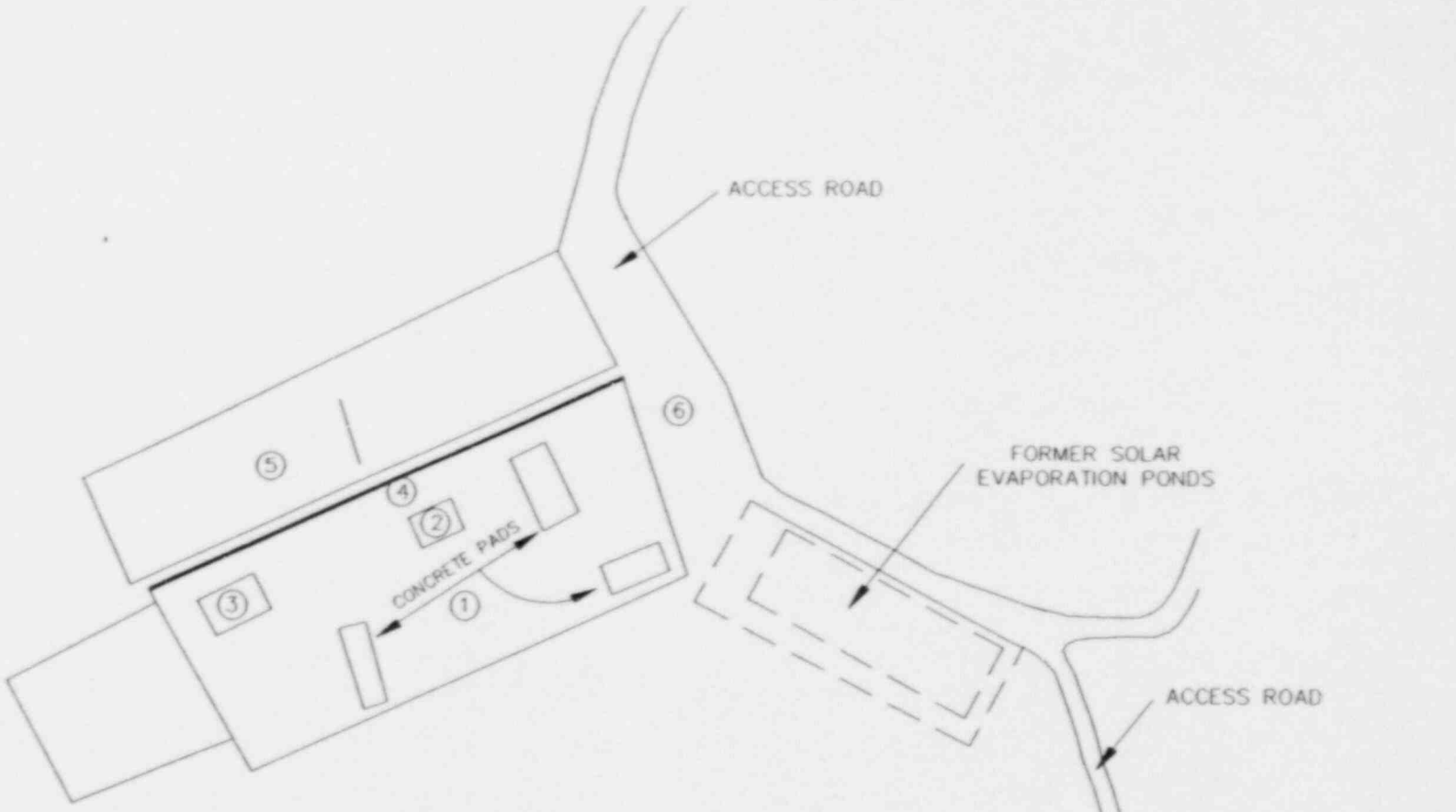


FIGURE 3: Area of GA Technologies Plant, Included in Phase II Decommissioning

GATi4a



(1) Waste Processing Facility and Lower Storage Yard

(2) Garage/Office Building

(3) By-Products Storage Building

(4) Embankment Wall Below the Upper Storage Yard

(5) Upper Storage Yard

(6) Main Access Road

(7) Incinerator Pad

FIGURE 4: Phase II Decommissioning Areas of the Former Waste Processing Facility

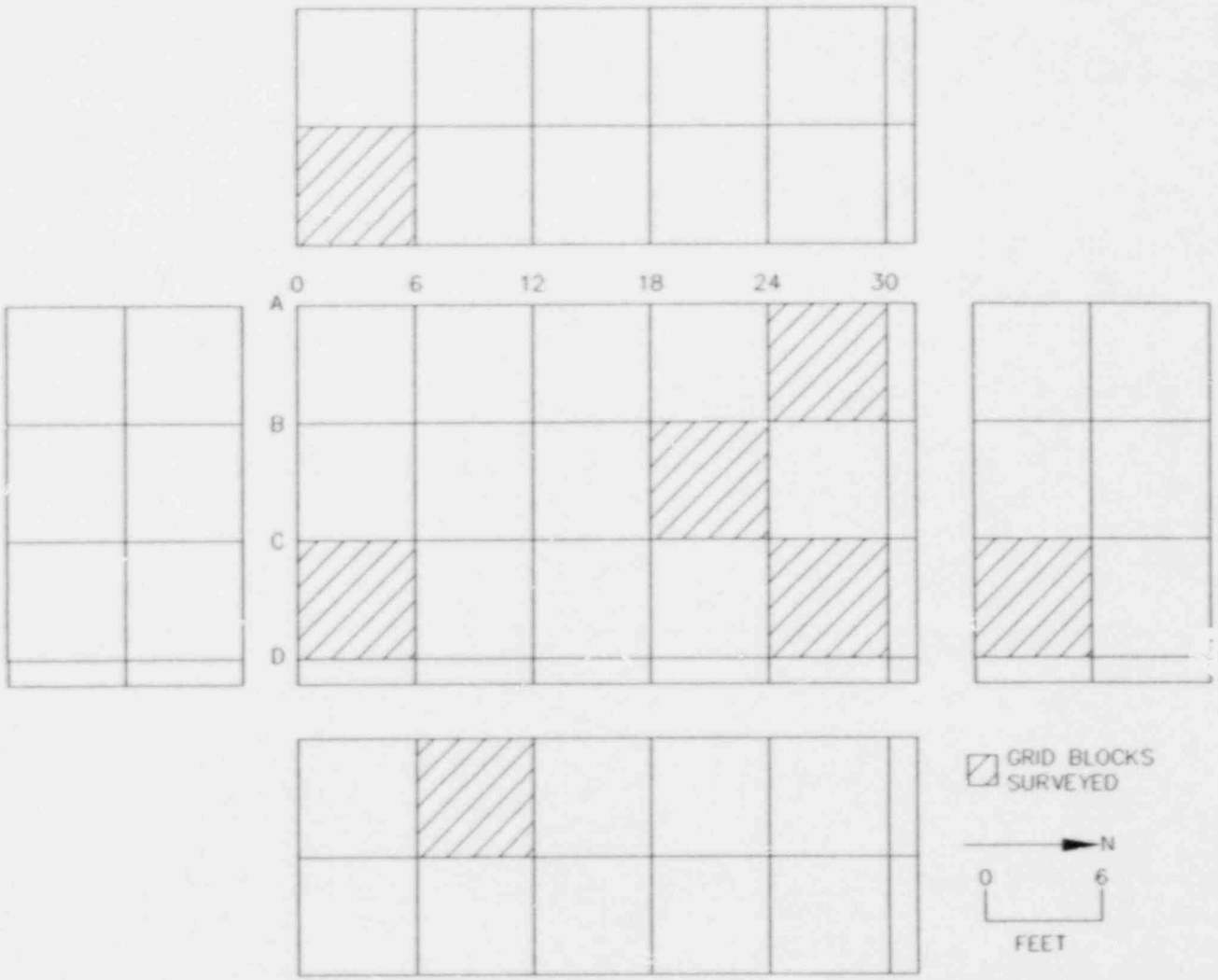


FIGURE 5: By-Products Storage Building Layout, Indicating the Reference Grid System and Locations of Contemination Measurements on the Floor and Lower Walls

