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VIA EXPRESS DELIVERY SERVICE

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U.S. Nuclear Regulatory Commission
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Subject: Docket No. 70-734; SNM-696: Request to Release the Non-TRIGA® Reactor Portion of GA's Building 21 Roof to Unrestricted Use

Dear Mr. Baker:

General Atomics (GA) is continuing its efforts directed at decontaminating, as appropriate, and obtaining the release to unrestricted use of selected facilities and land areas at General Atomics. GA has recently completed the Final Radiological Survey of the portion of GA's Building 21 Roof which is associated with GA's Special Nuclear Materials License SNM-696.

Building 21 houses GA's TRIGA® Reactors Facility, various decommissioned rooms that had previously served as laboratories, a vault-like storage room, and other office and storage areas. The roof over those portions of the building which are associated with previous and current activities directly in support of the operation and possession of GA's two TRIGA® reactors is under the jurisdiction of GA's non-power reactor licenses (i.e., NRC's Office of Nuclear Reactor Regulation (NRR)). The remainder of the Building 21 roof covers portions of the building wherein activities were conducted under the jurisdiction of GA's SNM-696 License. Thus, this portion of the roof is under the jurisdiction of GA's SNM-696 license; and it is this portion of the roof which is the subject of this request. (This portion of the roof is also referred to herein as the "Non-NRR" portion of the roof.)


The entire roof area of Building 21 is shown in Figure 2B of the enclosed report. The portion of the Building 21 roof covered by this report is shown in Figure 2C. The total area of this portion of the Building 21 roof is approximately 4,102 ft² (~381 m²). The TRIGA® reactors portion of the roof (i.e., the NRR portion) will be the subject of a separate future report and release request submitted to NRC's Office of NRR.

This report documents the results of GA's radiological measurements and surveys completed on the SNM-696 (aka Non-NRR) portion of the Building 21 roof. In summary: (1) exposure rate measurements on the roof are at or near normal background levels, (2) average radionuclide concentrations in the gravel were not discernable from normal background samples, and (3) average radionuclide concentrations of Cs-137 and Co-60 in

the tar were above normal background levels, but below the approved release criteria for soil (which can also be used for gravel, asphalt, and tar). No remediation was required. The results of these surveys demonstrate that the SNM-696, or Non-NRR, portion of the Building 21 Roof meets the NRC- and State- approved criteria for release to unrestricted use.

If you should have any questions regarding this request, or the enclosure, please don't hesitate to contact Ms. Laura Q. Gonzales at (858) 455-2758, or me at (858) 455-2823.

Very truly yours,

A handwritten signature in black ink that reads "Keith E. Asmussen". The signature is written in a cursive, slightly slanted style.

Keith E. Asmussen, Ph.D., Director
Licensing, Safety and Nuclear Compliance

Enclosure: "Final Radiological Survey Report for the Non-NRR Portion of the Building 21 (TRIGA® Facility) Roof" dated February 2006

cc: Dr. D. Blair Spitzberg, Chief, NMSS Branch 3, Region IV
Mr. Robert Evans, Fuel Cycle Inspector, NRC Region IV



**FINAL RADIOLOGICAL SURVEY REPORT
FOR THE NON-NRR PORTION OF THE BUILDING 21
(TRIGA[®] FACILITY) ROOF**

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February 2006

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Introduction

General Atomics (GA) is continuing its efforts directed at decontaminating, as appropriate, and obtaining the release to unrestricted use of selected facilities and land areas at General Atomics. GA has recently completed the Final Radiological Survey of a portion of GA's Building 21 roof. Building 21 houses GA's TRIGA® Reactor Facility, various decommissioned rooms, and other office and storage rooms.

The entire roof of Building 21 is shown in Figure 2B and the portion of the Building 21 roof covered by this report is shown in Figure 2C. The portion of the roof covered by this report is the portion not licensed under the NRC's Office of Nuclear Reactor Regulation (NRR) which has oversight responsibility for the licensing of research and test reactors. The portion of the roof covered by this report (herein called the "TRIGA® non-NRR roof") is under the jurisdiction of GA's NRC SNM-696 license. A future report will cover the "TRIGA® NRR portion" of the roof.

This report documents the results of GA's radiological measurements and surveys completed on the TRIGA® Non-NRR Roof. In summary: (1) Exposure rate measurements on the roof are at or near normal background levels, (2) Average radionuclide concentrations in the gravel were not discernable from normal background samples, and (3) Average radionuclide concentrations of Cs-137 and Co-60 in the tar portion of the roof were above normal background levels, but below the approved release criteria for soil (which can also be used for gravel, asphalt, and tar).

No remediation was required. The results of these surveys demonstrate that the TRIGA® Non-NRR Portion of the Building 21 Roof meets the NRC- and State- approved criteria for release to unrestricted use.

Site Description

Figure 1 shows a plan view of GA's Main Site and Sorrento Valley Site. Figure 2A shows GA's Torrey Pines (Main Site) Land Areas; including the general location of Building 21 (GA's TRIGA® Reactor Site). The roof of Building 21 is shown in Figure 2B and the portion of the Building 21 roof covered by this report is shown in Figure 2C.

The non-NRR portion of the Building 21 roof covers rooms 109, 110, 111, 112, 113, 114 and 115 as shown in Figure 2C. The total area of this portion of the TRIGA® Reactor Facility roof is approximately 4102 ft² (~381 m²).

History of Use and Classification

History

Room 109 was the former FDRL-1 lab (Fuel Development Research Lab-1) and room 110 was the

FDRL-2 lab where fission product release studies were performed.

Room 111 was the former TRIGA® Mark III reactor room. The TRIGA® Mark III was a 2000 kW(t) research reactor which achieved initial criticality in 1966. The reactor operated primarily for thermionics experiments. The Mark III reactor was shutdown; the fuel removed, and the license terminated in 1975. Following license termination, the facility was converted to laboratory and test facilities for HTGR (High Temperature Gas-Cooled Reactor) fuel. Final decommissioning activities for the remainder of the Mark III reactor facility were initiated in 1998. The metal reactor tank liner was removed, surveyed and appropriately disposed of, sub-flooring piping was excavated and removed, and post D&D surveys were conducted. Areas with elevated activity levels detected during this survey were remediated/decontaminated.

Room 112 was the former TTSX (TRIGA® Thermal Stability X-Ray) Laboratory and Room 113 was the former TTSL (TRIGA® Thermal Stability Laboratory). High temperature post-irradiation annealing of coated fuel particles and various other measurements including radiography, cleaning and density measurements took place in these laboratories. More recently, Room 112 has been used to store radioactive material.

Room 114 formerly housed a decontamination room used to support the fuel development laboratories and Room 115 was a restroom.

Survey Classification

Due to the extensive work with/use of radioactive materials in this facility, the entire facility including the roof, was classified as **Suspect Affected Area** for final radiological purposes.

Criteria for Release to Unrestricted Use

As Low As Reasonably Achievable (ALARA)

During decommissioning efforts, GA always attempts to decontaminate to levels as close to "background" as feasible and as far below the approved Release Criteria as reasonably achievable.

Release Criteria for Soils

The primary radionuclides found at other nearby GA facilities, on occasion, are enriched uranium and mixed fission and activation products (mainly Cs-137 and Co-60). The approved release criteria, for the predominant radionuclides found in the soil at GA (above normal background concentrations), as identified in the NRC- and State- approved GA Site Decommissioning Plan, are as follows:

Enriched Uranium (U-234 + U-235)	30 pCi/g
Thorium (Th-228 + Th-232)	10 pCi/g
Depleted Uranium	35 pCi/g
Cs-137	15 pCi/g

Cs-134

10 pCi/g

Co-60

8 pCi/g

If more than one radionuclide exists, the sum of the fractions of the concentrations is calculated as follows:

$$\sum_{i=1}^n \frac{C_i}{L_i} = <1$$

Where:

C_i = The average concentration levels of radionuclide i in the sample (above background).

L_i = The release criteria for radionuclide i .

The sum of the fractions must be less than or equal to one (1).

Exposure Rate Guideline

Exposure rates measured at 1 m above the surface are not to exceed 10 μ R/hr above normal background levels.

Instrumentation and Background Measurements

A list of instruments used during the radiological surveys is shown in Table 1. The table includes: (1) a description of the instrument, model number and its serial number, (2) a description of the detector (if applicable) and its serial number, (3) instrument ranges, (4) calibration due dates, (5) typical background readings and (6) calibration efficiencies (if applicable). All of the instruments used were calibrated semiannually and after repair, except for exposure rate meters which were calibrated quarterly and after repair.

