

General Atomics'

**Final Radiological Survey Report for the Non-Reactor
Portion of the TRIGA[®] (Building 21) Site**

Appendix A

**Final Survey Plans for the TRIGA[®] Non-Reactor Land Area and
The Non-Reactor Portion of Building 21**

April 22, 2005

Prepared By: W. T. LaBonte

Approved By: Laura Q. Gonzales
L. Q. Gonzales

Final Survey Plan for the Non-NRR Portion of the TRIGA® Land Area

This final radiological survey plan is for the Portion of TRIGA® land that is NOT Licensed by the Nuclear Research Reactor (NRR) Branch of the NRC. This Survey Plan covers *Mainly* open land areas. A large portion of this land area is paved with either asphalt or concrete. The portion of the TRIGA® land area included in the NRR license will be the subject of a future Final Survey Plan. This Final Survey Plan ONLY addresses Non-NRR TRIGA® land area.

This portion of the TRIGA® land area is approximately 19,600 ft² (~ 1800 m²). See Figure 1 for an illustration of the TRIGA® land area, including the Non-NRR portion. See Figure 2 for the *GRID WORK* measurements of this land area.

History and Classification

History

This land area provided access to the TRIGA® reactor facility, a staging area for equipment and materials used/removed from the TRIGA® reactor facility, and, a temporary storage area for packaged radioactive material awaiting disposition. This land also contained a machine shop which serviced TRIGA® reactor facility activities. This machine shop, which was constructed from corrugated metal on a concrete slab, was dismantled and disposed of in 2001.

Classification

This entire area is classified as a **Suspect Affected Area** for Final Survey Purposes.

Survey Objectives and Responsibility

The purpose of performing a final survey is to demonstrate that the radiological conditions within the Non-NRR portion of the TRIGA® Land Area satisfy the NRC and State of CA guidelines for release to unrestricted use, as identified in the GA Site Decommissioning Plan.

The objectives include (1) to show that the average surface contamination levels for each survey unit are within the authorized value, (2) to show that the maximum residual activity ("hot spot" area) do not exceed three times the average value in an area up to 100 cm², (3) that a reasonable effort has been made to clean removable contamination and fixed contamination, (4) to show that the residual soil activity is below the NRC and State approved release concentrations, and (5) that the exposure rates in occupiable locations are less than 10 µR/hr above background measured at 1 meter above the surface.

Samples will be counted in the Health Physics laboratory (onsite). Surveys will be taken only by

qualified Health Physics Technicians having a minimum of 3 years Health Physics Technician experience. The survey and final report documenting the survey will be performed by GA's Health Physics group.

Final Radiological Surveys Planned

The radiological surveys, identified in the table below are the minimum survey requirements. If elevated levels are found, the area may have to be re-classified to a higher survey classification and additional surveys will be required. Notify Health Physics management immediately if levels above the alert levels are detected during the performance of this survey.

Final Radiological Surveys Planned for the Non-NRR portion of the TRIGA® Land Area

Survey Type/Action	Suspect Affected Area
Grid Area	Yes, 10m x 10m grids.
Concrete/ Asphalt Surfaces ⁽¹⁾ (Scan w/ 434 cm ² alpha probe).	100% Scan of surfaces
Concrete/Asphalt Surfaces ⁽¹⁾ (Scan w/ 434 cm ² beta probe).	100% Scan of surfaces
Minimum number of Fixed Measurements ⁽³⁾ ⁽⁴⁾	Measurement every 2m (one/4m ²). Alternate between (1) a wipe ⁽²⁾ , (2) an alpha fixed measurement and (3) a beta fixed measurement on all Concrete/Asphalt surfaces . Total measurements =250 based on ~1000 m ² paved surfaces.
µR/hr Readings (scans) @ surface	100% of accessible surfaces
µR/hr Readings (Fixed) Fixed = @ 1m from surface	One (1) every ~ 2 m <u>plus</u> One (1) at each soil sample location.
Surface (0-6") Soil Samples @ 1m from surface	47 surface (0-6") samples (beneath Asphalt in Asphalt paved areas) based on a 5 m triangular grid sampling, see Figure-3 for locations.
Sub-Surface Soil Samples.	Sub-Surface Sampling: in the Six (6) areas identified in Figure-3, sample at 0-6", 6"-12", 12"-18", 18"-24", 24"-30", and 30"-36". A total of 36 samples.

- (1) Clean surfaces to remove debris or dirt.
- (2) For removable measurements, take a 100 cm² wipe at each location and count using a low level alpha/beta counter.
- (3) For the fixed measurements:
 - For α measurements; use either the hand held alpha counter (*minimum* of ~6 second count). Document all readings in cpm.
 - For β measurements; take a 2 minute count using the 100 cm² gas flow proportional detector (beta) with the Model 2221 ratemeter. Document all readings and mark on a drawing the locations the readings were taken.
- (4) A "measurement" is either (1) a "fixed" radiation measurement representing total activity or (2) a wipe (removable activity).

Release Criteria (per GA Site Decommissioning Plan)

Direct Surface Scans

Characterization surveys performed on this land area included gamma spectroscopy analysis. The predominate isotope detected was Cs-137.

The release criteria for most beta/gamma emitters (which includes Cs-137) is:

**5,000 dpm/100 cm², averaged over 1 m² area
15,000 dpm/100 cm², maximum in a 100 cm² area
1,000 dpm/100 cm², removable contamination.**

Exposure Rate Measurements

The release criteria for exposure rates measured at 1 m above the surface is 10 μ R/hr above background.

Soil Criteria (soil limits apply to roof gravel, concrete rubble and asphalt rubble)

The release criteria for soil are specified in the Site Decommissioning Plan and summarized below. The values presented below are above background levels.

Cs-137	15 pCi/g
Co-60	8 pCi/g
Enriched Uranium (U-234 plus U-235)	30 pCi/g
Thorium (Th-232 plus Th-228)	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

If the following "alert levels" are exceeded, notify HP Management so an evaluation can be performed to determine if increased survey coverage or decontamination is required.

On Concrete or Asphalt Surfaces

Note: The Alert levels provided below are based on the background cpm plus the meter cpm value taking into account the instrument efficiency and probe surface area. The alert level for each instrument used must be determined prior to performing surveys. The background determination must be performed in building 13 or other HP management approved area.