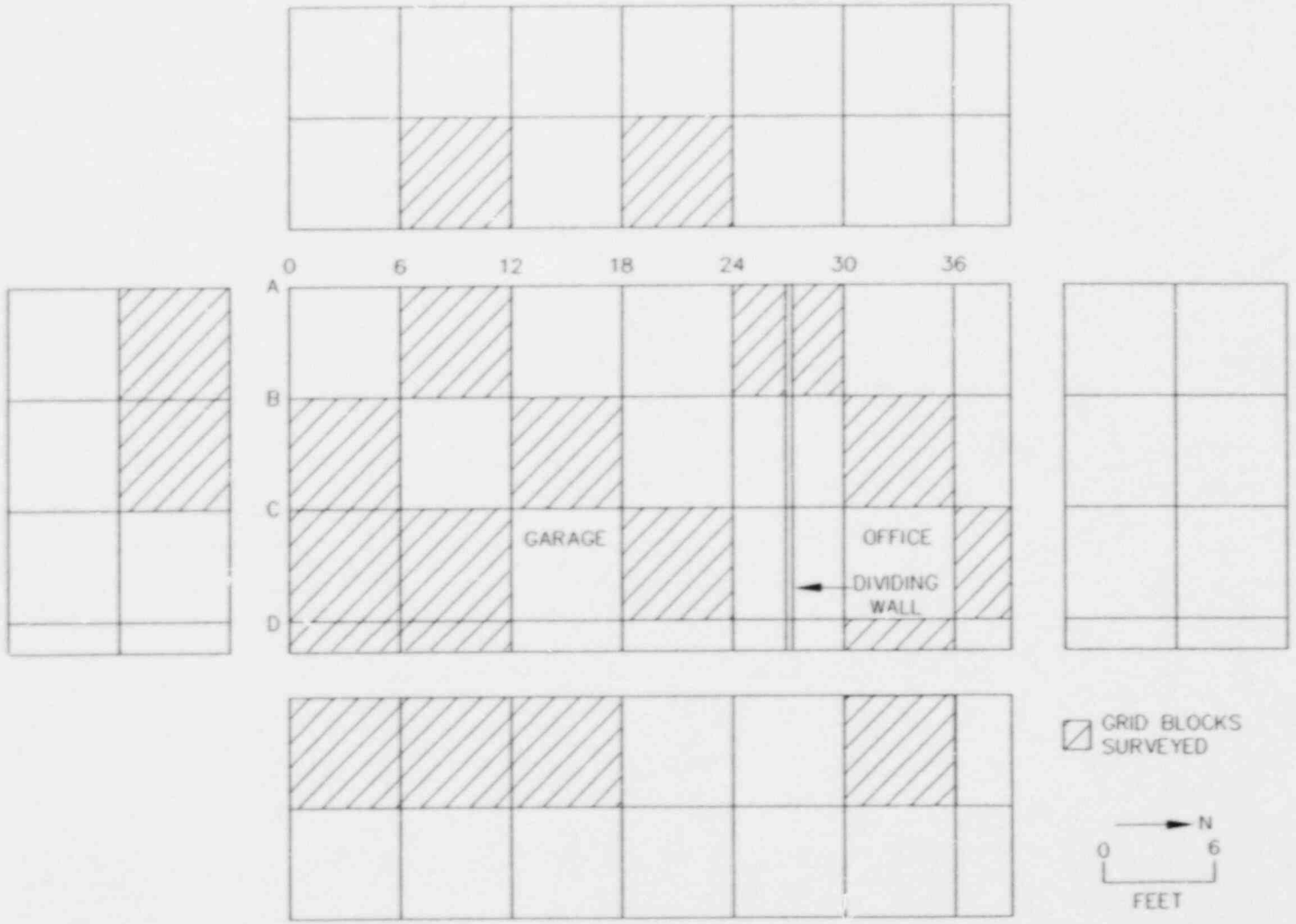


FIGURE 6: Garage/Office Building Layout, Indicating the Reference and System and Locations of Contamination Measurements on the Floor and Lower Walls

GAT1.3a

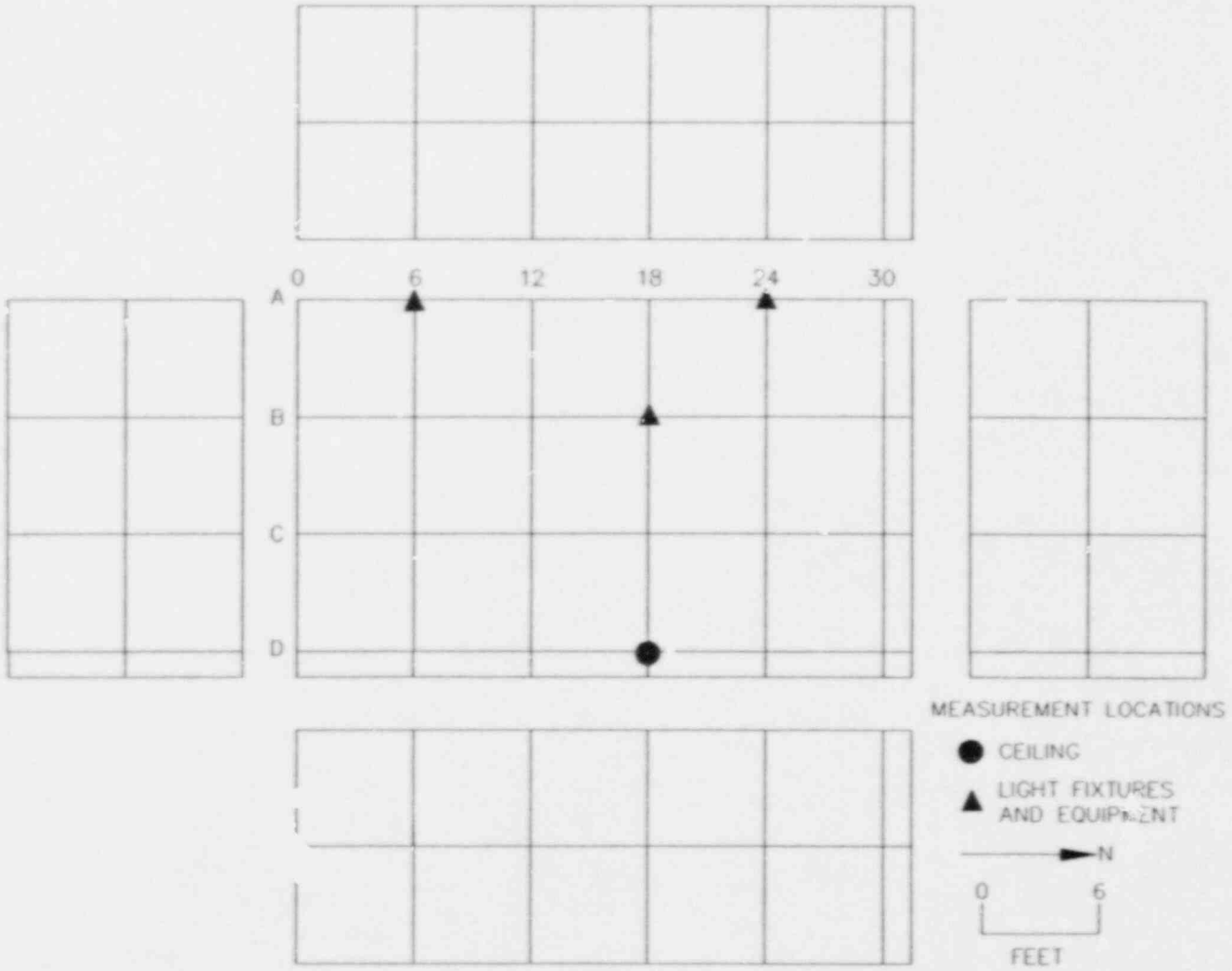


FIGURE 7: Measurement Locations on Other Surfaces in the By-Products Storage Building