Background Measurements for Instruments/Detectors

MicroR measurements on a non-impacted gravel roof (roof of Building 13) were taken for background comparisons. The results were 18-20 μ R/hr at contact and 16-17 μ R/hr at 1 m. See Table 1 for results.

Background Roofing Material Concentrations of Concern

Typical background concentrations measured by gamma spectroscopy in roofing material on non-impacted building roofs at the GA site (Buildings 15, 10 and 33) are provided in Table 2A (Roof Gravel) and Table 2B (Roof Tar).

Final Surveys Performed

Objectives and Responsibilities

The objectives of the final survey plans were: (1) to demonstrate the results of analyses of gravel samples were well below GA's approved release criteria for unrestricted use, and, (2) that the

exposure rate measurements taken in these areas, measured at 1 meter above the surface, were less than 10 $\mu\text{R/hr}$ above background.

Survey Plans

A Final Survey Plan was developed based on the previous history of use, results of periodic surveys performed on the Building 21 roof, the radionuclides of concern, the potential for contamination, the various types of surfaces encountered and the classification of the various areas.

Surveys were taken in accordance with an approved survey plan(s) by qualified Health Physics Technicians having a minimum of three years health physics experience.

Every survey taken was documented on a daily basis to a worksheet/drawing showing the approximate locations surveyed/sampled. The documentation included the results of the measurements (including units), the technician's signature, date, instrument(s) used (including the model and serial number of both the ratemeter and detector), calibration due date, % efficiency, background readings (if applicable) and any other pertinent information.

Survey Summary

Comparisons of the Site Decommissioning Plan requirements with the Final Surveys performed in relation to the percentage of surface area scanned, number of measurements (i.e., number of fixed radiation measurements), exposure rate measurements ($\mu\text{R/hr}$) and gravel/tar samples taken are provided as follows:

Comparisons of Site Decommissioning Plan Requirements with Final Surveys Performed on the Non-NRR Portion of the Building 21 Roof					
Survey Area ⁽¹⁾	Gridding Required ?	# of Direct Measurements Fixed α , β , or Wipes	# of Exposure Rate Measurements ($\mu\text{R/hr}$)	Surface Scans	# of Samples Taken and Analyzed
D-Plan ⁽²⁾ Suspect Affected Area (required) →	Yes, if feasible	Not Required	1 per 4 m ² or 1 every 2 m 95 measurements based on 381 m ²	100% of Suspect Affected Area	Not Applicable
Final Surveys Suspect Affected Area (performed) →	Yes, 10m x 10m grids.	None	110 @ 1 m and at contact and at 1 meter at each roof sample location.	100% of Suspect Affected Area surface scanned with a 2"x2" NaI(Tl) detector	Total = 17 gravel samples and 10 Tar samples

⁽¹⁾ The total surface area to be released is approximately 381 m² total area.

⁽²⁾ D-Plan = GA's NRC- and State- Approved Site Decommissioning Plan.

✦ GENERAL ATOMICS	FINAL RADIOLOGICAL SURVEY REPORT FOR THE NON-NRR PORTION OF THE BUILDING 21 (TRIGA® FACILITY) ROOF
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Gravel/Tar Sampling

A total of seventeen (17) gravel samples and ten (10) tar/backing material samples were taken. Each sample was placed in a Marinelli container and weighed. Weights varied between 500 g and 1000 g. The gravel and tar samples were analyzed in GA's Health Physics Laboratory with a Canberra Low Sensitivity Gamma Spectroscopy MCA System using a high purity germanium detector. The system is calibrated using NIST traceable standards and performance checked daily. The gravel samples were counted for a minimum of 30 minutes each. A 30 minute count was sufficient to detect the radionuclides of concern at levels well below GA's approved soil release criteria.

The results of the roof samples were compared with the results of background samples taken on non-impacted building roofs at the GA main site (Buildings 15, 10 and 33). See Tables 2A and 2B for roofing material gamma spectroscopy backgrounds. Background results were not subtracted from the roof results.

Results of the Final Surveys

The results of the Final Surveys conducted on the Non-NRR portion of the Building 21 Roof are provided in figures and tables as noted below:

Exposure Rate Scans

100% of the surface was scanned with a 2"x2" NaI(Tl) detector held within 1" of the surface. The results ranged from 10 to 15 $\mu\text{R/hr}$ over the main portion of the roof and 15 to 25 $\mu\text{R/hr}$ over the room 112 roof. The background for the instrument used was 18 to 20 $\mu\text{R/hr}$. See Figure 3 for locations and results.

Exposure Rate Fixed Measurements

110 fixed exposure rate measurements were taken at 1 meter from the surface. The maximum result was 12 $\mu\text{R/hr}$ located over the room 112 roof. The background for the instrument used was 16 to 17 $\mu\text{R/hr}$. See Figure 4 for locations and results.

Exposure Rate Measurements at Sample Locations

Contact and 1 meter from the surface exposure rate measurements were taken at each roof gravel sample location. The contact measurements ranged from 11 to 18 $\mu\text{R/hr}$, and the measurements at 1 meter from the surface also ranged from 11 to 18 $\mu\text{R/hr}$. See Figure 5 for locations and results.

Gravel/Tar Samples

A total of 27 gravel and tar samples (17 gravel and 10 tar) were taken on the Non-NRR portion of the Building 21 roof. Approximate locations are shown in Figure 5. The results for each sample are provided in Table 3.

A summary of the gamma spectroscopy results for these 27 gravel and tar samples is provided below.

	Gravel Sample Radionuclide Concentration (pCi/g)					
	¹³⁷ Cs	⁶⁰ Co	²³⁵ U	²³⁸ U	²²⁸ Th	²³² Th
High	2.23 ± 0.27	ND (MDA)	0.25 ± 0.11	2.49 ± 2.03	2.00 ± 0.53	ND (MDA)
Low	ND (MDA)	ND (MDA)	ND (MDA)	ND (mDA)	0.82 ± 0.16	ND (MDA)
Average (N = 17)	≤0.86	≤0.16	0.18	1.62	1.76	≤0.18

	Tar Sample Radionuclide Concentration (pCi/g)					
	¹³⁷ Cs	⁶⁰ Co	²³⁵ U	²³⁸ U	²²⁸ Th	²³² Th
High	5.08 ± 0.58	1.97 ± 0.29	0.18 ± 0.12	ND (MDA)	2.08 ± 0.36	2.32 ± 0.49
Low	ND (MDA)	ND (MDA)	ND (MDA)	1.53 ± 1.66	0.96 ± 0.23	1.03 ± 0.41
Average (N = 10)	2.77	1.04	≤0.15	≤1.58	1.48	1.80

Notes:

1. ND means not detected or less than the average minimum detectable activity (MDA) for the geometry and counting times used.
2. Average Minimum Detectable Activity (MDA):
 U-238 = 1.58 pCi/g (63 keV peak)
 U-235 = 0.14 pCi/g (186 keV peak)
 Cs-137 = 0.13 pCi/g (662 keV peak)
 Co-60 = 0.16 pCi/g (1173 keV peak)
 Th-228 = 0.21 pCi/g (238 keV peak)
 Th-232 = 0.43 pCi/g (911 keV peak)
3. The high concentrations for each isotope did not occur in the same sample. No sample had a sum of fractions greater than 1.0.
4. Background is not subtracted from results. See Tables 2A and 2B for Background Roofing Material concentrations.
5. The average MDA was used to determine the average activity when the results were ND.

Average radionuclide concentrations in the gravel were not discernable from normal background samples.

Average radionuclide concentrations of Cs-137 and Co-60 in the tar were above normal background levels, but below the approved release criteria for soil (which can also be used for gravel, asphalt, and tar).

Cs-137 was detected in 16 out of 17 gravel samples and 9 out of 10 tar samples. The highest activity was 2.23 ± 0.27 pCi/g in gravel and 5.08 ± 0.58 pCi/g in the tar samples. The average concentration

was ≤ 0.86 pCi/g in gravel and 2.77 pCi/g in tar. The average values are far below the approved release criteria of 15 pCi/g.

Co-60 was detected in 9 out of 10 tar samples. The highest activity in the tar samples was 1.97 ± 0.29 pCi/g, the average activity was ≤ 0.13 which is far below the approved release criteria of 8 pCi/g.