Alpha Monitoring

>100 cpm alpha using the large area (434 cm²) probe. If >100 cpm, check with a hand held alpha meter.
>60 cpm using a hand held alpha probe, notify Health Physics Management.

Beta Scanning using 434 cm² probe

> ~300 cpm above background using any other 434 cm² probe.

Beta Scanning using a 15 cm² pancake GM detector

> ~ 80 cpm above background.

Exposure Rate Measurement

Exposure rate measurements at contact (1-2" above the surface) and at 1m above the surface: 23 µR/hr.

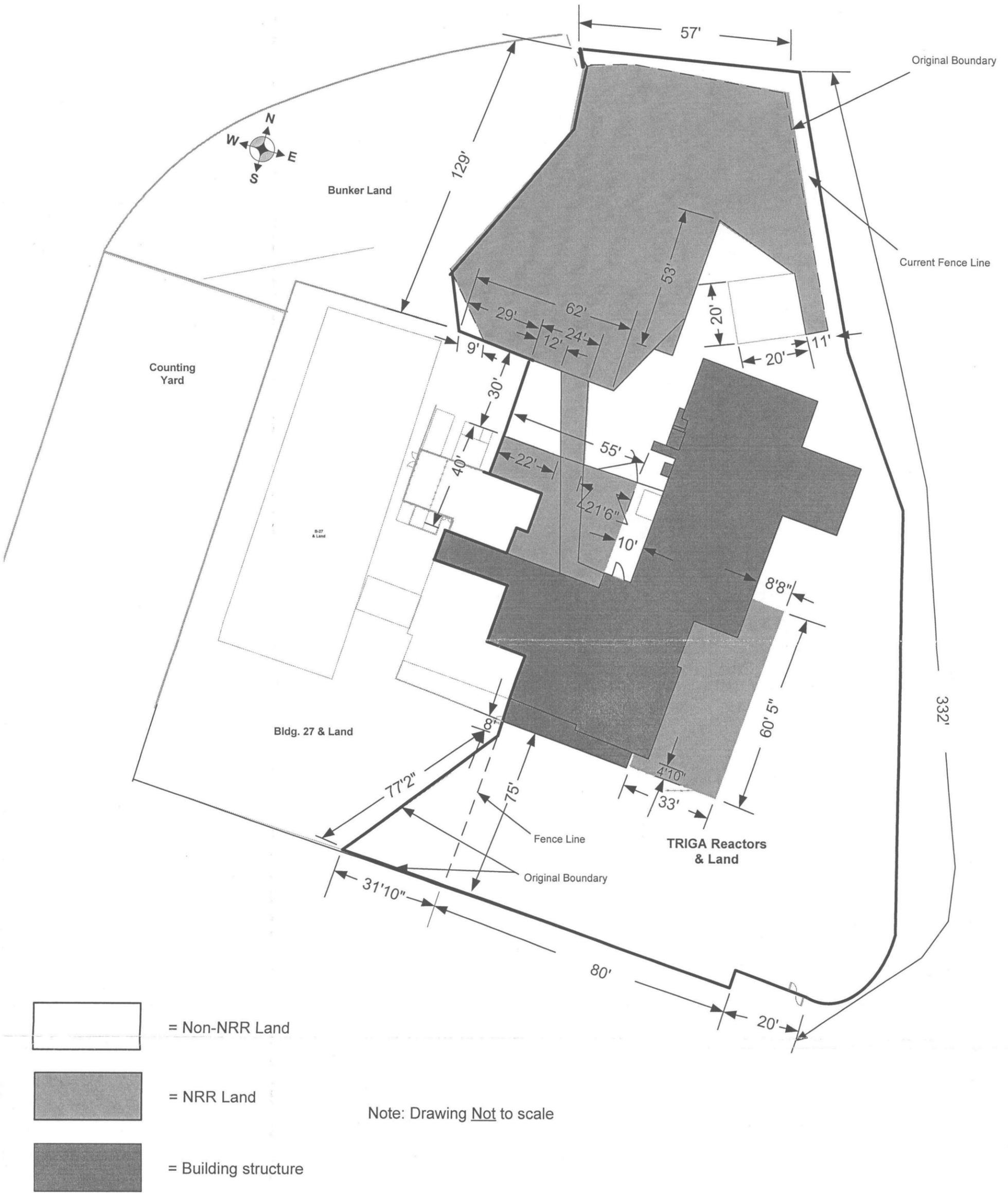
Soil Samples

Any Radionuclide above natural background levels (see HP-40 for background levels). All soil sample results must be reviewed by Laura Gonzales or Bill LaBonte.