GAT12a

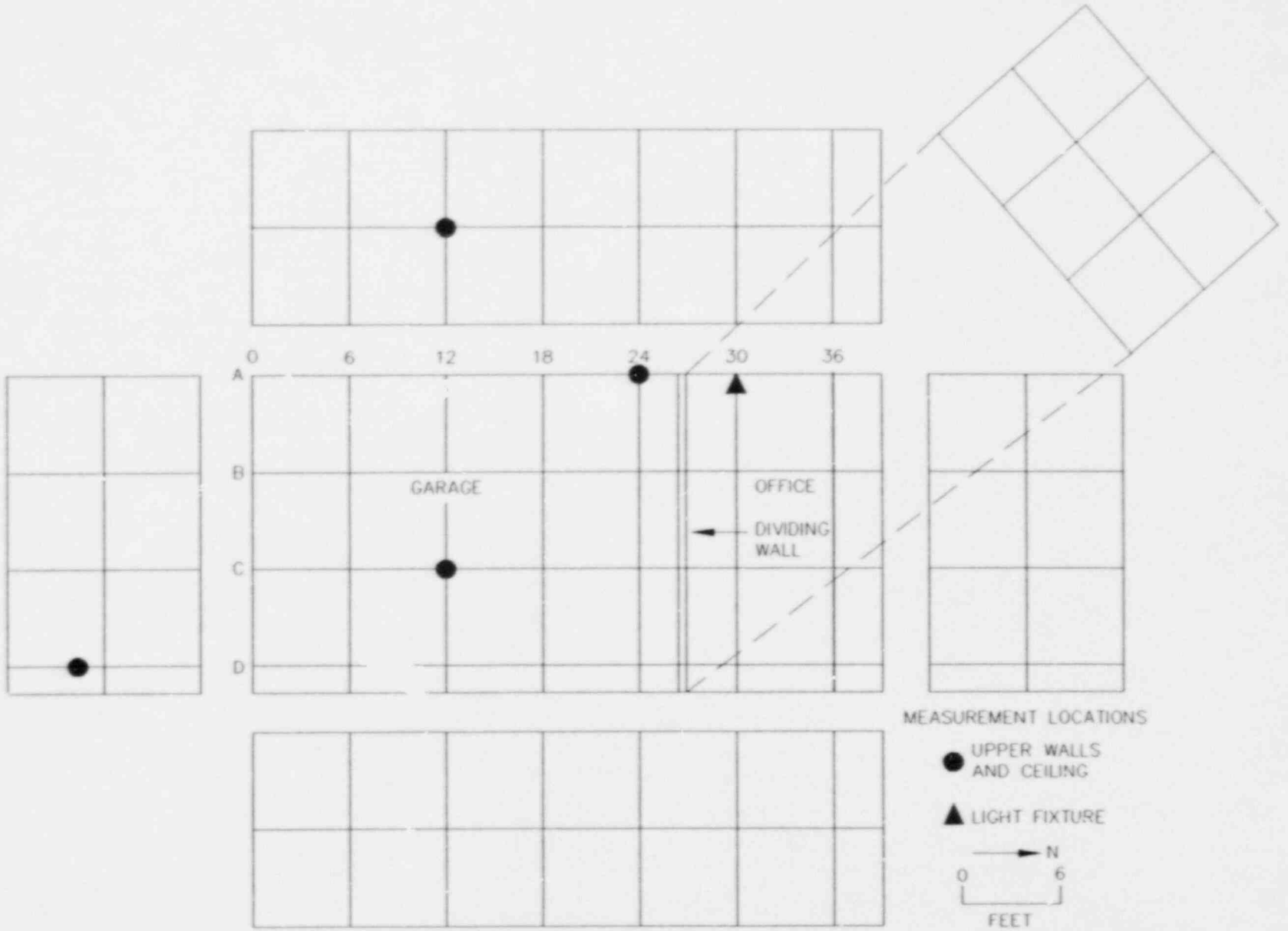


FIGURE 8: Measurement Locations on Other Surfaces in the Garage/Office Building

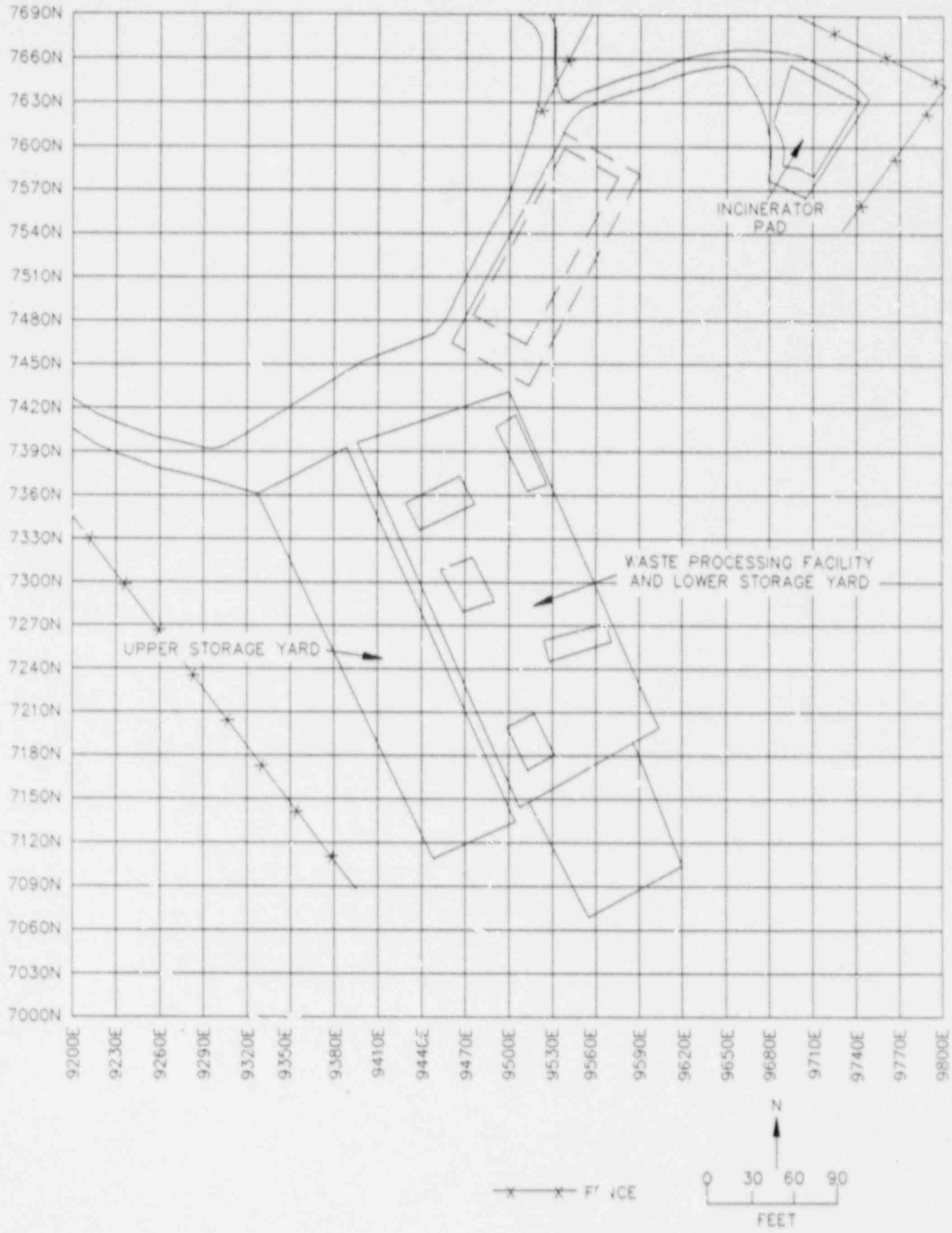


FIGURE 9: Phase II Area, Indicating the 30 ft. Grid System Used for Survey Reference

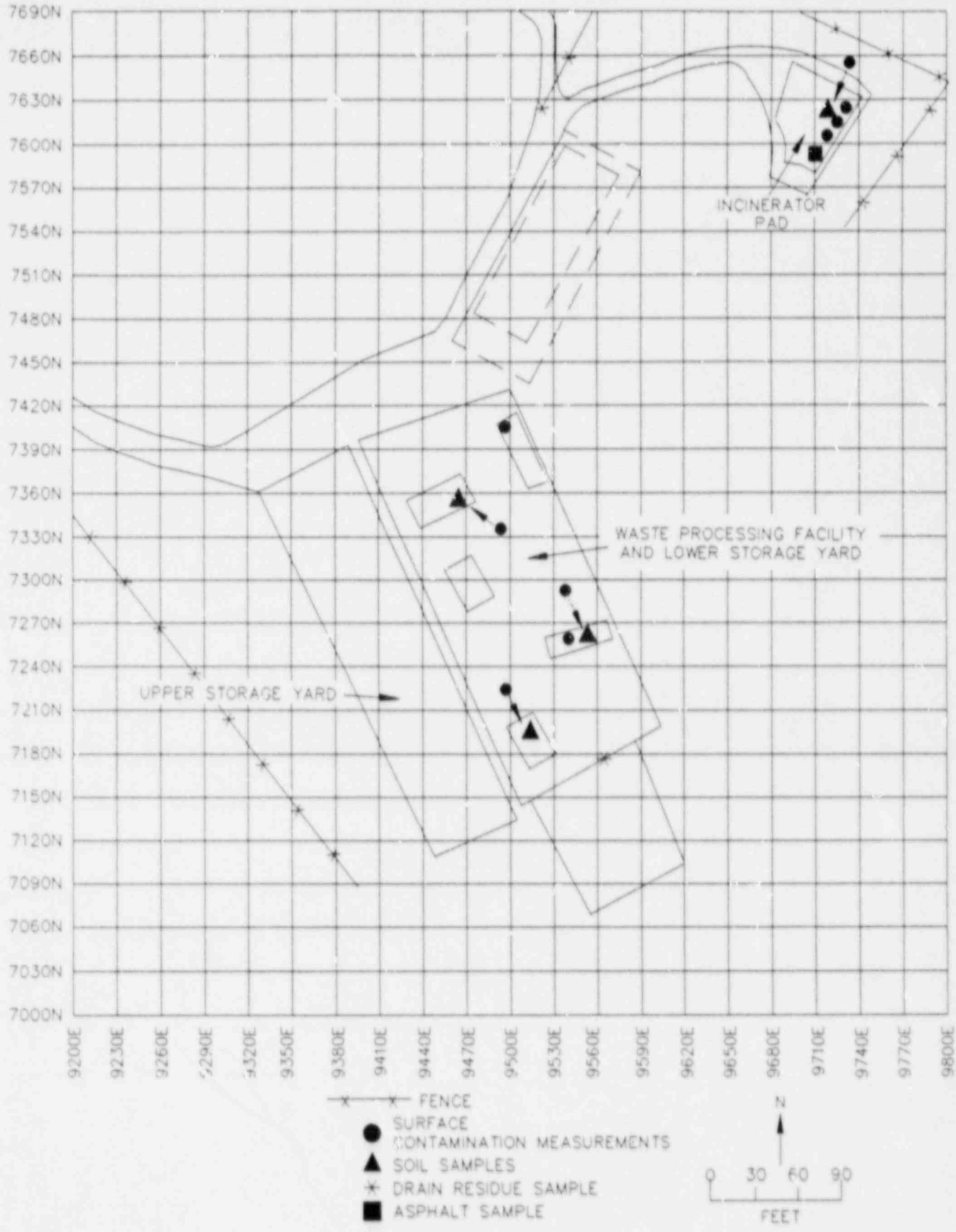


FIGURE 10: Locations of Surface Contamination Measurements and Samples from Pads and Foundations

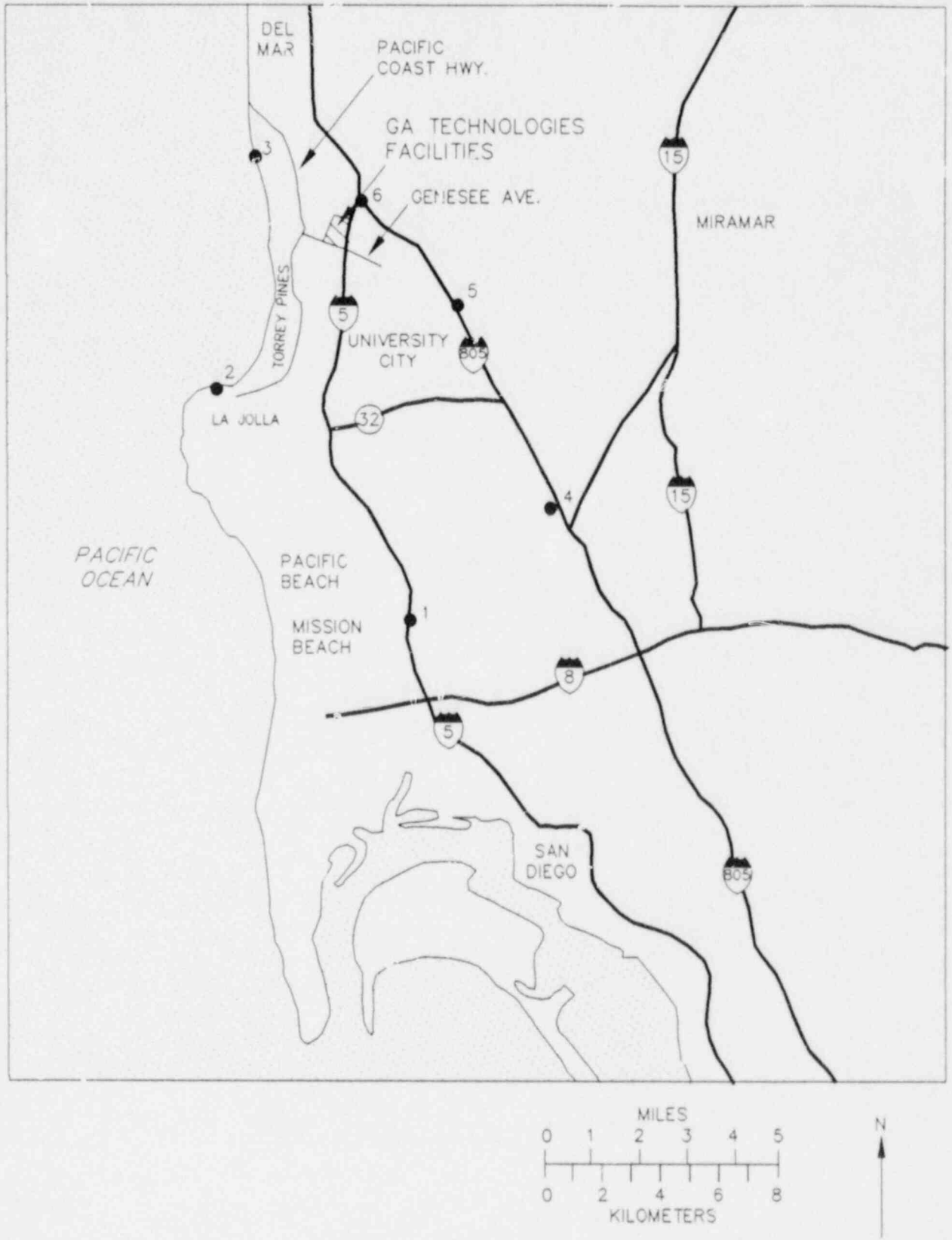


FIGURE 11: Locations (●) of Background Measurements and Baseline Soil Samples from the Vicinity of GA Technologies