The average concentrations of U-235, U-238, Th-228 and Th-232 in both the gravel and the tar were not discernible from normal background activity concentrations for these isotopes.

Confirmatory Surveys

An internal (GA) confirmatory survey was not performed on this portion of the Building 21 roof because of its small size and the fact that no remediation was required (no activity above the NRC- and State- approved release criteria was detected).

Conclusion

Final contamination and radiation surveys, as well as the results of analyses of gravel/tar samples, as documented in this report, demonstrate that the Non-NRR portion of the Building 21 Roof meets the NRC- and State- approved criteria for release to unrestricted use and that residual activity levels are as low as reasonably achievable.

TABLE 1: LIST OF INSTRUMENTS for the Non- NRR Roof of Building 21 (TRIGA® Facility)						
Instrument	Detector	Range ($\mu\text{R/hr}$)	Calibration Due Date	Efficiency	Background	Description
Ludlum Model 3 S/N 151348	Ludlum Model 44-10 NaI (TI) Scintillator Gamma Detector S/N 163169	Four Ranges 0-500 $\mu\text{R/hr}$	05/03/05	N/A	18-20 $\mu\text{R/hr}$ @ contact (Gravel Roof) 16-17 $\mu\text{R/hr}$ @ 1m (Gravel Roof)	2 inch x 2 inch NaI (TI) scintillator. Used for measuring external dose rates on the surface and at one meter.
Canberra Gamma Spectroscopy System	High Purity Germanium Detector	N/A	As needed	Varies with Sample	Varies with Sample	Gamma Spectroscopy MCA system using a high purity Germanium detector.

Table 2A: Background Roof Gravel Sample Results (Gamma Spectroscopy, 30 Minute Count Times)
(Samples Collected from Buildings 10, 33-1 and 33)

<i>Radionuclide Concentration (pCi/g) - Results \pm 2 SD</i>							
Sample ID	¹³⁷ Cs 661.6 keV peak	⁶⁰ Co Average of 1173 and 1332 peaks	²²⁸ Th Average of 238/583 keV peaks	²²⁸ Ra (²³² Th) Average of 338/911 keV peaks	Total Thorium ²²⁸ Th + ²³² Th	²³⁸ U 92.77 keV peak	²³⁵ U 186 (144) keV peak
B10-Roof-1G	ND	ND	0.26 \pm 0.04	0.45 \pm 0.14	0.71	0.88 \pm 0.27	0.06 \pm 0.03
B10-Roof-2G	ND	ND	0.25 \pm 0.06	0.51 \pm 0.21	0.76	1.03 \pm 0.40	0.06 \pm 0.04
B10-Roof-3G	ND	0.02 \pm 0.02	0.27 \pm 0.06	0.37 \pm 0.24	0.64	0.81 \pm 0.51	0.05 \pm 0.04
B10-Roof-4G	ND	ND	0.32 \pm 0.08	0.73 \pm 0.37	1.05	ND	0.06 \pm 0.06
B10-Roof-5G	ND	ND	0.35 \pm 0.09	0.77 \pm 0.33	1.12	0.70 \pm 0.50	0.10 \pm 0.07
B33-1-Roof-6G	1.10 \pm 0.10	ND	1.07 \pm 0.11	1.77 \pm 0.34	2.84	2.77 \pm 0.56	0.17 \pm 0.09
B33-1-Roof-7G	0.91 \pm 0.13	ND	3.01 \pm 0.35	1.81 \pm 0.43	4.82	2.41 \pm 0.70	0.27 \pm 0.12
B33-1-Roof-8G	1.09 \pm 0.10	ND	1.05 \pm 0.10	1.74 \pm 0.33	2.79	2.73 \pm 0.55	0.17 \pm 0.09
B33-1-Roof-9G	0.98 \pm 0.09	ND	2.55 \pm 0.28	1.66 \pm 0.35	4.21	1.77 \pm 0.43	0.27 \pm 0.07
B33-1-Roof-10G	0.87 \pm 0.09	ND	2.89 \pm 0.27	1.53 \pm 0.31	4.42	2.50 \pm 0.57	0.18 \pm 0.08
B33-Roof-1G	ND	ND	0.50 \pm 0.11	1.01 \pm 0.40	1.51	0.87 \pm 0.62	0.13 \pm 0.09
B33-Roof-2G	ND	0.04 \pm 0.05	0.50 \pm 0.10	1.05 \pm 0.41	1.55	0.72 \pm 0.58	0.10 \pm 0.08
B33-Roof-3G	ND	ND	0.59 \pm 0.10	1.08 \pm 0.33	1.67	1.09 \pm 0.54	0.05 \pm 0.06
B33-Roof-4G	ND	ND	0.49 \pm 0.08	0.77 \pm 0.25	1.26	0.82 \pm 0.40	0.10 \pm 0.06

Table 2A: Background Roof Gravel Sample Results (Gamma Spectroscopy, 30 Minute Count Times)
(Samples Collected from Buildings 10, 33-1 and 33)

<i>Radionuclide Concentration (pCi/g) - Results \pm 2 SD</i>							
Sample ID	¹³⁷ Cs 661.6 keV peak	⁶⁰ Co Average of 1173 and 1332 peaks	²²⁸ Th Average of 238/583 keV peaks	²²⁸ Ra (²³² Th) Average of 338/911 keV peaks	Total Thorium ²²⁸ Th + ²³² Th	²³⁸ U 92.77 keV peak	²³⁵ U 186 (144) keV peak
B33-Roof-5G	ND	ND	0.69 \pm 0.13	1.32 \pm 0.43	2.01	1.12 \pm 0.73	0.08 \pm 0.08
Average \pm 1 SD	0.33 \pm 0.49	< 0.06	0.98 \pm 0.99	1.10 \pm 0.51	2.09 \pm 1.41	1.35 \pm 0.86	0.12 \pm 0.07
Average plus 1 Standard Deviations	0.82	< 0.06	1.97	1.61	3.50	2.21	0.19
Average plus 2 Standard Deviations	1.30	< 0.06	2.96	2.12	4.91	3.07	0.26

Typical Gravel Background Levels in pCi/g (at \pm 2 SD)

U-238	1.35 pCi/g \pm 1.72
U-235	0.12 pCi/g \pm 0.14
Thorium (Total)	2.09 pCi/g \pm 2.82
Cs-137	0.33 pCi/g \pm 0.98
Co-60	< 0.06 pCi/g

ND = Not Detected

Not Detected = \leq 0.06 pCi/g for Cs-137 and Co-60, \leq 0.62 pCi/g for U-238

**Table 2B. Gamma Spectroscopy Results of (Background) Tar Samples Collected from Buildings 10, 33-1 and 33.
(Approximately 30 Minute Count Times)**

<i>Radionuclide Concentration (pCi/g) - Results \pm 2 SD</i>							
Sample ID	¹³⁷ Cs 661.6 keV peak	⁶⁰ Co Average of 1173 and 1332 peaks	²²⁸ Th Average of 583/238 keV peaks	²²⁸ Ra (²³² Th) Average of 338/911 keV peaks	Total Thorium ²²⁸ Th + ²³² Th	²³⁸ U 92.77 keV peak	²³⁵ U 186 (144) keV peak
B10-Roof-1T	0.26 \pm 0.12	ND	0.81 \pm 0.17	1.88 \pm 0.72	2.69	5.53 \pm 1.11	0.49 \pm 0.14
B10-Roof-2T	ND	ND	1.03 \pm 0.38	3.21 \pm 1.47	4.24	4.84 \pm 2.31	0.37 \pm 0.31
B10-Roof-3T	ND	ND	1.40 \pm 0.37	3.99 \pm 1.60	5.39	ND	ND
B10-Roof-4T	ND	ND	0.50 \pm 0.24	2.16 \pm 0.97	2.66	5.10 \pm 1.69	0.30 \pm 0.21
B10-Roof-5T	ND	ND	1.41 \pm 0.40	5.30 \pm 1.93	6.71	ND	ND
B33-1-Roof-6T	0.34 \pm 0.18	ND	0.49 \pm 0.19	1.93 \pm 0.70	2.42	3.03 \pm 1.63	0.30 \pm 0.18
B33-1-Roof-7T	ND	ND	2.71 \pm 0.66	6.32 \pm 2.66	9.03	ND	ND
B33-1-Roof-8T	0.36 \pm 0.20	0.23 \pm 0.13	0.76 \pm 0.37	1.73 \pm 1.31	2.49	4.75 \pm 1.66	0.30 \pm 0.26
B33-1-Roof-9T	0.29 \pm 0.24	ND	0.60 \pm 0.28	2.24 \pm 1.10	2.84	4.38 \pm 1.93	0.45 \pm 0.22
B33-1-Roof-10T	0.30 \pm 0.21	ND	1.98 \pm 0.47	6.02 \pm 2.10	8.00	ND	0.51 \pm 0.32
B33-Roof-1T	ND	ND	1.68 \pm 0.35	4.64 \pm 2.01	6.32	ND	0.32 \pm 0.25
B33-Roof-2T	0.19 \pm 0.15	ND	0.63 \pm 0.20	2.28 \pm 0.90	2.91	2.73 \pm 1.18	0.20 \pm 0.18
B33-Roof-3T	ND	ND	1.68 \pm 0.43	5.38 \pm 2.44	7.06	ND	0.31 \pm 0.32