Documentation

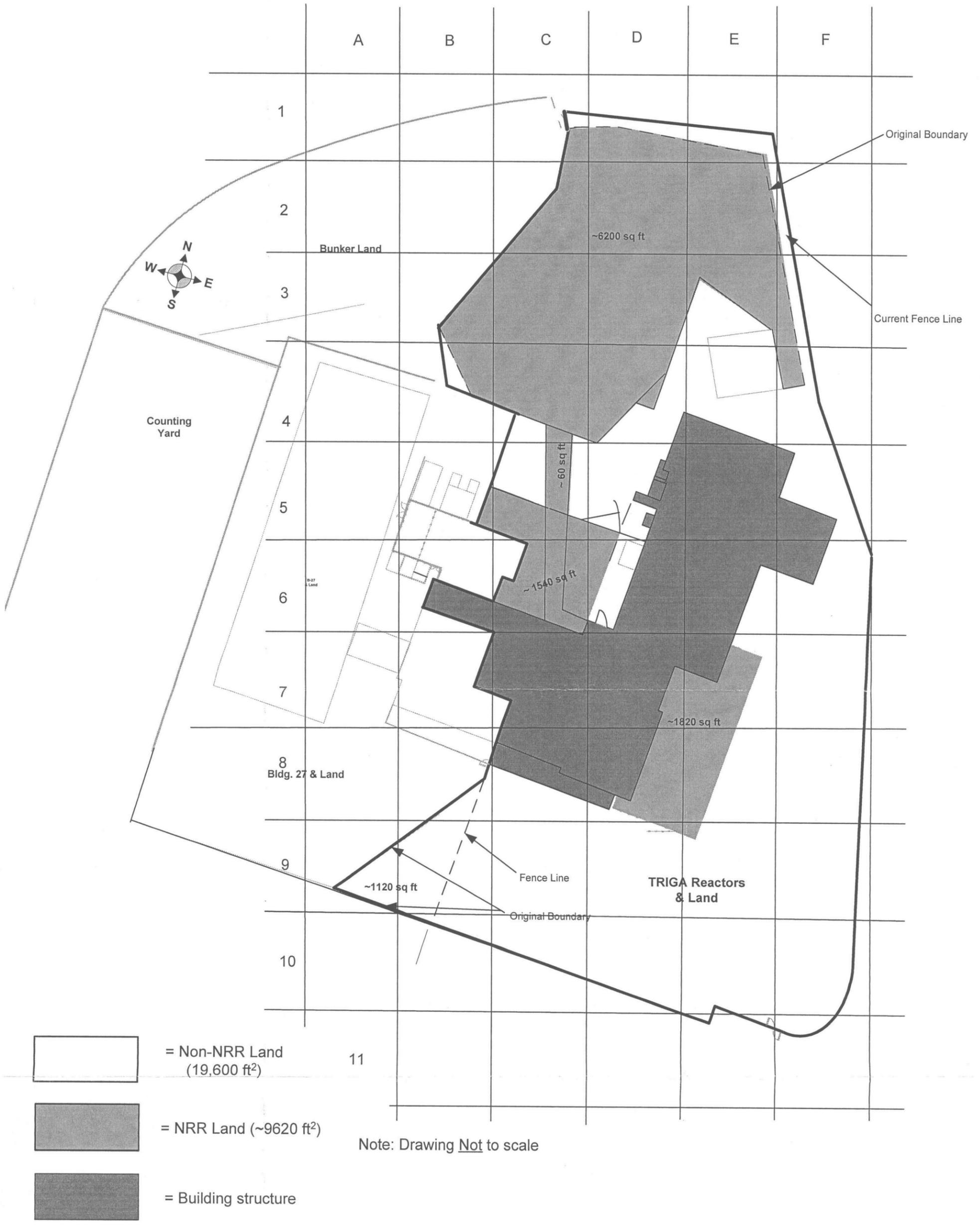
Every survey conducted must be documented on a daily basis on a drawing showing the approximate locations surveyed. Include the results (including units), the technicians signature, date, instrument(s) used (including model and serial number of both the ratemeter and the detector), calibration due date,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

Figure 1: TRIGA Land Area



April 8, 2005 WTL

Figure 2: TRIGA Land Area Grid



May 10, 2005 WTL

Figure 3: TRIGA Non-NRR Land Area
Soil Sample Locations

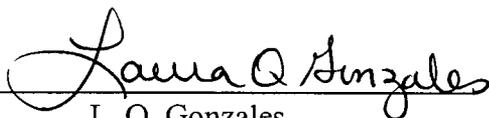


March 15, 2005

Prepared By: W. T. LaBonte



Approved By:


L. Q. Gonzales

Final Radiological Survey Plan for the Non-NRR Portion of the TRIGA® Facility(Building 21)

This Final Radiological Survey Plan is for the portion of the TRIGA® facility that is not under the NRC, NRR branch, license. This includes Room 112 and the interior building structures formerly known as Rooms 109, 110, 111, 113, 114 and 115 of Building 21. This space housed the former Mark III TRIGA® reactor and supporting facilities and equipment which have been dismantled, surveyed and accordingly disposed of.

See Figure 1 for location and Figure 2 for an illustration of the portion of the TRIGA® facility included in this Final Survey Plan.

History and Classification

TRIGA® Mark III reactor achieved initial criticality in 1996. The TRIGA® Mark III was a 2000 kW(t) reactor that primarily was operated for thermionics experiments. It was shutdown, it's fuel was removed and stored in the TRIGA® Mark F fuel pool, and it's license was terminated in 1975.

Following license termination, the facility was converted to laboratory and test facilities for HTGR fuel.

Classification

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

Survey Objectives and Responsibility

The purpose of performing a final survey is to demonstrate that the radiological conditions in the TRIGA® Mark III reactor facility satisfy the NRC and State of CA guidelines for release to unrestricted use. The objectives include (1) to show that the average surface contamination levels for each survey unit are within the authorized value, (2) to show that the maximum residual activity ("hot spot" area) do not exceed three times the average value in an area up to 100 cm², (3) that a reasonable effort has been made to clean removable contamination and fixed contamination and (4) that the exposure rates in occupiable locations are less than 10 µR/hr above background measured at 1 meter from any surface. Samples will be counted in the Health Physics laboratory (onsite). Surveys will be taken only by qualified Health Physics Technicians having a minimum of 3 years Health Physics Technician experience. The survey and final report documenting the survey will be performed by GA's Health Physics group.

Release Criteria (per GA Site Decommissioning Plan)**Concrete/Asphalt/building surface Release Criteria**

The NRC release criteria Beta Gamma emitters, which is the expected major contaminates, if present, is:

5,000 dpm /100 cm², averaged over a 1 m² area
 15,000 dpm /100 cm², total, maximum in a 100 cm² area
 1,000 dpm/100 cm², removable activity

The NRC release criteria for Alpha activity, which is not expected, is:

5,000 dpm /100 cm², averaged over a 1 m² area
 15,000 dpm /100 cm², total, maximum in a 100 cm² area
 1,000 dpm/100 cm², removable activity

Exposure Rate Measurements

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

Alert Levels**Alpha Alert Values**

If the following "alert levels" are exceeded, notify HP Management so an evaluation can be performed and to evaluate if decontamination is required.

- > 100 cpm alpha using the large area (434 cm²) probe (check area with a hand-held alpha meter).
- > 60 cpm using a 50 cm² hand-held alpha probe (~ 600 dpm/100 cm²)

Beta Monitoring

- >250 cpm above the appropriate background using the 434 cm² probe.
- >100 cpm above the appropriate background using the 100 cm² probe.
- >40 cpm above background using a portable GM detector. (**Note: this meter should ONLY be used in areas the 434cm² or 100 cm² probes will not fit).**

Exposure Rate Measurements

- > 25 µR/hr at surface
- > 20 µR/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.