GAT13b

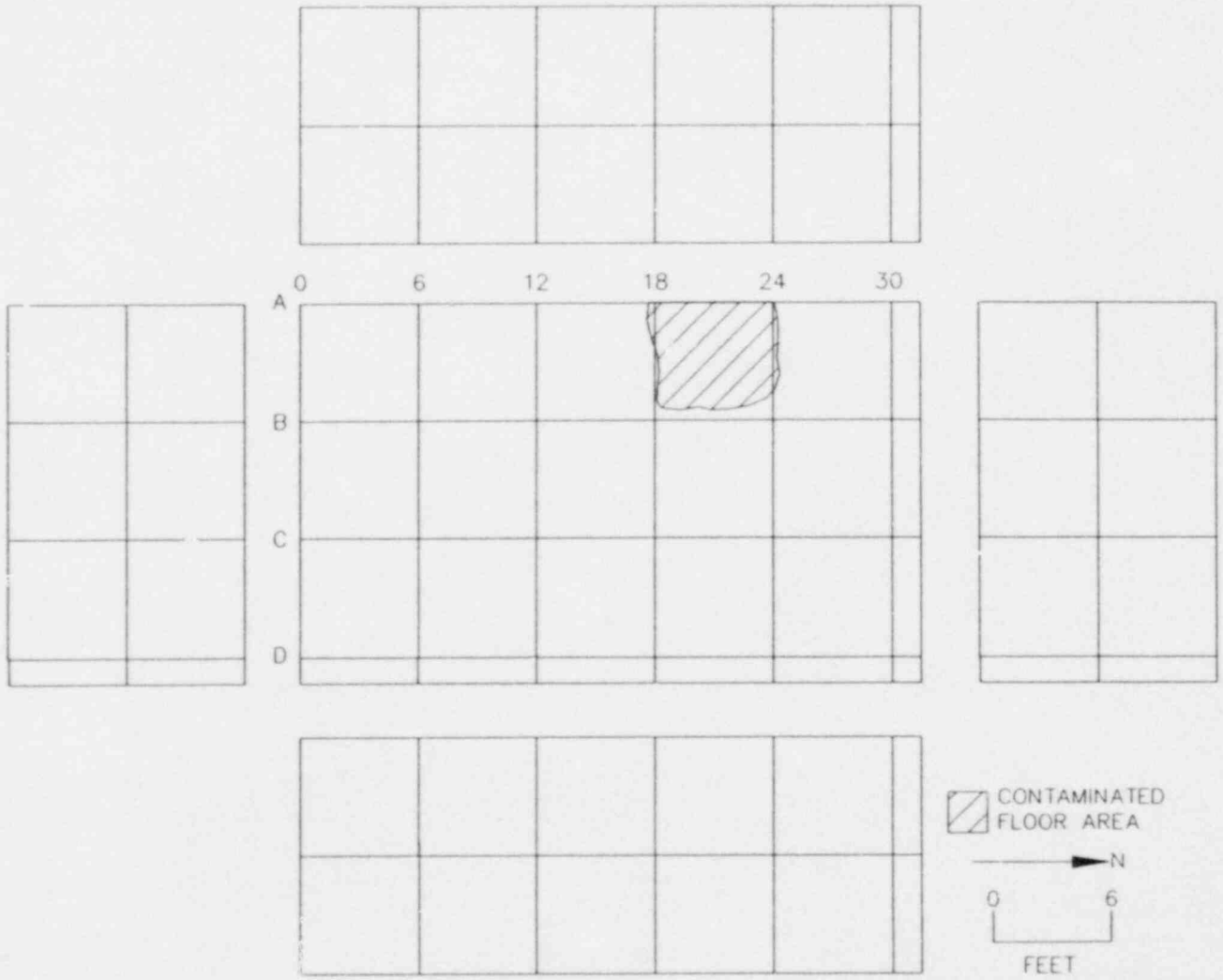


FIGURE 12: Area on the By-Products Storage Building Floor, Identified by Surface Scans

GAT15a

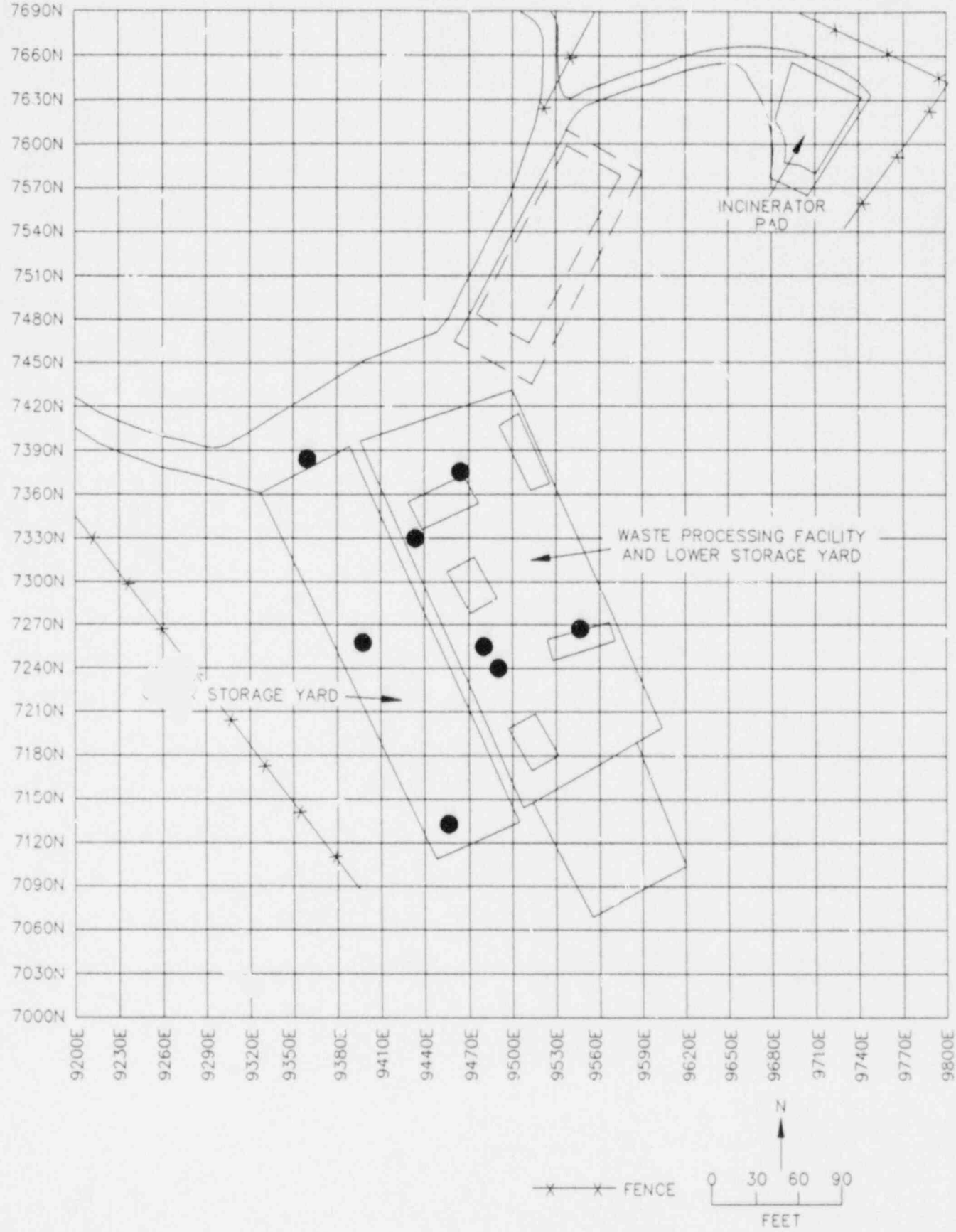


FIGURE 13: Locations (●) of Elevated Direct Radiation, Identified by Surface Gamma Scans

TABLE 1

BACKGROUND RADIATION LEVELS
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Location[a]	Gamma Exposure Rates at 1 m Above the Surface (μR/h)	Gamma Exposure Rates at the Surface (μR/h)
1	7	8
2	8	8
3	7	7
4	10	10
5	13	15
6	13	15
RANGE	7 TO 13	7 TO 15
AVERAGE	9.7	10.5

[a]Refer to Figure 11.

TABLE 2

BASELINE RADIONUCLIDE CONCENTRATIONS IN SOIL
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Location[a]	Radionuclide Concentrations (pCi/g)						
	Co-60	Cs-137	Ra-226	U-235	U-238	Th(228 & 232)	K-40
1	<0.03	<0.02	0.59 ± 0.14[b]	<0.17	1.6 ± 1.2	1.34 ± 0.46	14.0 ± 1.7
2	<0.05	0.16 ± 0.11	0.53 ± 0.22	<0.20	1.6 ± 1.5	1.98 ± 0.86	25.0 ± 3.3
3	<0.04	<0.04	0.79 ± 0.20	0.39 ± 0.24	1.1 ± 0.5	2.24 ± 0.62	10.4 ± 1.7
4	<0.08	<0.05	1.20 ± 0.29	<0.32	<1.1	3.08 ± 0.79	29.0 ± 3.4
5	<0.05	<0.05	1.23 ± 0.22	0.69 ± 0.55	1.3 ± 0.6	3.20 ± 0.80	24.3 ± 2.7
6	<0.05	<0.05	0.65 ± 0.16	<0.22	1.0 ± 0.9	1.92 ± 0.78	30.2 ± 2.9
RANGE	<0.03 to <0.08[b]	<0.02 to <0.16	0.53 to 1.23	<0.17 to 0.69	1.1 to 1.6	1.34 to 3.20	10.4 to 30.2
AVERAGE	<0.05	<0.06	0.83	<0.33	1.3	2.29	22.2

[a]Refer to Figure 11.
[b]Uncertainties represent the 95% confidence levels, based only on counting statistics; additional laboratory uncertainties of 6 to 10% have not been propagated in these data.