**Table 2B. Gamma Spectroscopy Results of (Background) Tar Samples Collected from Buildings 10, 33-1 and 33.
(Approximately 30 Minute Count Times)**

<i>Radionuclide Concentration (pCi/g) - Results \pm 2 SD</i>							
Sample ID	¹³⁷ Cs 661.6 keV peak	⁶⁰ Co Average of 1173 and 1332 peaks	²²⁸ Th Average of 583/238 keV peaks	²²⁸ Ra (²³² Th) Average of 338/911 keV peaks	Total Thorium ²²⁸ Th + ²³² Th	²³⁸ U 92.77 keV peak	²³⁵ U 186 (144) keV peak
B33-Roof-4T	0.25 \pm 0.20	ND	0.70 \pm 0.28	2.67 \pm 0.91	3.37	4.26 \pm 1.78	0.25 \pm 0.21
B33-Roof-5T	ND	ND	1.69 \pm 0.38	4.85 \pm 2.04	6.54	ND	0.31 \pm 0.30
Average \pm 1 σ	0.13 pCi/g \pm 0.15	0.02 pCi/g \pm 0.06	1.20 pCi/g \pm 0.65	3.64 pCi/g \pm 1.65	4.84 pCi/g \pm 2.27	2.31 pCi/g \pm 2.34	0.27 pCi/g \pm 0.16
Average plus 1 σ	0.28 pCi/g	0.08 pCi/g	1.85 pCi/g	5.29 pCi/g	7.11 pCi/g	4.65 pCi/g	0.43 pCi/g
Average plus 2 σ	0.43 pCi/g	0.14 pCi/g	2.50 pCi/g	6.94 pCi/g	9.38 pCi/g	6.99 pCi/g	0.59 pCi/g

Typical Tar Background Levels in pCi/g (at \pm 2 SD)

U-238	2.31 pCi/g \pm 4.68
U-235	0.27 pCi/g \pm 0.32
Thorium (Total)	4.84 pCi/g \pm 4.54
Cs-137	0.13 pCi/g \pm 0.30
Co-60	0.02 pCi/g \pm 0.12

ND = Not Detected

Not Detected: \leq 0.32 pCi/g for Cs-137, \leq 0.29 pCi/g for Co-60, \leq 2.30 pCi/g for U-238, \leq 0.28 pCi/g for U-235 (186 keV),
 \leq 2.07 pCi/g for Ac-228 (338 keV).

Table 3: Gamma Spectroscopy Results of Gravel and Roof Core samples taken from the Non-NRR Portion of the Building 21 (TRIGA®) Roof

Energy Peaks →	¹³⁷ Cs 661.6 keV	⁶⁰ Co 1173 keV	²²⁸ Th 238 keV (²¹² Pb)	²²⁸ Ra (²³² Th) 911 keV (²²⁸ Ac)	(Total) Th ²²⁸ Th + ²³² Th	²³⁸ U 63.3 (92.7) keV (²³⁴ Th)	²³⁵ U (144) 186 keV
Sample ID ↓	Radionuclide Concentrations (pCi/g) - Results ± 2σ - 30 Minute Counts (except as noted) - Backgrounds <u>Not</u> Subtracted						
Roof Gravel 01	1.03 ± 0.23	ND	1.72 ± 0.24	ND	1.72 ± 0.24	ND	0.16 ± 0.08
Roof Gravel 02	0.88 ± 0.14	ND	1.74 ± 0.24	ND	1.74 ± 0.24	ND	0.19 ± 0.08
Roof Gravel 03	0.84 ± 0.14	ND	1.85 ± 0.35	ND	1.85 ± 0.35	ND	0.20 ± 0.09
Roof Gravel 04	0.94 ± 0.17	ND	1.86 ± 0.26	ND	1.86 ± 0.26	1.34 ± 1.49	0.23 ± 0.10
Roof Gravel 05	0.74 ± 0.13	ND	1.89 ± 0.26	ND	1.89 ± 0.26	ND	0.25 ± 0.11
Roof Gravel 06	0.78 ± 0.13	ND	1.86 ± 0.26	ND	1.86 ± 0.26	1.88 ± 1.51	0.13 ± 0.09
Roof Gravel 07	0.59 ± 0.11	ND	1.78 ± 0.25	ND	1.78 ± 0.25	1.88 ± 1.51	0.18 ± 0.08
Roof Gravel 08	0.67 ± 0.12	ND	1.86 ± 0.26	ND	1.86 ± 0.26	1.15 ± 1.10	0.22 ± 0.13
Roof Gravel 09	1.00 ± 0.18	ND	2.00 ± 0.53	ND	2.00 ± 0.53	2.05 ± 1.73	0.20 ± 0.10
Roof Gravel 10	2.23 ± 0.27	ND	1.97 ± 0.27	ND	1.97 ± 0.27	ND	0.15 ± 0.10
Roof Gravel 11	0.92 ± 0.14	ND	1.94 ± 0.27	ND	1.94 ± 0.27	2.49 ± 2.03	0.19 ± 0.10
Roof Gravel 12	0.94 ± 0.15	ND	1.87 ± 0.26	ND	1.87 ± 0.26	ND	0.20 ± 0.08
Roof Gravel 13	1.00 ± 0.16	ND	1.79 ± 0.43	ND	1.79 ± 0.43	1.33 ± 1.35	0.19 ± 0.09
Roof Gravel 14	0.81 ± 0.14	ND	1.89 ± 0.35	ND	1.89 ± 0.35	1.44 ± 1.46	0.13 ± 0.07
Roof Gravel 15	1.01 ± 0.15	ND	1.75 ± 0.24	ND	1.75 ± 0.24	1.31 ± 1.33	0.19 ± 0.09
Roof Gravel 16	ND	ND	0.82 ± 0.16	ND	0.82 ± 0.16	ND	ND
Roof Gravel 17	0.11 ± 0.06	ND	1.37 ± 0.25	ND	1.37 ± 0.25	ND	0.13 ± 0.07
Roof Core 42	ND	ND	0.96 ± 0.23	1.08 ± 0.55	2.04 ± 0.78	ND	ND

Table 3: Gamma Spectroscopy Results of Gravel and Roof Core samples taken from the Non-NRR Portion of the Building 21 (TRIGA®) Roof

Energy Peaks →	¹³⁷ Cs 661.6 keV	⁶⁰ Co 1173 keV	²²⁸ Th 238 keV (²¹² Pb)	²²⁸ Ra (²³² Th) 911 keV (²²⁸ Ac)	(Total) Th ²²⁸ Th + ²³² Th	²³⁸ U 63.3 (92.7) keV (²³⁴ Th)	²³⁵ U (144) 186 keV
Sample ID ↓	<i>Radionuclide Concentrations (pCi/g) - Results ± 2σ - 30 Minute Counts (except as noted) - Backgrounds <u>Not</u> Subtracted</i>						
Roof Core 43	4.92 ± 0.57	1.97 ± 0.29	1.68 ± 0.40	2.14 ± 0.60	3.82 ± 1.00	ND	0.14 ± 0.15
Roof Core 44	1.95 ± 0.26	0.49 ± 0.13	0.49 ± 0.17	1.03 ± 0.41	1.52 ± 0.58	ND	0.14 ± 0.15
Roof Core 45	5.08 ± 0.58	1.80 ± 0.26	1.69 ± 0.39	1.81 ± 0.47	3.50 ± 0.86	ND	0.11 ± 0.13
Roof Core 46	2.88 ± 0.35	1.70 ± 0.26	1.47 ± 0.23	1.76 ± 0.57	3.23 ± 0.80	ND	0.13 ± 0.09
Roof Core 47	1.91 ± 0.27	0.34 ± 0.13	1.64 ± 0.25	2.23 ± 0.56	3.87 ± 0.81	ND	0.18 ± 0.12
Roof Core 48	1.68 ± 0.26	0.48 ± 0.13	1.57 ± 0.25	2.01 ± 0.48	3.58 ± 0.73	ND	0.16 ± 0.11
Roof Core 49	2.94 ± 0.39	0.95 ± 0.21	1.70 ± 0.32	1.74 ± 0.52	3.44 ± 0.84	ND	0.16 ± 0.12
Roof Core 50	4.22 ± 0.49	1.62 ± 0.25	1.56 ± 0.38	1.92 ± 0.53	3.48 ± 0.91	1.53 ± 1.66	0.17 ± 0.14
Roof Core 51	1.94 ± 0.27	0.90 ± 0.18	2.08 ± 0.36	2.32 ± 0.49	4.40 ± 0.85	ND	0.12 ± 0.09