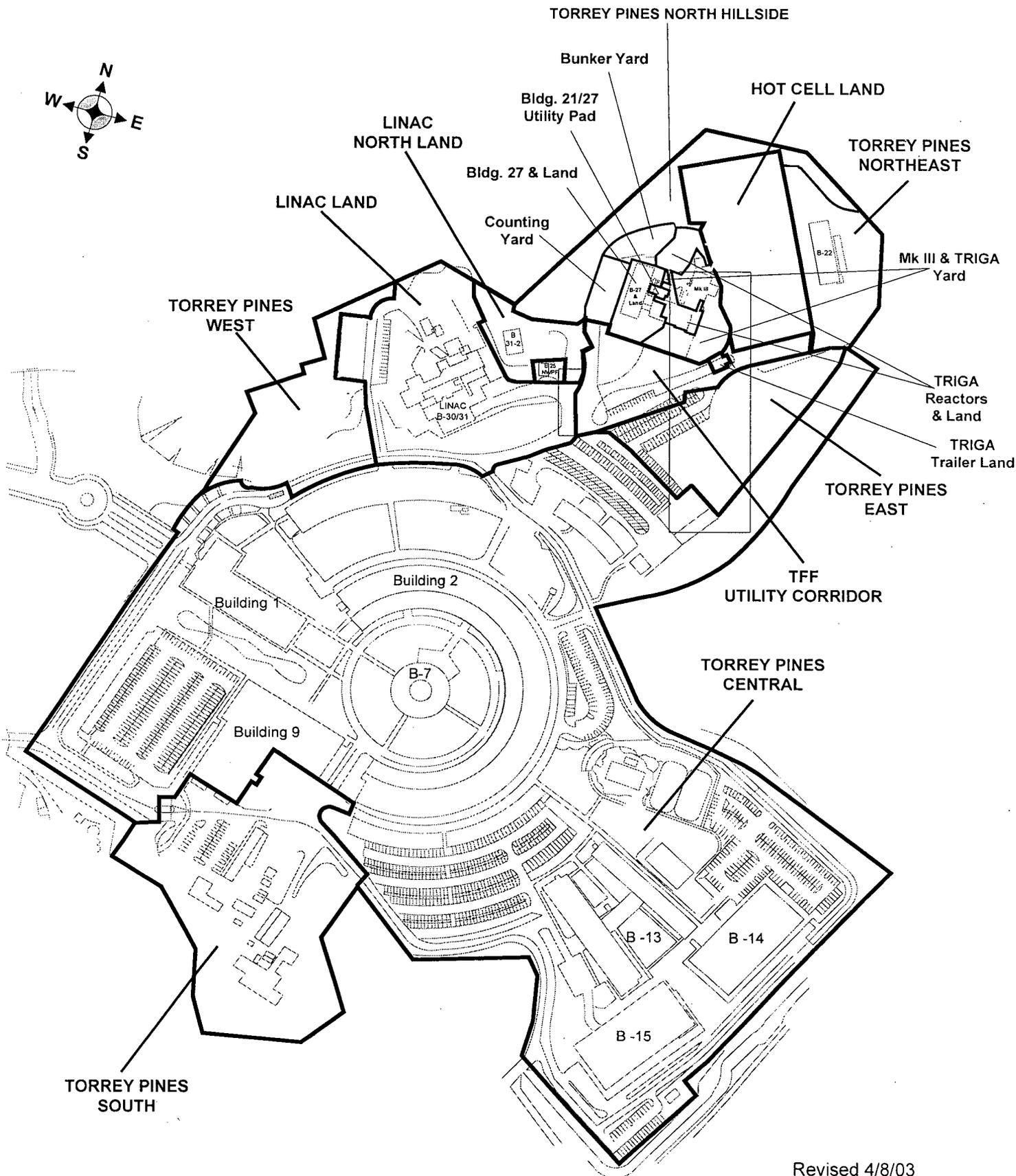
Documentation

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 Radiological Surveys Planned for the TRIGA® Mark III Reactor Facility

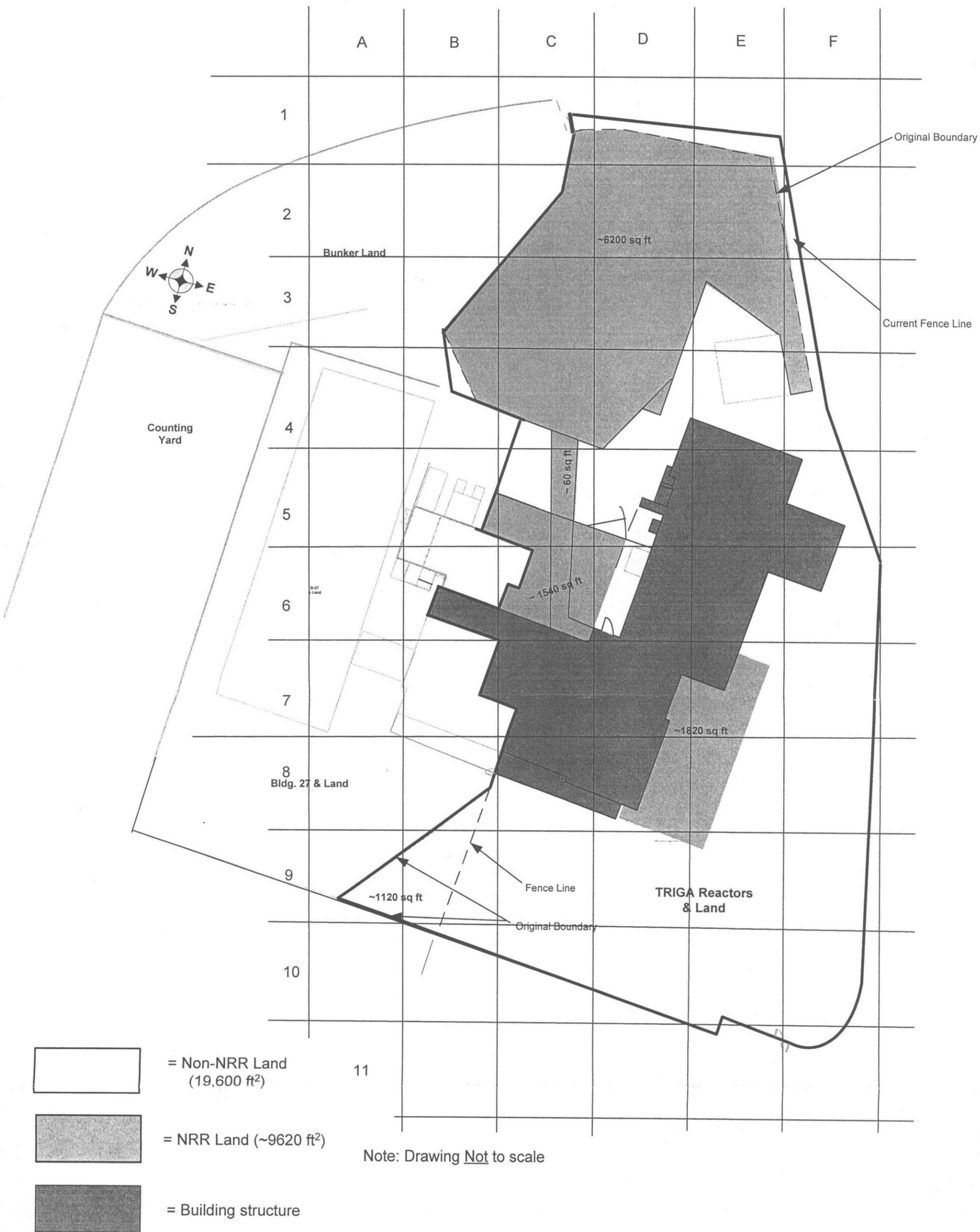
Type of Survey/Activity	Suspect Affected Area
Gridding Required?	Yes, 1m x 1m grids
α and β Surface Scan Measurements	Scan 100% of floors and walls up to 2m with an α and a β 434 cm ² gas flow proportional detector held within 1" of the surface. Scan 10% of surfaces above 2m.
Fixed Measurements	Alternately, take one (1) α , β , or wipe survey measurement every 4 m ² (every 2m). Include measurements on light fixtures, pipes, vent ducts, etc. All wipe samples should be analyzed for α & β activity at the Health Physics laboratory.
Exposure rate Surface Scan Measurements	Scan 100% of floors and walls up to 2m with a 2" x 2" NaI(Tl) detector held within 1" of the surface. Scan 10% of surfaces above 2m.
Fixed Exposure Rate Measurements @ 1m from surface	Take one (1) exposure rate measurement with a 2" x 2" NaI(Tl) detector held 1m from the surface every 2m (one measurement every 4m ²) on floors and walls up to 2m.