TABLE 3

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS IN THE
BY-PRODUCTS STORAGE AND GARAGE/OFFICE BUILDINGS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Location[a]	Number of Grid Blocks Surveyed	TOTAL CONTAMINATION (dpm/100 cm^2)		REMOVABLE CONTAMINATION (dpm/100 cm^2)		Number of Areas Exceeding Criteria
		Alpha Range	Beta-Gamma Range	Alpha Range	Beta Range	
BY-PRODUCTS STORAGE BUILDING						
Floors	6	330 - 10600	820 - 17800	<3 - 27	<6 - 8	1[c]
Lower walls	3	36 - 80	<470	<3 - 7	<6 - 9	0
Upper walls/ceiling /equipment[b]	4	90 - 300	<470	<3 - 4	<6	0
GARAGE/OFFICE BUILDING						
Floors	11	50 - 130	<470 - 2550	<3 - 5	<6 - 12	0
Lower walls	9	<27 - 120	<470	<3	<6 - 10	0
Upper walls/ceiling[b]	3	<27	<470	<3	<6	0

[a]Refer to Figures 5, 6, 7, and 8.
[b]Single point measurements.
[c]Area remediated, resurvey reduced alpha levels from 10600 to <27 dpm/100 cm^2 and beta-gamma level from 17800 to 890 dpm/100 cm^2.

TABLE 4

EXPOSURE RATES MEASURED AT 30 FT GRID INTERVALS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Location[a]	Gamma Exposure Rates at 1m above the surface (μR/h)	Gamma Exposure Rates at the surface (μR/h)
7360N, 9260E	13	15
7330N, 9260E	13	14
7300N, 9260E	14	14
7240N, 9290E	11	11
7270N, 9290E	13	13
7310N, 9290E	13	14
7330N, 9290E	13	14
7360N, 9290E	--[b]	--
7210N, 9320E	13	13
7240N, 9320E	13	13
7270N, 9320E	13	12
7300N, 9320E	--	--
7330N, 9320E	13	13
7360N, 9320E	14	13
7390N, 9320E	--	--
7420N, 9320E	--	--
7180N, 9350E	13	13
7210N, 9350E	13	13
7240N, 9350E	--	--
7270N, 9350E	11	11
7300N, 9350E	14	14
7330N, 9350E	13	13
7360N, 9350E	--	--

TABLE 4 (Continued)

EXPOSURE RATES MEASURED AT 30 FT GRID INTERVALS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Location	Gamma Exposure Rates at 1m above the surface (μR/h)	Gamma Exposure Rates at the surface (μR/h)
7390N, 9350E	--	--
7420N, 9350E	11	11
7120N, 9380E	11	11
7150N, 9380E	13	11
7180N, 9380E	11	11
7210N, 9380E	13	13
7240N, 9380E	13	12
7270N, 9380E	--	--
7300N, 9390E	--	--
7330N, 9390E	--	--
7360N, 9390E	--	--
7390N, 9390E	--	--
7420N, 9380E	--	--
7090N, 9410E	11	11
7120N, 9410E	11	11
7150N, 9410E	11	11
7180N, 9410E	12	12
7210N, 9410E	12	13
7240N, 9410E	--	--
7270N, 9410E	--	--
7300N, 9410E	--	--
7330N, 9410E	--	--
7360N, 9410E	--	--

TABLE 4 (Continued)

EXPOSURE RATES MEASURED AT 30 FT GRID INTERVALS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Location	Gamma Exposure Rates at 1m above the surface (μR/h)	Gamma Exposure Rates at the surface (μR/h)
7390N, 9410E	--	--
7380N, 9410E	13	13
7090N, 9440E	--	--
7120N, 9440E	11	11
7150N, 9440E	--	--
7180N, 9440E	--	--
7210N, 9440E	--	--
7240N, 9440E	--	--
7270N, 9440E	--	--
7300N, 9440E	--	--
7330N, 9440E	13	14
7360N, 9440E	15	16
7390N, 9440E	11	13
7420N, 9440E	--	--
7450N, 9440E	--	--
7120N, 9470E	13	12
7150N, 9470E	--	--
7180N, 9470E	--	--
7210N, 9470E	--	--
7240N, 9470E	16	16
7300N, 9410E	--	--
7330N, 9470E	13	13
7369N, 9470E	--	--

TABLE 4 (Continued)

EXPOSURE RATES MEASURED AT 30 FT GRID INTERVALS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Location	Gamma Exposure Rates at 1m above the surface (μR/h)	Gamma Exposure Rates at the surface (μR/h)
7390N, 9410E	14	13
7420N, 9470E	13	12
7450N, 9470E	--	--
7480N, 9470E	--	--
7030N, 9500E	--	--
7060N, 9500E	11	11
7090N, 9500E	11	11
7120N, 9500E	13	14
7150N, 9500E	--	--
7180N, 9500E	--	--
7210N, 9500E	--	--
7240N, 9500E	16	17
7270N, 9500E	15	14
7300N, 9500E	--	--
7335N, 9500E	15	15
7360N, 9500E	--	--
7390N, 9500E	--	--
7420N, 9500E	--	--
7450N, 9500E	--	--
7480N, 9500E	--	--
7510N, 9500E	--	--
7030N, 9500E	--	--
7060N, 9530E	12	12

TABLE 4 (Continued)

EXPOSURE RATES MEASURED AT 30 FT GRID INTERVALS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Location	Gamma Exposure Rates at 1m above the surface (μR/h)	Gamma Exposure Rates at the surface (μR/h)
7090N, 9530E	11	11
7120N, 9530E	13	13
7150N, 9530E	13	13
7180N, 9530E	--	--
7210N, 9530E	13	13
7240N, 9530E	--	--
7270N, 9530E	--	--
7300N, 9530E	--	--
7320N, 9530E	--	--
7360N, 9530E	16	17
7000N, 9560E	--	--
7030N, 9560E	--	--
7060N, 9560E	13	13
7090N, 9560E	15	16
7120N, 9560E	13	13
7150N, 9560E	13	13
7180N, 9560E	15	15
7210N, 9560E	14	13
7240N, 9560E	15	15
7270N, 9560E	14	14
7300N, 9560E	16	21
7330N, 9560E	--	--
7360N, 9560E	--	--

[a]Refer to Figure 9.
[b](---) indicates measurement not performed.

TABLE 5

EXPOSURE RATES MEASURED IN THE INCINERATOR PAD AREA
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Location[a]	Gamma Exposure Rates at 1 m above the surface (μR/h)	Gamma Exposure Rates at the surface (μR/h)
7620N, 9715E	16	18
7585N, 9722E	20	28
7627N, 9675E	16	16
7610N, 9670E	15	16
7565N, 9690E	16	20
7645N, 9658E	16	18
7587N, 9710E	16	16

[a]Refer to Figure 9.

TABLE 6

DIRECT RADIATION LEVELS MEASURED ON CONCRETE PADS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Location[a]	Description	Gamma Exposure Rates at 1m above the surface (μR/h)	Gamma Exposure Rates at the surface (μR/h)
7261N, 9551E	Waste Pad	15	16
7197N, 9515E	By Products Storage Bldg.	13	15
7354N, 9458E	North Waste Pad	13	16
7625N, 9720E	Incinerator Pad	16	18

[a]Refer to Figure 9.

TABLE 7

EXPOSURE RATES MEASURED AFTER REMEDIATION OF AREAS
IDENTIFIED BY SURFACE SCANS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Location[a]	Gamma Exposure Rates at 1 m above the surface (μR/h)	Gamma Exposure Rates at the surface (μR/h)
7240N, 9490E	20	20
7260N, 9480E	18	18
7270N, 9480E	18	21
7370N, 9543E	15	15
7330N, 9430E	14	16
7260N, 9400E	13	13
7135N, 9455E	13	11
7380N, 9360E	13	14

[a]Refer to Figure 13.

TABLE 8

SUMMARY OF SURFACE CONTAMINATION MEASUREMENTS - CONCRETE PADS AND FOUNDATIONS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Location[a]	TOTAL CONTAMINATION (dpm/100 cm^2)		REMOVABLE CONTAMINATION (dpm/100 cm^2)	
	ALPHA	BETA-GAMMA	ALPHA	BETA
7620N, 9730E	370	1240	5	<6
7610N, 9720E	36	1880	<3	<6
7260N, 9550E	310	5390	<3	<6
7355N, 9455E	<27	3420	<3	<6
7370N, 9480E	130	1330	<3	<6
7405N, 9425E	<27	---[b]	---	---
7260N, 9547E	330	5640	<3	<6
7615N, 9725E	1550	1150	<3	<6
7624N, 9723E	930	1270	<3	<6

[a]Refer to Figure 10.
[b]Dash indicates measurement not performed.