- Notes:
1. ND means not detected.
 2. Roof Gravel Samples are the surface layer of roof. Roof Core samples are tar samples from below the surface gravel.
 3. Average Minimum Detectable Activities (MDAs):

U-238 = 1.58 pCi/g (63 keV peak)	Co-60 = 0.16 pCi/g (1173 keV peak)
U-235 = 0.14 pCi/g (186 keV peak)	Th-228 = 0.21 pCi/g (238 keV peak)
Cs-137 = 0.13 pCi/g (662 keV peak)	Th-232 = 0.43 pCi/g (911 keV peak)

Building Numbers Names

Building 1	Administration
Building 2	Science Laboratories A, B, C
Building 7	Cafeteria
Building 9	Office/Lab Building
Building 10	Office Building/Health Physics
Building 13	Technical Office Building
Building 14	Technical Office East
Building 15	Technical Office East
Building 19	Swimming Pool Building
Building 21	TRIGA Reactor Facility
Building 22	Inertial Confinement Development Building
Building 23	Former Hot Cell Facility
Building 25	Former Liquid Waste Treatment (NWPF)
Building 27	Space Power Building
Building 29	Office Building
Building 29-2	Landscaper's Building
Building 30	Office/Lab Building (Former LINAC Complex)
Building 31	Storage/Nuclear Calibration
Building 31-2	ECF Critical Building
Building 33	ICF Lab Building
Building 33-1	ICF Office Building
Building 33-5	Painters Building
Building 34	Fusion DIII-D Building
Building 34-1	Fusion DIII-D Capacitor Building
Building 34-2	Fusion DIII-D Lab Building
Building 34-3	Fusion DIII-D Storage Building
Building 35	Test Tower Building
Building 35-1	Facilities (Shipping & Receiving)
Building 36	Experimental Building
Building 37	Sorrento Valley Building A
Building 39-1	Storage Building
Building 41	Former Nuclear Waste Processing Facility (southern end) -Dismantled Remaining Portion of Building - R&D Laboratory Building (QA)
Building 42	Machine Shop
Building 45	Machine Shop
Building 63	3550 Dunhill St.
Building 64	11030 Roselle St.
Building 65	11040 Roselle St.
Building 66	3520 Dunhill St.
Building 66	3510 Dunhill St.

Figure 1: GA's Main Site and Sorrento Valley Site

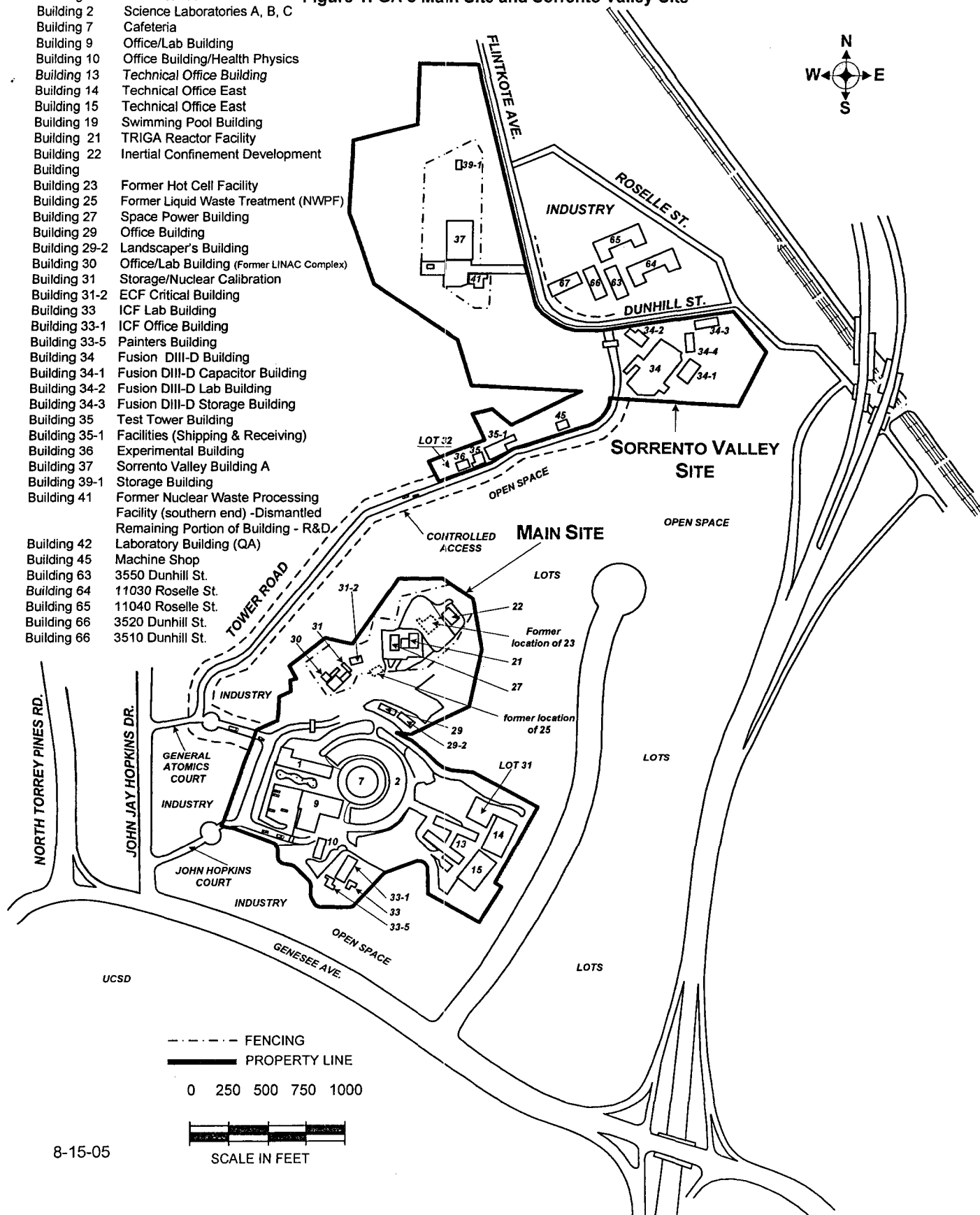
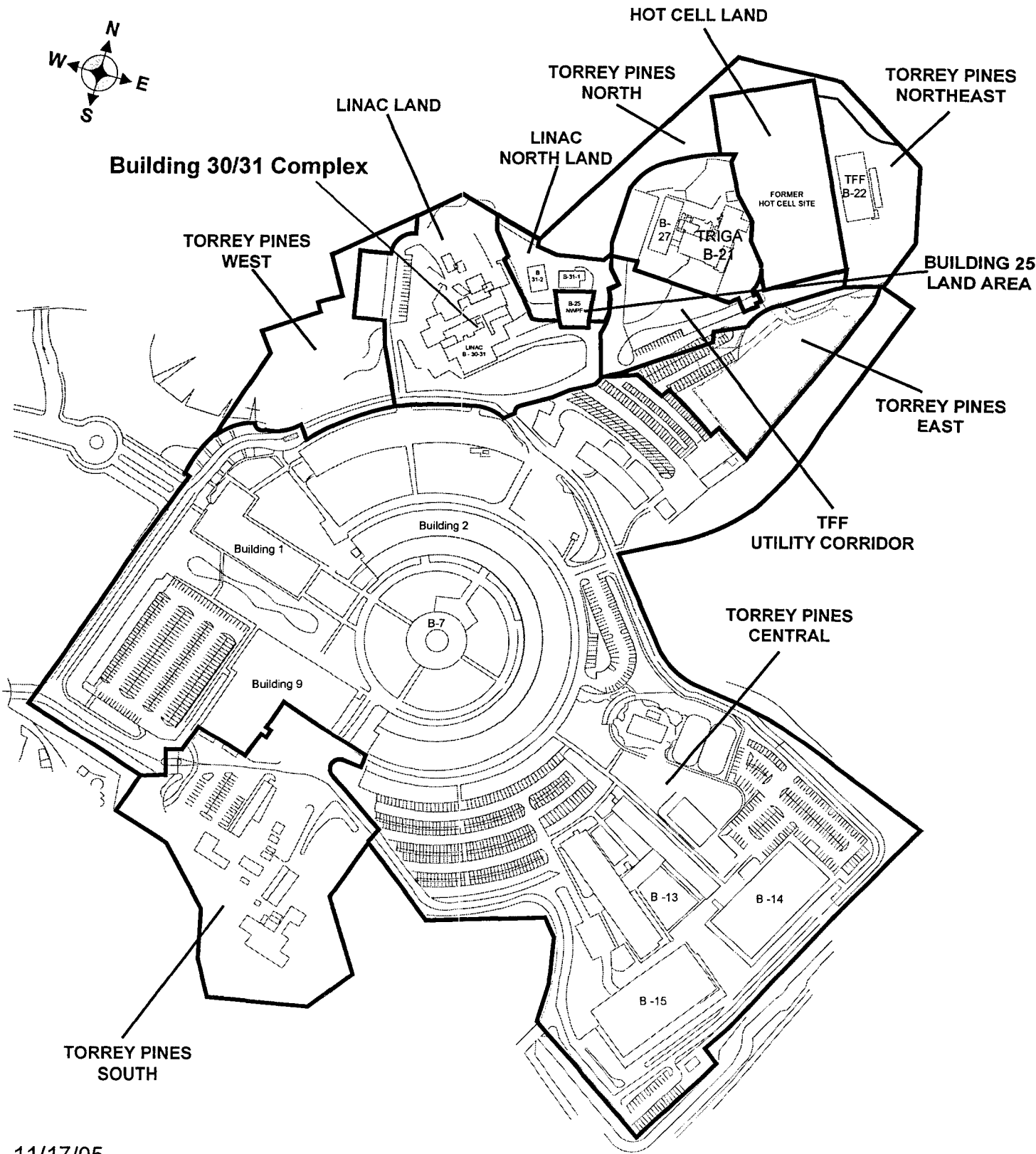