Figure 1 Torrey Pines (Main) Site Land Areas



Revised 4/8/03

Figure 2: TRIGA Land Area Grid



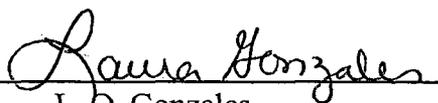
May 10, 2005 WTL

August
August 30, 2006

LB Prepared By: W. T. LaBonte



Approved By:


L. Q. Gonzales

Final Survey Plan for the Non-NRR Portion of the TRIGA® Land Area

Supplement-1

This Supplement to the final radiological survey plan for the Make Up Tank (MUT) excavation pit Portion of TRIGA® land that is NOT Licensed by the Nuclear Research Reactor (NRR) Branch of the NRC which was unintentionally omitted in the original Final Survey Plan. The portion of the TRIGA® land area included in the NRR license will be the subject of a future Final Survey Plan. This Final Survey Plan supplement ONLY addresses Non-Reactor TRIGA® portion of the MUT excavation pit. See Figure 1 for an illustration of the TRIGA® land area, including the Non-NRR portion and the MUT pit area.

History and Classification

History

This excavation pit was created during the removal of the Make Up Tank (pure supply water). The portion of the pit closest to the TRIGA® building is in the Non-reactor portion of the TRIGA® complex.

Classification

This entire area is classified as a **Suspect Affected Area** for Final Survey Purposes.

Survey Objectives and Responsibility

The purpose of performing a final survey is to demonstrate that the radiological conditions within the Non-NRR portion of the TRIGA® Land Area satisfy the NRC and State of CA guidelines for release to unrestricted use, as identified in the GA Site Decommissioning Plan.

The objectives include (1) to show that the average surface contamination levels for each survey unit are within the authorized value, (2) to show that the maximum residual activity ("hot spot" area) do not exceed three times the average value in an area up to 100 cm², (3) that a reasonable effort has been made to clean removable contamination and fixed contamination, (4) to show that the residual soil activity is below the NRC and State approved release concentrations, and (5) that the exposure rates in occupiable locations are less than 10 µR/hr above background measured at 1 meter above the surface.

Samples will be counted in the Health Physics laboratory (onsite). Surveys will be taken only by qualified Health Physics Technicians having a minimum of 3 years Health Physics Technician experience. The survey and final report documenting the survey will be performed by GA's Health

Physics group.

Final Radiological Surveys Planned

The radiological surveys, identified in the table below are the minimum survey requirements. If elevated levels are found, the area may have to be re-classified to a higher survey classification and additional surveys will be required. Notify Health Physics management immediately if levels above the alert levels are detected during the performance of this survey.

Final Radiological Surveys Planned for the Non-Reactor portion of the MUT excavation pit

Survey Type/Action	Suspect Affected Area
Grid Area	Yes, 10m x 10m grids.
µR/hr Readings (scans) @ surface	100% of accessible surfaces
µR/hr Readings (Fixed) Fixed = @ 1m from surface	At least two (2) evenly spaced measurements <u>plus</u> One (1) at each soil sample location.
Surface (0-6") Soil Samples @ 1m from surface	3 surface (0-6") samples , roughly equally spaced

Release Criteria (per GA Site Decommissioning Plan)

Exposure Rate Measurements

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

Soil Criteria (soil limits apply to roof gravel, concrete rubble and asphalt rubble)

The release criteria for soil are specified in the Site Decommissioning Plan and summarized below. The values presented below are above background levels.

Cs-137	15 pCi/g
Co-60	8 pCi/g
Enriched Uranium (U-234 plus U-235)	30 pCi/g
Thorium (Th-232 plus Th-228)	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

If the following "alert levels" are exceeded, notify HP Management so an evaluation can be performed

to determine if increased survey coverage or decontamination is required.

On Concrete or Asphalt Surfaces

Note: The Alert levels provided below are based on the background cpm plus the meter cpm value taking into account the instrument efficiency and probe surface area. The alert level for each instrument used must be determined prior to performing surveys. The background determination must be performed in building 13 or other HP management approved area.