TABLE 9

RADIONUCLIDE CONCENTRATIONS IN SURFACE SOIL SAMPLES
FROM 30 FT GRID INTERVALS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Sample No.	Location[a]	Radionuclide Concentrations (pCi/g)						
		Co-60	Cs-137	Ra-226	U-235	U-238	Th-228	Th-232
114A	7360N,9260E	<0.05	0.26 ± 0.07	1.14 ± 0.20	0.08 ± 0.10	0.8 ± 0.5	1.22 ± 0.22	1.24 ± 0.33
115A	7330N,9260E	<0.07	0.27 ± 0.13	1.33 ± 0.28	0.16 ± 0.11	1.0 ± 1.4	1.64 ± 0.47	2.10 ± 0.50
116A	7300N,9260E	<0.04	0.15 ± 0.11	0.98 ± 0.23	0.20 ± 0.08	0.9 ± 1.2	1.45 ± 0.33	1.65 ± 0.52
117A	7240N,9290E	<0.03	0.27 ± 0.10	0.77 ± 0.17	0.77 ± 0.09	1.1 ± 0.9	0.75 ± 0.25	0.62 ± 0.40
118A	7270N,9290E	<0.03	0.14 ± 0.09	0.78 ± 0.19	0.12 ± 0.04	0.8 ± 0.5	0.89 ± 0.28	0.76 ± 0.41
119A	7300N,9290E	<0.05	<0.04	1.12 ± 0.31	0.18 ± 0.10	1.4 ± 1.1	1.22 ± 0.39	1.81 ± 0.47
120A	7330N,9320E	<0.05	0.26 ± 0.09	1.03 ± 0.22	<0.21	2.5 ± 0.5	1.28 ± 0.28	0.97 ± 0.35
121A	7210N,9320E	<0.05	0.45 ± 0.11	0.73 ± 0.21	0.17 ± 0.09	1.0 ± 1.0	0.64 ± 0.22	0.76 ± 0.32
122A	7240N,9320E	<0.13	0.45 ± 0.24	1.40 ± 0.46	0.06 ± 0.18	<1.2	0.78 ± 0.53	0.64 ± 0.68
123A	7270N,9320E	<0.05	0.26 ± 0.10	0.74 ± 0.15	0.12 ± 0.11	0.9 ± 1.0	1.11 ± 0.31	0.76 ± 0.37
124A	7330N,9320E	<0.05	0.49 ± 0.13	1.14 ± 0.27	0.13 ± 0.10	1.5 ± 0.9	1.25 ± 0.31	1.35 ± 0.43
125A	7360N,9320E	0.03 ± 0.15[b]	0.41 ± 0.13	1.16 ± 0.30	0.19 ± 0.11	0.6 ± 1.4	1.62 ± 4.07	1.57 ± 0.47
126A	7180N,9350E	<0.19	0.56 ± 0.11	1.22 ± 0.89	0.13 ± 0.08	4.9 ± 0.3	0.67 ± 0.28	1.06 ± 0.36
127A	7210N,9350E	<0.54	0.11 ± 0.11	1.30 ± 0.24	0.18 ± 0.11	0.3 ± 1.0	1.11 ± 0.28	0.70 ± 0.51
128A	7270N,9350E	<0.04	0.22 ± 0.07	0.62 ± 0.25	0.09 ± 0.07	0.8 ± 0.8	2.56 ± 0.58	0.70 ± 0.40
129A	7300N,9350E	<0.06	0.34 ± 0.10	0.93 ± 0.30	0.13 ± 0.11	<0.9	1.03 ± 0.47	1.16 ± 0.57
130A	7330N,9350E	<0.09	0.68 ± 0.20	1.16 ± 0.51	0.07 ± 0.20	1.9 ± 1.0	1.39 ± 0.50	1.49 ± 0.81

TABLE 9 (Continued)

RADIONUCLIDE CONCENTRATIONS IN SURFACE SOIL SAMPLES
FROM 30 FT GRID INTERVALS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Sample No.	Location	Radionuclide Concentrations (pCi/g)						
		Co-60	Cs-137	Ra-226	U-235	U-238	Th-228	Th-232
131A	7420N,9350E	<0.06	0.40 ± 0.11	1.37 ± 0.24	0.23 ± 0.13	<0.8	1.47 ± 0.36	1.30 ± 0.44
132A	7120N,9380E	<0.44	0.18 ± 0.08	0.93 ± 0.19	0.05 ± 0.06	0.6 ± 0.1	0.70 ± 0.19	0.52 ± 0.40
133A	7150N,9380E	<0.05	<0.03	0.97 ± 0.20	0.13 ± 0.11	0.6 ± 1.1	1.06 ± 0.28	0.91 ± 0.40
134A	7180N,9380E	<0.06	0.52 ± 0.12	0.73 ± 0.26	0.07 ± 0.11	0.9 ± 0.9	0.53 ± 0.22	0.83 ± 0.36
135A	7210N,9380E	<0.13	0.30 ± 0.20	0.78 ± 0.63	0.10 ± 0.18	1.5 ± 1.6	0.93 ± 0.81	0.87 ± 0.84
136A	7240N,9380E	<0.05	0.43 ± 0.11	1.21 ± 0.25	0.14 ± 0.52	1.1 ± 0.8	0.86 ± 0.28	1.18 ± 0.45
137A	7270N,9380E	<0.05	0.11 ± 0.06	1.04 ± 0.24	0.30 ± 0.11	1.5 ± 1.3	1.62 ± 0.36	1.50 ± 0.51
138A	7090N,9410E	<0.04	<0.03	0.61 ± 0.22	0.14 ± 0.07	0.3 ± 0.8	0.56 ± 0.22	0.46 ± 0.32
139A	7120N,9410E	<0.06	1.30 ± 0.15	0.62 ± 0.20	0.10 ± 0.05	<0.6	0.47 ± 0.22	0.60 ± 0.32
140A	7150N,9410E	<0.05	0.18 ± 0.12	0.73 ± 0.26	0.13 ± 0.09	<0.5	0.61 ± 0.31	0.40 ± 0.51
141A	7180N,9410E	<0.06	0.31 ± 0.08	0.74 ± 0.27	0.12 ± 0.10	1.6 ± 2.7	0.81 ± 0.36	0.88 ± 0.28
142A	7210N,9410E	0.10 ± 0.10	1.03 ± 0.19	0.75 ± 0.19	0.26 ± 0.08	1.0 ± 0.9	0.70 ± 0.22	1.02 ± 0.34
143A	7380N,9410E	0.21 ± 0.09	3.10 ± 0.24	1.16 ± 0.24	0.21 ± 0.12	0.4 ± 1.2	1.39 ± 0.33	1.41 ± 0.55
144A	7120N,9440E	<0.05	0.46 ± 0.11	0.73 ± 0.26	<0.25	1.0 ± 0.5	0.75 ± 0.30	0.58 ± 0.39
145A	7330N,9440E	<0.03	0.45 ± 0.11	0.62 ± 0.30	0.05 ± 0.14	<0.7	0.97 ± 0.31	1.15 ± 2.0
146A	7360N,9440E	<0.07	1.57 ± 0.20	1.30 ± 0.29	0.14 ± 0.13	1.1 ± 0.6	1.50 ± 0.36	1.45 ± 0.48

TABLE 9 (Continued)

RADIONUCLIDE CONCENTRATIONS IN SURFACE SOIL SAMPLES
FROM 30 FT GRID INTERVALS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Sample No.	Location	Radionuclide Concentrations (pCi/g)						
		Co-60	Cs-137	Ra-226	U-235	U-238	Th-228	Th-232
147A	7390N,9440E	<0.03	0.06 ± 0.04	0.44 ± 0.16	0.09 ± 0.09	<0.6	0.67 ± 0.25	0.73 ± 0.31
148A	7120N,9470E	<0.06	0.30 ± 0.11	0.85 ± 0.18	0.10 ± 0.08	<0.5	0.86 ± 0.28	0.41 ± 0.45
149A	7240N,9470E	0.90 ± 0.17	9.54 ± 0.41	1.41 ± 0.30	0.21 ± 0.14	<0.7	1.22 ± 0.36	1.44 ± 0.44
150A	7330N,9470E	0.09 ± 0.10	0.17 ± 0.09	0.69 ± 0.16	0.12 ± 0.10	0.9 ± 1.2	1.16 ± 0.30	1.11 ± 0.38
151A	7390N,9470E	<0.06	0.45 ± 0.12	1.02 ± 0.30	<0.25	<0.7	1.94 ± 0.30	1.53 ± 0.60
152A	7450N,9470E	<0.05	0.52 ± 0.13	1.36 + 0.35	0.15 ± 0.11	1.1 ± 1.0	1.45 ± 0.33	1.72 ± 0.41
153A	7060N,9500E	<0.05	<0.03	0.70 ± 0.21	0.09 ± 0.09	0.7 ± 0.8	0.63 ± 0.22	0.79 ± 0.28
154A	7090N,9500E	<0.04	0.05 ± 0.06	0.60 ± 0.21	<0.18	<0.5	0.83 ± 0.20	0.81 ± 0.27
155A	7120N,9500E	<0.04	0.23 + 0.11	0.86 ± 0.23	0.14 ± 0.08	0.5 ± 1.0	0.78 ± 0.19	0.85 ± 0.43
156A	7240N,9500E	0.33 ± 0.18	2.60 ± 0.24	1.00 ± 0.28	0.19 ± 0.12	1.8 ± 1.3	1.85 ± 0.42	1.72 ± 0.60
157A	7270N,9500E	0.20 ± 0.14	0.05 ± 0.09	1.15 ± 0.25	<0.26	<0.8	1.72 ± 0.33	1.45 ± 0.44
158A	7335N,9500E	<0.32	2.74 ± 0.28	1.29 ± 0.24	0.24 ± 0.12	1.7 ± 0.7	1.78 ± 0.36	2.70 ± 0.55
159A	7060N,9530E	<0.05	0.02 ± 0.08	0.70 ± 0.16	0.12 ± 0.09	<0.7	0.84 ± 0.27	0.95 ± 0.31
160A	7090N,9530E	<0.07	0.39 ± 0.13	1.11 ± 0.30	<0.24	<0.8	1.44 ± 0.81	2.01 ± 0.46
161A	7120N,9530E	<0.04	<0.05	1.48 ± 0.24	0.20 ± 0.09	1.4 ± 0.5	1.17 ± 0.28	1.08 ± 0.42
162A	7150N,9530E	<0.06	0.27 ± 0.13	1.85 ± 0.30	0.56 ± 0.53	2.5 ± 1.6	1.35 ± 0.52	1.42 ± 0.39

TABLE 9 (Continued)

RADIONUCLIDE CONCENTRATIONS IN SURFACE SOIL SAMPLES
FROM 30 FT GRID INTERVALS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Sample No.	Location	Radionuclide Concentrations (pCi/g)						
		Co-60	Cs-137	Ra-226	U-235	U-238	Th-228	Th-232
163A	7360N,9530E	0.61 ± 0.17	6.64 ± 0.31	1.18 ± 0.25	<0.25	<0.7	1.08 ± 0.40	1.13 ± 0.58
164A	7060N,9560E	<0.04	0.06 ± 0.04	1.02 ± 0.23	0.11 ± 0.09	0.9 ± 0.5	1.00 ± 0.25	1.19 ± 0.45
165A	7090N,9560E	<0.04	<0.06	1.31 ± 0.31	0.25 ± 0.13	0.9 ± 1.6	1.2 ± 0.47	1.42 ± 0.49
166A	7120N,9560E	<0.05	0.03 ± 0.07	1.09 ± 0.28	0.14 ± 0.07	1.2 ± 0.5	1.17 ± 0.28	1.13 ± 0.41
167A	7150N,9560E	<0.06	<0.06	1.27 ± 0.26	<0.26	<0.8	1.86 ± 0.36	1.59 ± 0.58
168A	7180N,9560E	<0.05	0.47 ± 0.10	1.00 ± 0.26	0.39 ± 0.12	2.9 ± 1.6	1.63 ± 0.52	1.60 ± 0.52
169A	7210N,9560E	0.24 ± 0.17	<0.07	1.03 ± 0.26	<0.24	<0.8	1.11 ± 0.42	1.00 ± 0.79
170A	7240N,9560E	0.21 ± 0.17	2.10 ± 0.21	1.28 ± 0.27	0.41 ± 0.08	3.9 ± 0.8	2.80 ± 0.33	2.67 ± 0.50
171A	7270N,9560E	0.17 ± 0.10	2.14 ± 0.20	1.05 ± 0.26	0.23 ± 0.13	1.7 ± 1.2	1.34 ± 0.26	1.43 ± 0.40
172A	7300N,9560E	0.29 ± 0.12	3.05 ± 0.25	1.10 ± 0.28	1.26 ± 0.71	<0.9	1.78 ± 0.47	1.86 ± 0.47
173A	7210N,9530E	0.14 ± 0.12	<0.05	2.23 ± 0.35	<0.30	3.6 ± 0.8	1.50 ± 0.36	1.30 ± 0.48

[a]Refer to Figure 9.