Figure 2A: Torrey Pines (Main) Site Land Areas



Architectural floor plan of the Upper Roof of the National Aeronautics and Space Administration (NASA) building. The plan shows a complex layout with various rooms, corridors, and structural elements. Key dimensions are provided: overall width 61.6', overall depth 68.9', and a large rectangular section measuring 43' by 24'. A smaller section on the right is 22' by 24.4'. A large circular feature is labeled 'MK III'. A diagonal line indicates the 'Upper Roof' structure. A note points to an 'Overhang' area. A compass rose shows North (N), South (S), East (E), and West (W).

Figure 2C: Non-NRR Portion of the Building 21 (TRIGA) Roof

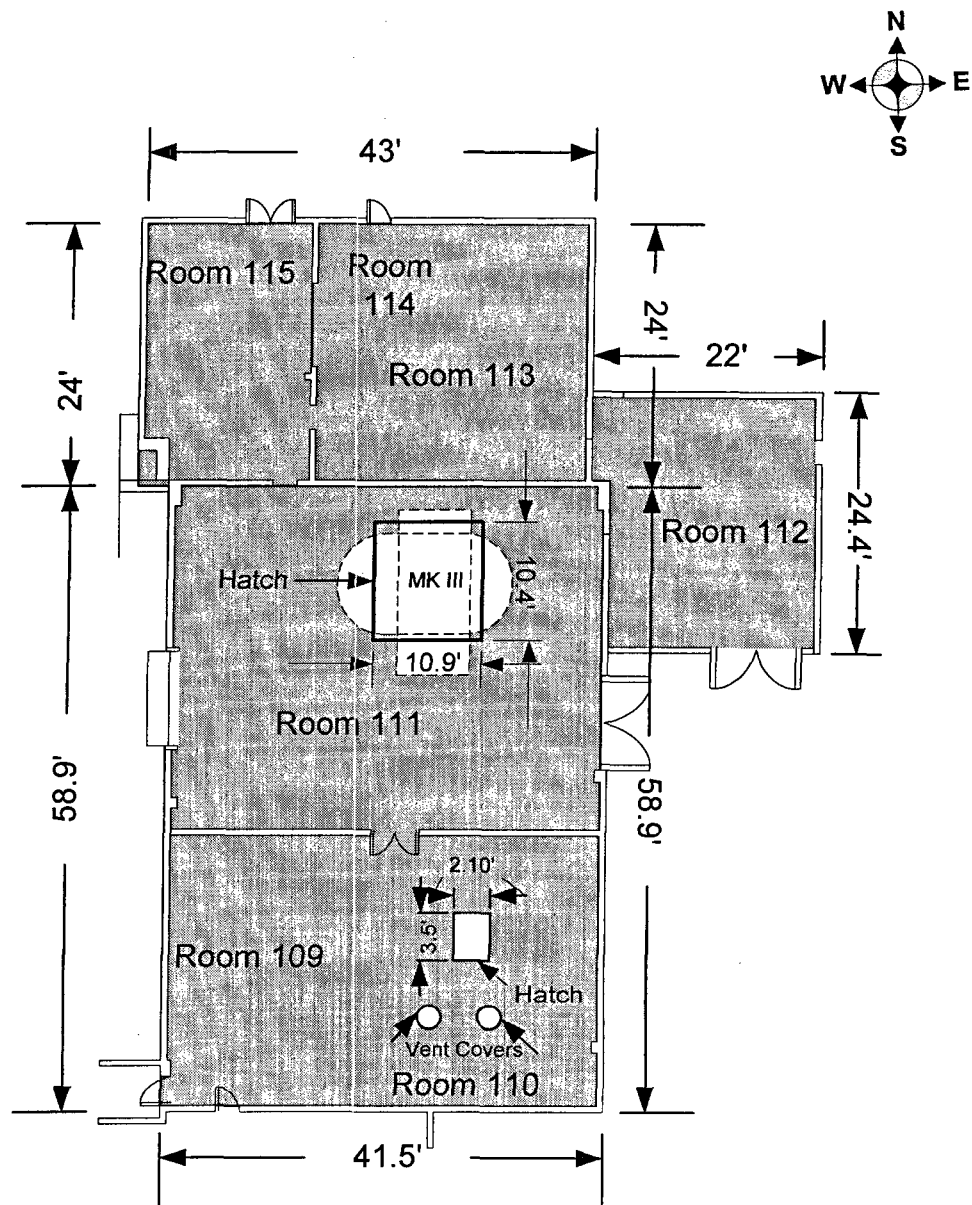
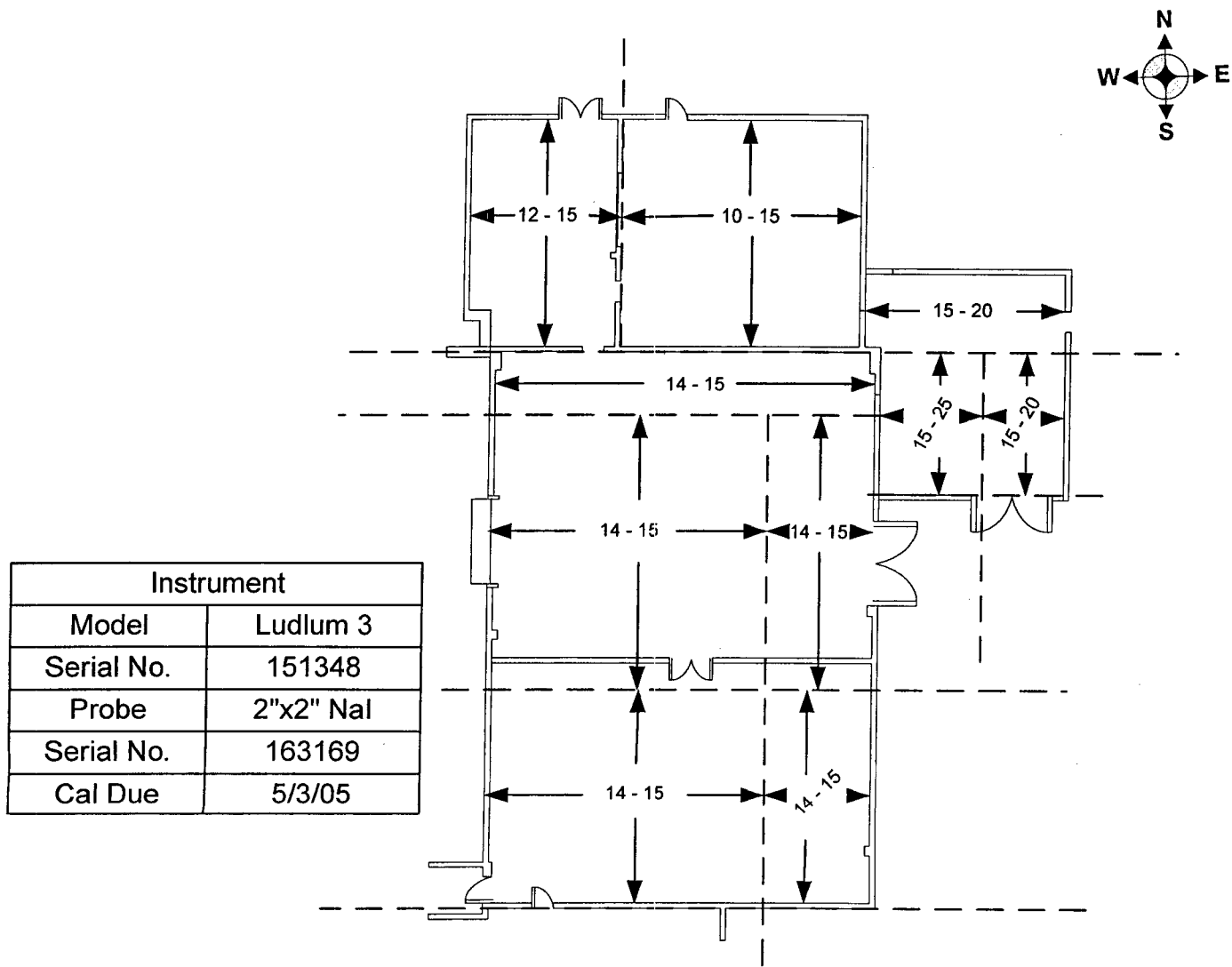