Exposure Rate Measurement

Exposure rate measurements at contact (1-2" above the surface) and at 1m above the surface: 23 μ R/hr.

Soil Samples

Any Radionuclide above natural background levels (see HP-40 for background levels). All soil sample results must be reviewed by Laura Gonzales or Bill LaBonte.

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.

Figure 1: TRIGA Non-NRR Land Area, Supplement 1



- = Non-NRR Land (19,600 ft²)
- = NRR Land (~9620 ft²)
- = Building structure
- = Area to be surveyed

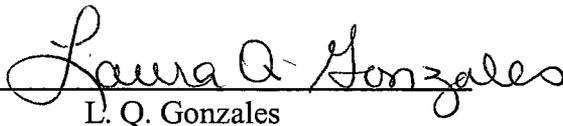
Note: Drawing Not to scale

August 30, 2006 WTL

January 9, 2006

Prepared By: W. T. LaBonte

Approved By:


L. Q. Gonzales**Final Radiological Survey Plan for the Non-NRR Portion of the TRIGA® Facility(Building 21)**

This Final Radiological Survey Plan is for the portion of the TRIGA® facility that is not under the NRC, NRR branch, license. This includes Room 112 and the interior building structures formerly known as Rooms 109, 110, 111, 113, 114 and 115 of Building 21. This space housed the former Mark III TRIGA® reactor and supporting facilities and equipment which have been dismantled, surveyed and accordingly disposed of.

This Survey Plan does NOT include soil sampling requirements under the building structure or core sampling adjacent to the reactor cavity walls. Experience has shown, by core sampling through the Mark I reactor cavity walls, that soil may become activated at the point where neutrons emitted during reactor operations become thermalized.

See Figure 1 for location and Figure 2 for an illustration of the portion of the TRIGA® facility included in this Final Survey Plan.

History and Classification

TRIGA® Mark III reactor achieved initial criticality in 1996. The TRIGA® Mark III was a 2000 kW(t) reactor that primarily was operated for thermionics experiments. It was shutdown, it's fuel was removed and stored in the TRIGA® Mark F fuel pool, and it's license was terminated in 1975.

Following license termination, the facility was converted to laboratory and test facilities for HTGR fuel.

Classification

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

Survey Objectives and Responsibility

The purpose of performing a final survey is to demonstrate that the radiological conditions in the TRIGA® Mark III reactor facility satisfy the NRC and State of CA guidelines for release to unrestricted use. The objectives include (1) to show that the average surface contamination levels for each survey unit are within the authorized value, (2) to show that the maximum residual activity ("hot spot" area) do not exceed three times the average value in an area up to 100 cm², (3) that a reasonable effort has been made to clean removable contamination and fixed contamination and (4) that the exposure rates

R:\nwpl FSPlan.wpd

NOTE: MARK I REACTOR IS PART OF THE NRR LICENSED FACILITY.

in occupiable locations are less than 10 $\mu\text{R/hr}$ above background measured at 1 meter from any surface. Samples will be counted in the Health Physics laboratory (onsite). Surveys will be taken only by qualified Health Physics Technicians having a minimum of 3 years Health Physics Technician experience. The survey and final report documenting the survey will be performed by GA's Health Physics group.

Release Criteria (per GA Site Decommissioning Plan)

Concrete/Asphalt/building surface Release Criteria

The NRC release criteria Beta Gamma emitters, which is the expected major contaminates, if present, is:

5,000 dpm /100 cm^2 , averaged over a 1 m^2 area
15,000 dpm /100 cm^2 , total, maximum in a 100 cm^2 area
1,000 dpm/100 cm^2 , removable activity

The NRC release criteria for Alpha activity, which is not expected, is:

5,000 dpm /100 cm^2 , averaged over a 1 m^2 area
15,000 dpm /100 cm^2 , total, maximum in a 100 cm^2 area
1,000 dpm/100 cm^2 , removable activity

Exposure Rate Measurements

The guideline value for exposure rates measured at 1 m above the surface, is 10 $\mu\text{R/hr}$ above background.

Alert Levels

Alpha Alert Values

If the following "alert levels" are exceeded, notify HP Management so an evaluation can be performed and to evaluate if decontamination is required.

- > 100 cpm alpha using the large area (434 cm^2) probe (check area with a hand-held alpha meter).
- > 60 cpm using a 50 cm^2 hand-held alpha probe (~ 600 dpm/100 cm^2)

Beta Monitoring

- >250 cpm above the appropriate background using the 434 cm^2 probe.
- >100 cpm above the appropriate background using the 100 cm^2 probe.
- >40 cpm above background using a portable GM detector. (Note: this meter should ONLY be used in areas the 434 cm^2 or 100 cm^2 probes will not fit).

Exposure Rate Measurements

- > 25 $\mu\text{R/hr}$ at surface
- > 20 $\mu\text{R/hr}$ at 1 m

Soil Criteria

The release criteria for soil are specified in the Site Decommissioning Plan and summarized below. The values presented below are above background levels.

Cs-137	15 pCi/g
Co-60	8 pCi/g
Enriched Uranium (U-234 plus U-235)	30 pCi/g
Thorium (Th-232 plus Th-228)	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.**

Soil Samples

Any Radionuclide above natural background levels (see HP-40 for background levels). All soil sample results must be reviewed by Laura Gonzales or Bill LaBonte.

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.