[b]Uncertainties represent the 95% confidence levels based only on counting statistics; additional laboratory uncertainties of 6 to 10% have not been propagated into these data.

TABLE 10

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES COLLECTED
FROM THE INCINERATOR PAD AREA
PHASE II DECOMMISSIONING
GA TECHNOLOGIES SAMPLES
SAN DIEGO, CALIFORNIA

Sample No.	Location[a]	Radionuclide Concentrations (pCI/g)						
		Co-60	Cs-137	Ra-226	U-235	U-238	Th-228	Th-232
107A	7620N, 9715E	0.84 ± 0.18[b]	1.46 ± 0.18	1.33 ± 0.31	0.54 ± 0.54	1.31 ± 1.04	1.75 ± 0.36	1.82 ± 0.51
108A	7585N, 9722E	1.37 ± 0.20	19.28 ± 0.56	0.97 ± 0.32	0.66 ± 0.78	<1.05	1.45 ± 0.44	1.74 ± 0.46
109A	7630N, 9680E	<0.06	<0.04	1.27 ± 0.25	<0.22	<0.75	1.50 ± 0.36	1.85 ± 0.38
110A	7610N, 9670E	<0.06	0.11 ± 0.08	1.12 ± 0.27	<0.25	0.50 ± 0.11	1.39 ± 0.31	1.52 ± 0.42
111A	7565N, 9690E	0.82 ± 0.20	9.71 ± 0.40	1.17 ± 0.27	<0.36	<0.70	1.22 ± 0.36	1.56 ± 0.43
112A	7645N, 9685E	0.32 ± 0.18	<0.04	1.74 ± 0.30	<0.30	<0.98	2.11 ± 0.44	2.26 ± 0.56
113A	7587N, 9710E	<0.08	1.05 ± 0.15	0.97 ± 0.21	<0.23	<0.81	1.53 ± 0.36	1.39 ± 0.48

[a]Refer to Figure 9.

[b]Uncertainties represent the 95% confidence levels based only on counting statistics; addditional laboratory uncertaintles of 6 to 10% have not been propagated into these data.

TABLE 11

RADIONCULIDE CONCENTRATIONS IN SOIL FROM BENEATH CONCRETE PADS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Sample No.	Location[a]	Radionuclide Concentrations (pCI/g)						
		Co-60	Cs-137	Ra-226	U-235	U-238	Th-228	Th-232
001B	7261N, 9551E	<0.10	0.29 ± 0.16[b]	3.41 ± 0.36	<0.38	<1.2	1.70 ± 0.53	1.38 ± 0.63
003B	7354N, 9458E	<0.03	0.03 ± 0.03	0.43 ± 0.10	<0.17	<0.5	0.46 ± 0.20	0.39 ± 0.41
004B	7625N, 9720E	<0.06	0.05 ± 0.14	0.85 ± 0.19	<0.29	<0.7	0.78 ± 0.40	0.81 ± 0.50

[a]Refer to Figure 10.

[b]Uncertainties represent the 95% confidence levels based only on counting statistics; addditional laboratory uncertainties of 6 to 10% have not been propagated into these data.

TABLE 12

RADIONUCLIDE CONCENTRATIONS IN SURFACE SOIL SAMPLES COLLECTED FOLLOWING REMEDIATION
OF AREAS IDENTIFIED BY SURFACE SCANS
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Sample No.	Location	Radionuclide Concentrations (pCi/g) Co-60	Cs-137	Ra-226	U-235	U-238	Th-228	Th-232
174A	7240N,9490E	0.53 ± 0.19	2.94 ± 0.25	1.24 ± 0.28	0.24 ± 0.12	2.1 ± 1.7	1.73 ± 0.33	2.00 ± 0.45
175A	7270N,9480E	0.85 ± 0.19	9.68 ± 0.39	1.32 ± 0.36	0.88 ± 0.64	2.1 ± 1.7	2.64 ± 0.35	2.53 ± 0.53
176A	7270N,9543E	1.77 ± 0.27	15.62 ± 0.52	1.00 ± 0.40	<0.41	1.1 ± 0.8	2.06 ± 0.42	1.58 ± 0.47
177A	7370N,9460E	0.06 ± 0.19	0.63 ± 0.15	1.23 ± 0.67	0.22 ± 0.12	0.8 ± 1.5	1.81 ± 0.40	1.73 ± 0.43
178A	7330N,9460E	<0.04	0.12 ± 0.09	1.25 ± 0.24	<0.22	<0.8	1.61 ± 0.36	1.60 ± 0.42
179A	7260N,9400E	<0.04	<0.04	1.15 ± 0.24	<0.24	1.1 ± 0.6	1.44 ± 0.31	1.27 ± 0.39
180A	7135N,9455E	<0.04	0.09 ± 0.09	1.24 ± 0.25	0.24 ± 0.11	0.9 ± 1.2	1.40 ± 0.35	1.48 ± 0.46
181A	7380N,9360E	<0.04	<0.05	0.71 ± 0.18	<0.20	<0.6	1.06 ± 0.28	0.77 ± 0.47

[a]Refer to Figure 13.

[b]Uncertainties represent the 95% confidence levels based only on counting statistics; additional laboratory uncertainties of 6 to 10% have not been propagated into these data.

TABLE 13

RADIONUCLIDE CONCENTRATIONS IN COMPOSITE SOIL
PHASE II DECOMMISSIONING
GA TECHNOLOGIES
SAN DIEGO, CALIFORNIA

Sample Type[a]	Depth	Radionuclide Concentrations (pCi/g)			
		Sr-90	U-234	U-235	U-238
Composite A	Surface	0.72 ± 0.16[b]	1.58 ± 0.22	0.05 ± 0.04	1.04 ± 0.18
Composite B		1.46 ± 0.25	3.83 ± 0.37	0.16 ± 0.09	2.19 ± 0.28
Composite C		0.21 ± 0.15	1.53 ± 0.24	0.05 ± 0.05	1.32 ± 0.22

[a]Sample identification numbers:
Composite A: (7060N, 9500E; 7090N, 9500E; 7120N, 9500E; 7240N, 9500E; 7270N,9500E)
Composite B: (7240N, 9490E; 7270N, 9480E)
Composite C: (7261N, 9551E; 7197N, 9458E; 7354N, 9458E; 7625N, 9720E)
[b]Uncertainties represent the 95% confidence levels, based only on counting statistics; additional laboratory uncertainties of 6 to 10% have not been propagated into these data.

TABLE 14

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS SAMPLES
PHASE II DECOMMISSIONING
GA TECHNOLOGIES SAMPLES
SAN DIEGO, CALIFORNIA

Description and Location[a]	Radionuclide Concentrations (pCi/g						
	Co-60	Cs-137	Ra-226	U-235	U-238	Th-228	Th-232
SOIL FROM BENEATH BY-PRODUCTS STORAGE BUILDING FLOOR (7197N, 9515E)	<0.06	<0.06	0.85 ± 0.36[b]	<0.21	<0.6	<0.23	0.85 ± 0.35
DRAIN RESIDUE (7170N, 9562E)	0.14 ± 0.26	2.41 ± 0.31	1.07 ± 0.58	0.24 ± 0.74	<1.3	<0.46	1.89 ± 0.84
ASPHALT (7587N, 9710E)	<0.05	0.48 ± 0.09	1.49 ± 0.24	<0.29	2.1 ± 0.9	<0.26	1.78 ± 0.58

[a]Refer to Figures 9 and 10.
[b]Uncertainties represent the 95% confidence levels based only on counting statistics; addditional laboratory uncertainties of 6 to 10% have not been propagated into these data.

REFERENCES

1. "Confirmatory Survey of Phase I Decommissioning Former, Waste Processing Facility, GA Technologies, San Diego, California," Oak Ridge Associated Universities, July 1986.

2. "Follow-Up Confirmatory Survey of Phase I Decommissioning, Former Waste Processing Facility, GA Technologies, San Diego, California," Oak Ridge Associated Universities, March 1988.

3. "Confirmatory Survey of Phase III Decommissioning, GA Technologies, San Diego, California," Oak Ridge Associated Universities, February 1988.

4. Letter from K. Asmussen (GA Technologies, Inc.) to R. D. Thomas (U.S. Nuclear Regulatory Commission, Region V), Reference: "License SNM-696, Docket 70-734", August 25, 1987.

5. "Proposed Confirmatory Survey Plan for Phase I (Follow-up) and Phase II of the Former Waste Processing Facility, GA Technologies, San Diego, California," Oak Ridge Associated Universities, September 4, 1987.

APPENDIX A

MAJOR SAMPLING AND ANALYTICAL EQUIPMENT

APPENDIX A

MAJOR SAMPLING AND ANALYTICAL EQUIPMENT

The display or description of a specific product is not to be construed as an endorsement of that product or its manufacturer by the authors or their employer.