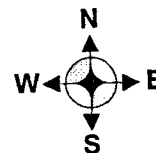
Figure 3: Building 21, Non-NRR TRIGA Roof, Exposure Rate Scan Locations and Results



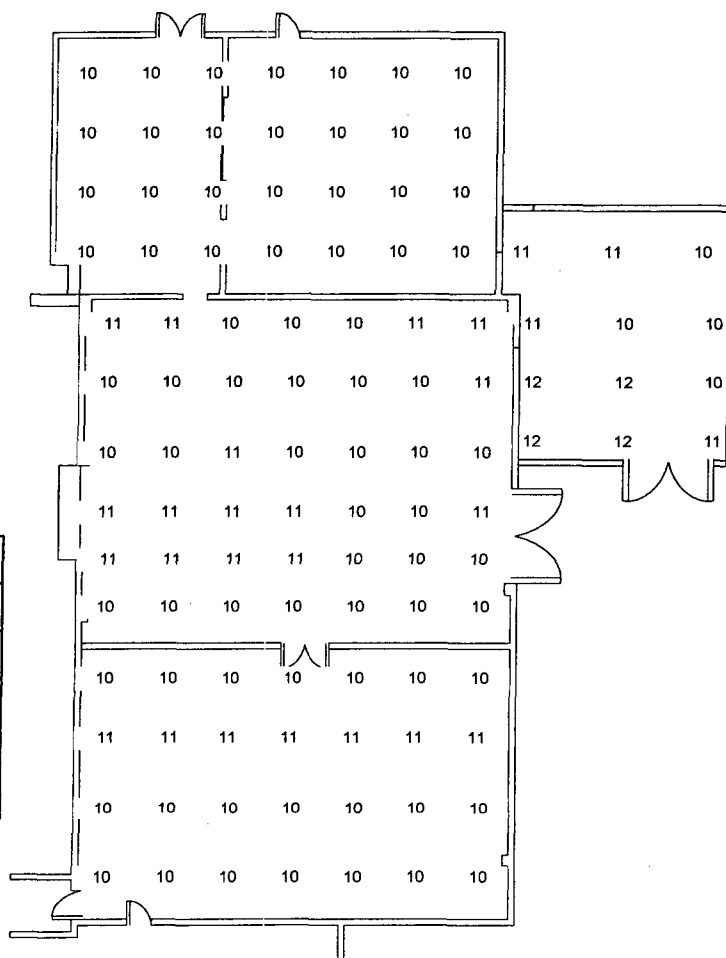
Technicians: Scott Cowan/Joseph Sullivan Date: 3/25/05

- Notes:
1. All measurements taken within 1" of the surface
 2. All results in $\mu\text{R/hr}$
 3. 100% of the surface was scanned

Figure 4: Building 21, Non-NRR TRIGA Roof, Fixed Exposure Rate Locations and Results



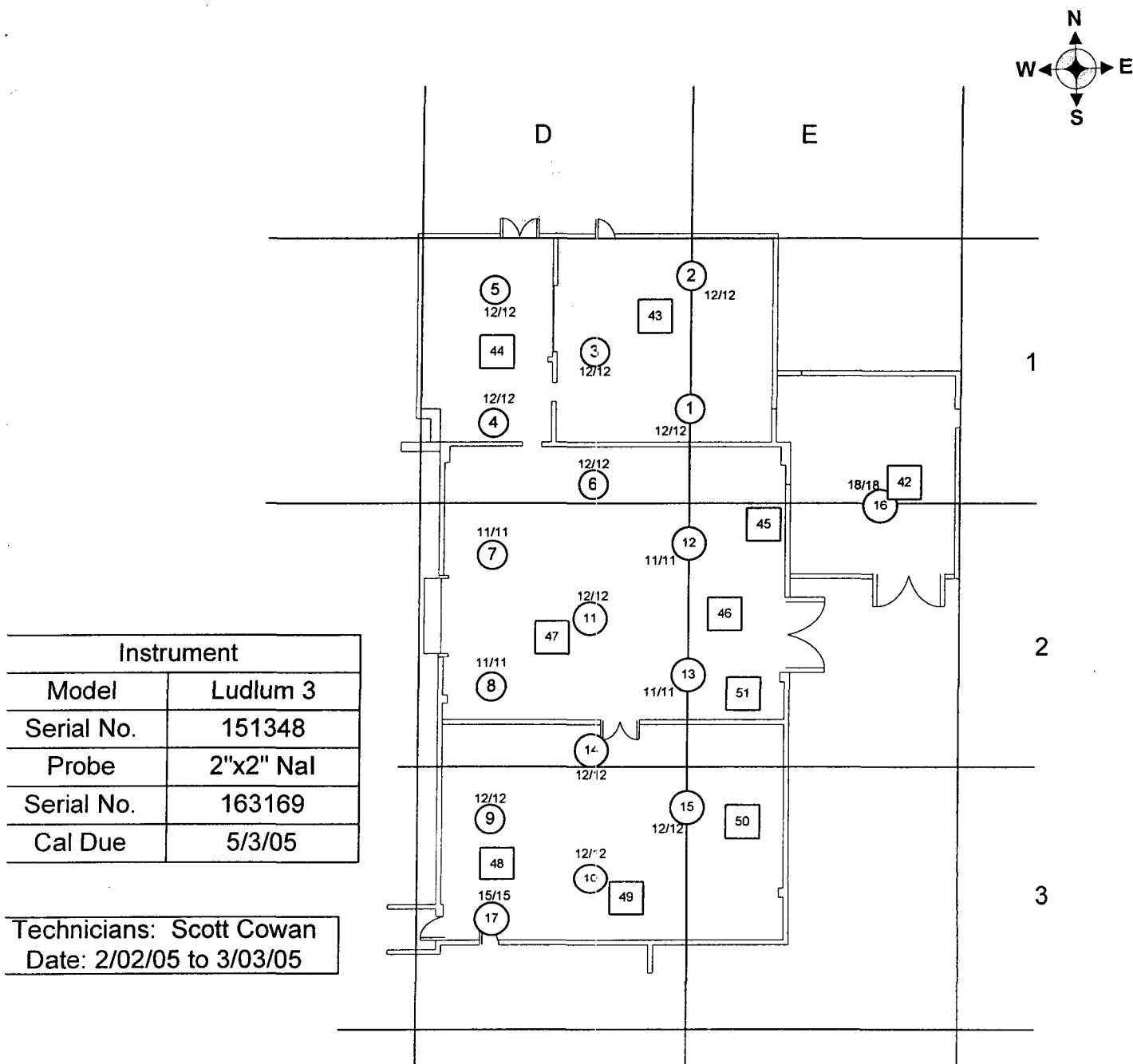
Instrument	
Model	Ludlum 3
Serial No.	151348
Probe	2"x2" NaI
Serial No.	163169
Cal Due	5/3/05