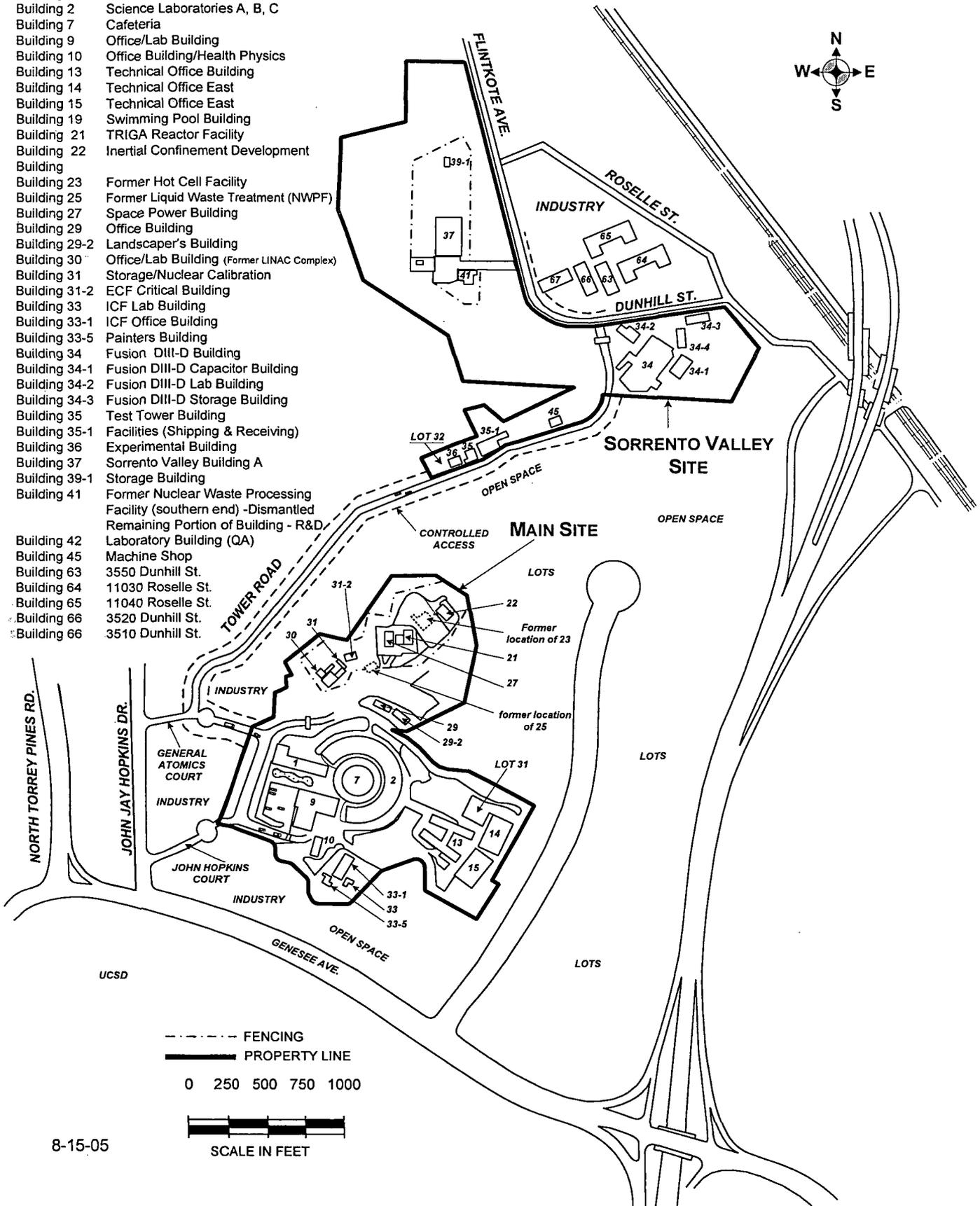
Final Radiological Surveys Planned for the TRIGA® Mark III Reactor Facility

Type of Survey/Activity	Suspect Affected Area
Gridding Required?	Yes, 1m x 1m grids
α and β Surface Scan Measurements	Scan 100% of floors and walls up to 2m with an α and a β 434 cm ² gas flow proportional detector held within 1" of the surface. Scan 10% of surfaces above 2m.
Fixed Measurements	Alternately, take one (1) α , β , or wipe survey measurement every 4 m ² (every 2m). Include measurements on light fixtures, pipes, vent ducts, etc. All wipe samples should be analyzed for α & β activity at the Health Physics laboratory.
Soil Samples	Take one (1) surface (0-6") soil sample every one (1) meter in the pipe excavation trench that runs from room #113 through rooms #114 and #115.
Exposure rate Surface Scan Measurements	Scan 100% of floors and walls up to 2m with a 2" x 2" NaI(Tl) detector held within 1" of the surface. Scan 10% of surfaces above 2m.
Fixed Exposure Rate Measurements @ 1m from surface	Take one (1) exposure rate measurement with a 2" x 2" NaI(Tl) detector held 1m from the surface every 2m (one measurement every 4m ²) on floors and walls up to 2m.