A. Direct Radiation Measurements

Eberline "RASCAL"
Portable Ratemeter-Scaler
Model PRS-1
(Eberline, Sante Fe, NM)

Eberline PRM-6
Portable Ratemeter
(Eberline, Sante Fe, NM)

Ludlum Floor Monitor
Model 239-1
(Ludlum, Sweetwater, TX)

Eberline Alpha Scintillation Probe
Model AC-3-7
(Eberline, Sante Fe, NM)

Eberline GM Pancake Probe
Model HP-260
(Eberline, Sante Fe, NM)

Victoreen Beta-Gamma "Pancake" Detector
Model 489-110
(Victoreen, Cleveland, OH)

Victoreen NaI Scintillation Detector
Model 489-55
(Victoreen, Cleveland, OH)

Reuter-Stokes Pressurized Ionization Chamber
Model RSS-111
(Reuter-Stokes, Cleveland, OH)

B. Laboratory Analyses

Automatic low-background Alpha-Beta Counter
Model LB5110-2080
(Tennelec, Inc., Oak Ridge, TN)

High-Purity Germanium Detector
Model GMX-23195-S, 23% efficiency
(EG&G ORTEC, Oak Ridge, TN)

Used in conjunction with:
Lead Shield, G-16
(Gamma Products Inc., Palos Hills, IL)

High Purity Germanium Coaxial Well Detector
Model GWL-110210-PWS-S, 23% Efficiency
(EG&G ORTEC, Oak Ridge, TN)

Used in conjunction with:
Lead Shield Model G-16
(Applied Physical Technology, Atlanta, GA)

High Purity Germanium Detector
Model IGC25, 25% Efficiency
(Princeton Gamma-Tech, Princeton, NJ)

Used in conjunction with:
Lead Shield
(Nuclear Data, Schaumburg, IL)

Multichannel Analyzer
ND-66/ND-680 System
(Nuclear Data Inc., Schaumburg, IL)

Alpha Spectrometry System
Tennelec Electronics
(Tennelec, Oak Ridge, TN)

Surface Barrier Detectors
(EG&G ORTEC, Oak Ridge, TN)

Multichannel Analyzer
Model ND-66
(Nuclear Data, Schaumburg, IL)

APPENDIX B

MEASUREMENT AND ANALYTICAL PROCEDURES

APPENDIX B

Measurement and Analytical Procedures

Surface Scans

Surface scans were performed by passing the probes slowly over the surface. The distance between the probes and the surface was maintained at a minimum - nominally about 1 cm. Identification of elevated levels was based on increases in the audible signal from the recording or indicating instrument. Alpha and beta-gamma scans of large surface areas on the floor of the facility were accomplished by use of a gas proportional floor monitor, with a 600 cm^2 sensitive area. The instrument was slowly moved in a systematic pattern to cover 100% of the accessible area. Combinations of detectors and instrument for the scans were:

Beta-Gamma - Pancake GM probe with PRM-6 ratemeter.
Beta-Gamma - Pancake GM probe with PRS-1 scaler/ratemeter.
Gamma - NaI scintillation detector (3.2 cm x 3.8 cm crystal) with PRM-6 ratemeter.
Alpha - ZnS probe with PRS-1 scaler/ratemeter.
Alpha/Beta - Gas proportional floor monitor with Ludlum Model 2220 scaler/ratemeter.

Alpha and Beta-gamma Surface Contamination Measurements

Measurements of total alpha radiation level were performed using Eberline Model PRS-1 portable scaler/ratemeters with Model AC-3-7 alpha scintillation probes. Measurements of total beta-gamma radiation levels were performed using Eberline Model PRS-1 portable scaler/ratemeters with Model HP-260 thin-window "pancake" GM probes. Count rates (cpm) were converted to disintegration rates (dpm/100 cm^2) by dividing the net rate by the 4π efficiency and correcting for the active area of the detector. Effective window areas were 59 cm^2 for the ZnS detectors and 15 cm^2 for the GM detectors. The background count rate for ZnS alpha probes averaged approximately 2 cpm; the average background count rate was approximately 40 cpm for the GM detectors.

Removable Contamination Measurements

Smear measurements were performed on numbered filter paper disks, 47 mm in diameter. Smears were placed in labeled envelopes with the location and other pertinent information recorded. Smears were counted on a low background proportional counter at the Oak Ridge laboratory.

Exposure Rate Measurements

Measurements of gamma exposure rates were performed using an Eberline PRM-6 portable ratemeter with a Victoreen Model 489-55 gamma scintillation probe containing a 3.2 cm x 3.8 cm NaI(Tl) scintillation crystal. Count rates were converted to exposure rates (μR/h) by onsite cross-calibration using a Reuter Stokes model RSS-111 pressurized ionization chamber.

Soil, Asphalt, and Residue Sample Analysis

Gamma Spectroscopy

Samples were dried, mixed, and a portion sealed in 0.5-liter Marinelli beaker. The quantity placed in the beaker was chosen to reproduce the calibrated counting geometry and ranged from 600 to 800 g of soil. Net soil weights were determined and the samples counted using intrinsic germanium and Ge(Li) detectors coupled to a Nuclear Data Model ND-680 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:

Co-60 - 1.173 MeV
Cs-137 - 0.662 MeV
Ra-226 - 0.609 MeV from Bi-214 (secular equilibrium assumed)
U-235 - 0.144 MeV
U-238 - 0.094 MeV from Th-234 (secular equilibrium assumed)
Th-228 - 0.583 MeV from Tl-209 (secular equilibrium assumed)
Th-232 - 0.911 MeV from Ac-228 (secular equilibrium assumed)

Spectra were also reviewed for the presence of other radionuclides.

Strontium-90 Analysis

Aliquots of soil were dissolved by pyrosulfate fusion and the strontium precipitated as a sulfate. Successive treatments with EDTA preferentially removed lead and excess calcium and returned the strontium to solution. Ferric and other insoluble hydroxides was precipitated at a pH of 12 to 14. Strontium was reprecipitated as a sulfate. Barium was removed as a chromate using DTPA. The final precipitate of strontium carbonate was counted using a low-background Tennelec alpha-beta proportional counter.

Alpha Spectrometry for Isotopic Uranium

Aliquots of soil were dissolved by pyrosulfate fusion and precipitated with barium sulfate. The barium sulfate precipitates were redissolved and uranium separated by liquid - liquid extraction. Uranium was then precipitated with a cerium fluoride carrier and counted using surface barrier detectors (ORTEC), alpha spectrometers (Tennelec), and an ND-66 Multichannel Analyzer (Nuclear Data).

Uncertainties and Detection Limits

The uncertainties associated with the analytical data presented in the tables of this report, represent the 95% confidence levels for that data. These uncertainties were calculated based on both the gross sample count levels and the associated background count levels. When the net sample count was less than the 95% statistical deviation of the background count, the sample concentration was reported as less than the detection capability of the measurement procedure. Because of variations in background levels and Compton contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument. Additional uncertainties of ± 6 to 10%, associated with sampling and laboratory procedures, have not been propagated into the data presented in this report.

Calibration and Quality Assurance

Laboratory and field survey procedures are documented in the following manuals, developed specifically for the Oak Ridge Associated Universities'

Radiological Site Assessment Program: "Survey Procedures Manual," Revision 3, May 1987; "Laboratory Procedures Manual", Revision 3, May 1987 and "Quality Assurance Manual", Revision 1, June 1987.

With the exception of the measurements conducted with portable gamma scintillation survey meters, instruments were calibrated with NBS-traceable standards. The calibration procedures for the portable gamma instruments are performed by comparison with an NBS calibrated pressurized ionization chamber.

Quality control procedures on all instruments included daily background and check-source measurements to confirm equipment operation within acceptable statistical fluctuations. The ORAU laboratory participates in the EPA and EML Quality Assurance Programs.

APPENDIX C

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE OR SPECIAL NUCLEAR MATERIAL

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 & Material Safety
Washington, D.C. 20555

July 1982

The instructions in this guide, in conjunction with Table 1, specify the radionuclides and radiation exposure rate limits which should be used in decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table 1 do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control is considered on case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 1 prior to the application of the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces or premises, equipment, or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to, special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests must:

   a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

   b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table 1. A copy of

the survey report shall be filed with the Division of Fuel Cycle and Material Safety, USNRC, Washington, D.C. 20555, and also the Administrator of the NRC Regional Office having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. They survey report shall:

a. Identify the premises.

b. Show that reasonable effort has been made to eliminate residual contamination.

c. Describe the scope of the survey and general procedures followed.

d. State the findings of the survey in units specified in the instruction.

Following review of the report, the NRC will consider visiting the facilities to confirm the survey.

TABLE 1

ACCEPTABLE SURFACE CONTAMINATION LEVELS

Nuclides[a]	Average[b,c,f]	Maximum[b,d,f]	Removable[b,e,f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223 Ra-224, U-232, I-126, I-131, I-133	1000 dpm/100 cm^2	3000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5000 dpm $\beta\gamma$/100 cm^2	15,000 dpm $\beta\gamma$/100 cm^2	1000 dpm $\beta\gamma$/100 cm^2

[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 instrumentation.

[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 absorbent 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 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/h at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

APPENDIX D

DECOMMISSIONING GUIDELINES FOR THE GA TECHNOLOGIES WASTE PROCESSING FACILITY

APPENDIX D

Decommissioning Guidelines for the
GA Technologies Waste Processing Facilities

Target criteria for unrestricted release of the GA Technologies' Waste Processing Facility and surrounding areas are presented in the licensee's final report and are as follows:

External Radiation

The gamma exposure rate at 1 m above the ground surface shall not exceed 10 μR/h above background for an area of greater than 30 ft (9.1 m) x 30 ft (9.1 m) and shall not exceed 20 μR/h above background for any discrete area [i.e. less than 30 ft (9.1 m) x 30 ft (9.1 m)].

Inhalation and Ingestion

Concentrations of radionuclides in soil shall be such that inhalation and ingestion are not expected to result in annual dose equivalents exceeding 20 mrem to the lung or 60 mrem to the bone.

Limiting soil concentrations were derived to satisfy these external and internal target criteria. The concentration limits are presented in the following Table.

Radionuclide	Concentration Limit Above Background (pCi/g)
Depleted Uranium	35
Enriched Uranium	30
Thorium (Natural)	10
Co-60	8
Cs-137	15
Sr-90	1.8×10^3

Where more than one radionuclide is present, the sum of the ratios of the individual radionuclide concentrations to their respective concentration limits shall not exceed 1.