Technicians: Scott Cowan/Joseph Sullivan Date: 3/28/05

- Notes: 1. All measurements taken at 1m from the surface
2. All results in $\mu\text{R/hr}$

Figure 5: Building 21, Non-NRR TRIGA Roof, Gravel/Tar Sample Locations and Exposure Rate Measurement Locations and Results



General Atomics'

**Final Radiological Survey Report for the Building 21, Non-NRR
TRIGA[®] Facility, Roof**

Appendix A

**Final Survey Plans for the Building 21, Non-NRR TRIGA[®] Facility,
Roof**

January 7, 2005

Prepared By: W. T. LaBonte

Approved By:

Laura Gonzales
L. Q. Gonzales

Final Radiological Survey Plan for the Non-NRR Portions of TRIGA® Roof

This Final Survey Plan is for the Non-NRR Portions of the TRIGA® reactor facility (Building 21). See figure 1 for an illustration of the areas included in this survey plan. This roof has a total surface area of approximately 4102 ft² (~381 m²).

Classification

Building 21 (TRIGA®) is classified as a **Suspect Affected Area**. The most likely potential contaminants are Cs-137 and Co-60.

Survey Objectives and Responsibility

The purpose of performing a final survey is to demonstrate that the radiological conditions satisfy the NRC and State of California guidelines for release to unrestricted use contained in the GA Site Decommissioning Plan as reproduced below.

Surveys and sampling will be performed by qualified Health Physics technicians having a minimum of 3 years Health Physics Technician experience following approved Health Physics procedures and this plan. The results of this survey will be documented in the Non-NRR TRIGA® facility final report.

Release criteria (per GA Site Decommissioning Plan)

1. **Exposure Rate Measurements**

The guideline value for exposure rates measured at 1 m above the surface is 10 µR/hr above background.

2. **Soil:**

The release criteria for roofing material, which is considered to be similar to soil, is specified in the Site Decommissioning Plan are summarized below. It is GA's intent to remediate the area until sample results are < 10% of the soil release criteria provided below. Any samples above 10% of the soil release criteria will be re-evaluated. The values presented below are above background levels.

Cs-134	10 pCi/g
Cs-137	15 pCi/g
Co-60	8 pCi/g
Eu-152	11 pCi/g
Eu-154	10 pCi/g
Sr-90	1800 pCi/g

If multiple nuclides are present, the sum of the ratios of the concentration of each Radionuclide to its respective guideline must not exceed 1. **If other nuclides are encountered, notify HP Management for release criteria.**

Alert Levels

Exposure Rate Measurements

> 25 μ R/hr at surface

> 20 μ R/hr at 1 m

Background Measurements

Background measurements must be made with each instrument used on each type of surface (i.e., concrete, metal, dry wall, etc.,) prior to using the instrument.

Instrument Response Checks

Instrument response checks must be made on a daily basis for each instrument in use, prior to use, to assure the instrument is properly responding to the type of applicable radiation.

Documentation

Every survey conducted must be documented **on a daily basis** on a drawing showing the approximate locations surveyed. Include the results (including units), the technicians signature, date, instrument(s) used (including model and serial number of both the ratemeter and the detector), calibration due date, % efficiency, background readings (if applicable) and any other applicable information.

Final Survey Requirements

Final survey requirements are provided in the following table:

Final Radiological Surveys Planned for the Non-NRR TRIGA® Roof

Type of Survey/Activity	Suspect Affected Area
Gridding Required?	Yes, 10m x 10m grids.
Roof Gravel Samples	Take 15 gravel samples in a 5 meter triangular grid pattern, as identified in Figure 2. Analyze samples by gamma spectroscopy.
Exposure Rate Scan Survey	<p>100 % of roof area, with detector held ~1" from surface</p> <p>Caution: Do Not Survey or approach any area within 2m (~6ft) of the roof edge.</p>
Fixed Exposure Rate Measurements (@ 1m from surface)	<p>1 per 4 m², or 1 every 2m.</p> <p>Minimum number of measurements =95 Based on ~ 381 m².</p> <p>Caution: Do Not Survey or approach any area within 2m (~6ft) of the roof</p>

Figure 1: Building 21, Non-NRR TRIGA Roof

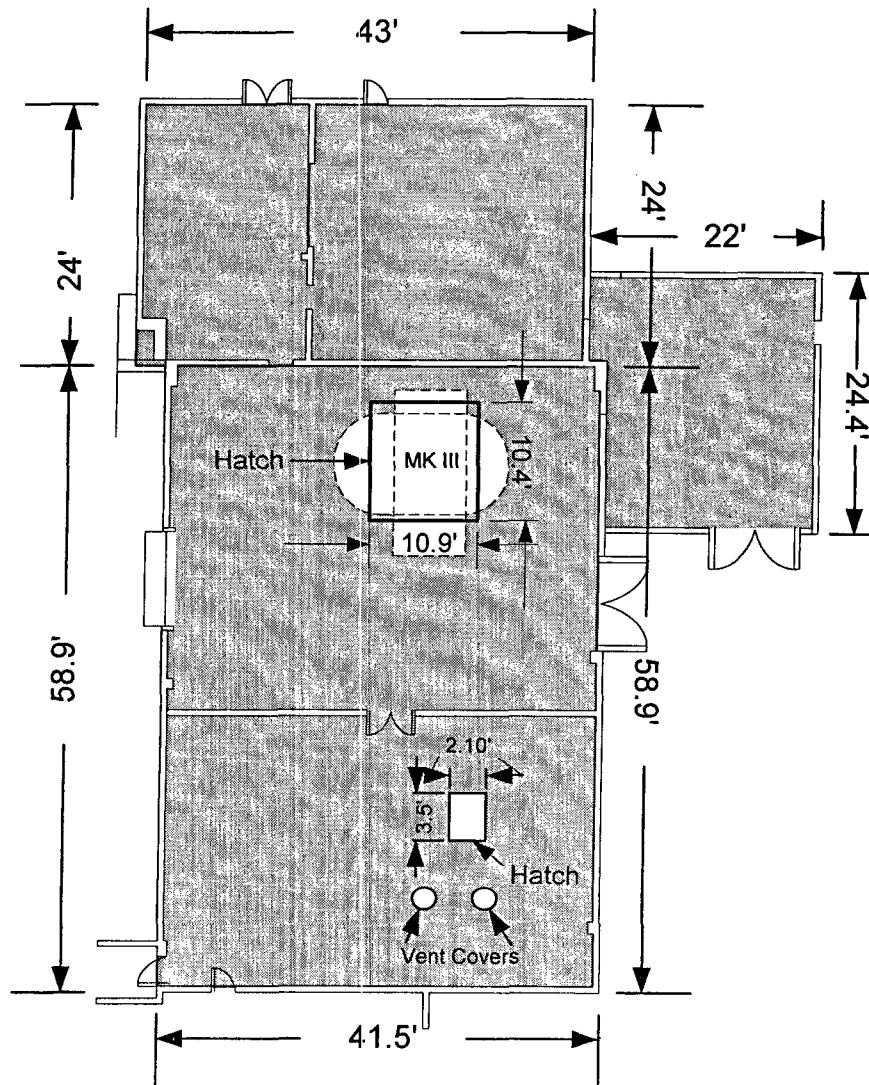


Figure 2: Building 21 (TRIGA) Roof Gravel Sample Locations