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

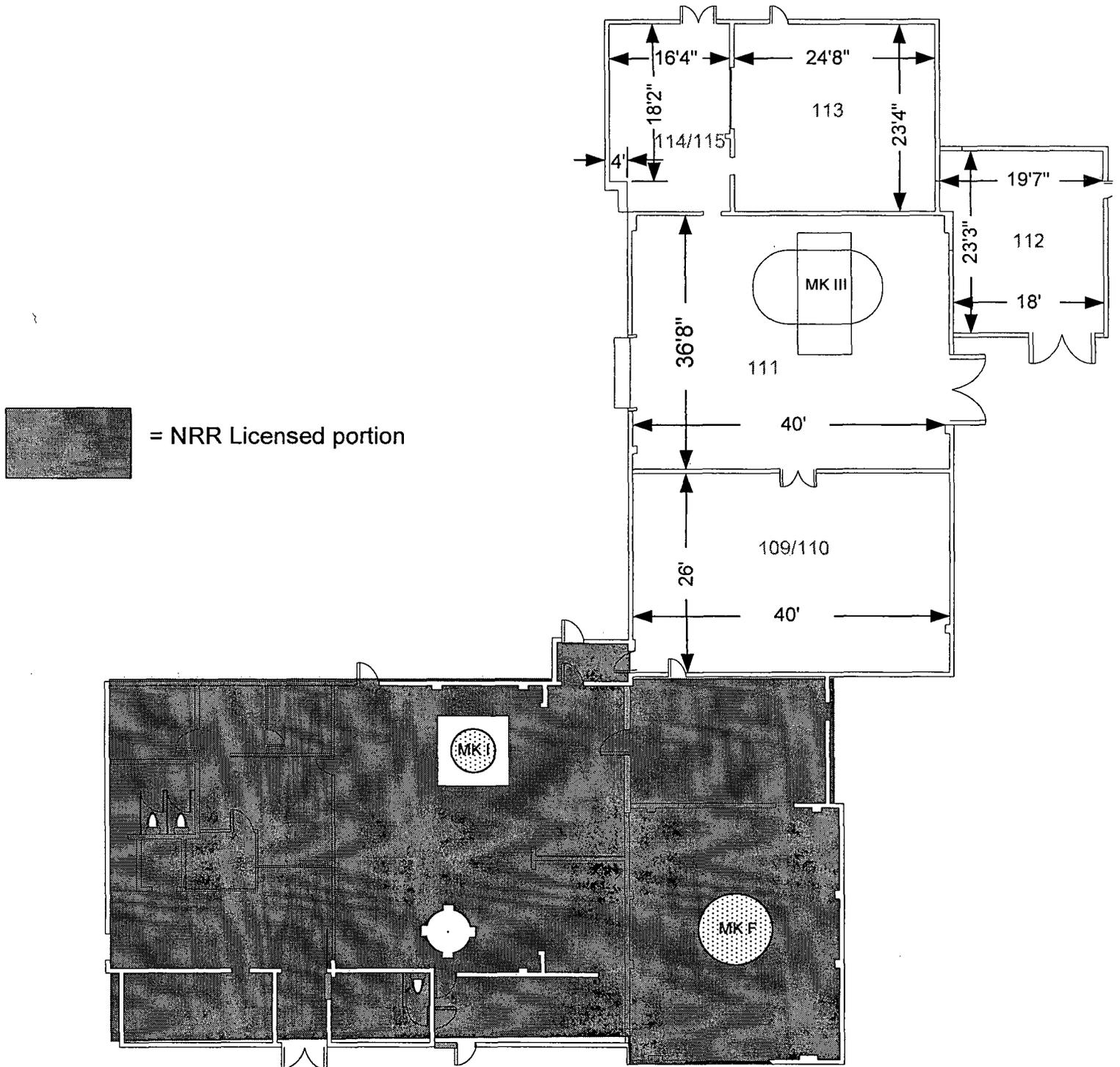
Building Numbers Names

- 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 3550 Dunhill St.
- 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.



8-15-05

FIGURE 2: Building 21 (TRIGA) Non-NRR Dimensions



January 9, 2006

Revision A, May 5, 2006

Prepared By: W. T. LaBonte

Approved By: Laura Gonzales
L. Q. Gonzales

Final Radiological Survey Plan for the Non-NRR Portion of the TRIGA® Facility(Building 21)
Revision A

The purpose of this revision is to address the excavation trenches that were not addressed in the original plan. The additional trenches are the trenches discovered in Room 111 and the trench in former Rooms 109 and 110.

NOTE: The trench in former Rooms 109 and 110 is NOT part of this survey. It will be addressed in the NRR portion of the TRIGA® Facility Final Survey.

This Final Radiological Survey Plan is for the portion of the TRIGA® facility that is not under the NRC, NRR branch, license. This includes Room 112 and the interior building structures formerly known as Rooms 109, 110, 111, 113, 114 and 115 of Building 21. This space housed the former Mark III TRIGA® reactor and supporting facilities and equipment which have been dismantled, surveyed and accordingly disposed of. This survey plan excludes the trench in former Rooms 109 and 110, and, the mezzanine above the former Room 110.

This Survey Plan does NOT include soil sampling requirements under the building structure or core sampling adjacent to the reactor cavity walls. Experience has shown, by core sampling through the Mark I reactor cavity walls, that soil may become activated at the point where neutrons emitted during reactor operations become thermalized.

See Figure 1 for location and Figure 2 for an illustration of the portion of the TRIGA® facility included in this Final Survey Plan.

History and Classification

TRIGA® Mark III reactor achieved initial criticality in 1996. The TRIGA® Mark III was a 2000 kW(t) reactor that primarily was operated for thermionics experiments. It was shutdown, it's fuel was removed and stored in the TRIGA® Mark F fuel pool, and it's license was terminated in 1975.

Following license termination, the facility was converted to laboratory and test facilities for HTGR fuel.

Classification

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

Survey Objectives and Responsibility

The purpose of performing a final survey is to demonstrate that the radiological conditions in the TRIGA® Mark III reactor facility satisfy the NRC and State of CA guidelines for release to unrestricted use. The objectives include (1) to show that the average surface contamination levels for each survey unit are within the authorized value, (2) to show that the maximum residual activity ("hot spot" area) do not exceed three times the average value in an area up to 100 cm², (3) that a reasonable effort has been made to clean removable contamination and fixed contamination and (4) that the exposure rates in occupiable locations are less than 10 µR/hr above background measured at 1 meter from any surface. Samples will be counted in the Health Physics laboratory (onsite). Surveys will be taken only by qualified Health Physics Technicians having a minimum of 3 years Health Physics Technician experience. The survey and final report documenting the survey will be performed by GA's Health Physics group.

Release Criteria (per GA Site Decommissioning Plan)Concrete/Asphalt/building surface Release Criteria

The NRC release criteria Beta Gamma emitters, which is the expected major contaminants, if present, is:

5,000 dpm /100 cm², averaged over a 1 m² area
15,000 dpm /100 cm², total, maximum in a 100 cm² area
1,000 dpm/100 cm², removable activity

The NRC release criteria for Alpha activity, which is not expected, is:

5,000 dpm /100 cm², averaged over a 1 m² area
15,000 dpm /100 cm², total, maximum in a 100 cm² area
1,000 dpm/100 cm², removable activity

Exposure Rate Measurements

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

Alert LevelsAlpha Alert Values

If the following "alert levels" are exceeded, notify HP Management so an evaluation can be performed and to evaluate if decontamination is required.

- > 100 cpm alpha using the large area (434 cm²) probe (check area with a hand-held alpha meter).
- > 60 cpm using a 50 cm² hand-held alpha probe (~ 600 dpm/100 cm²)

Beta Monitoring

- >250 cpm above the appropriate background using the 434 cm² probe.
- >100 cpm above the appropriate background using the 100 cm² probe.
- >40 cpm above background using a portable GM detector. (**Note: this meter should ONLY be used in areas the 434cm² or 100 cm² probes will not fit).**

Exposure Rate Measurements

- > 25 µR/hr at surface
- > 20 µR/hr at 1 m

Soil Criteria

The release criteria for soil are specified in the Site Decommissioning Plan and summarized below. The values presented below are above background levels.

Cs-137	15 pCi/g
Co-60	8 pCi/g
Enriched Uranium (U-234 plus U-235)	30 pCi/g
Thorium (Th-232 plus Th-228)	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.**

Soil Samples

Any Radionuclide above natural background levels (see HP-40 for background levels). All soil sample results must be reviewed by Laura Gonzales or Bill LaBonte.

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.

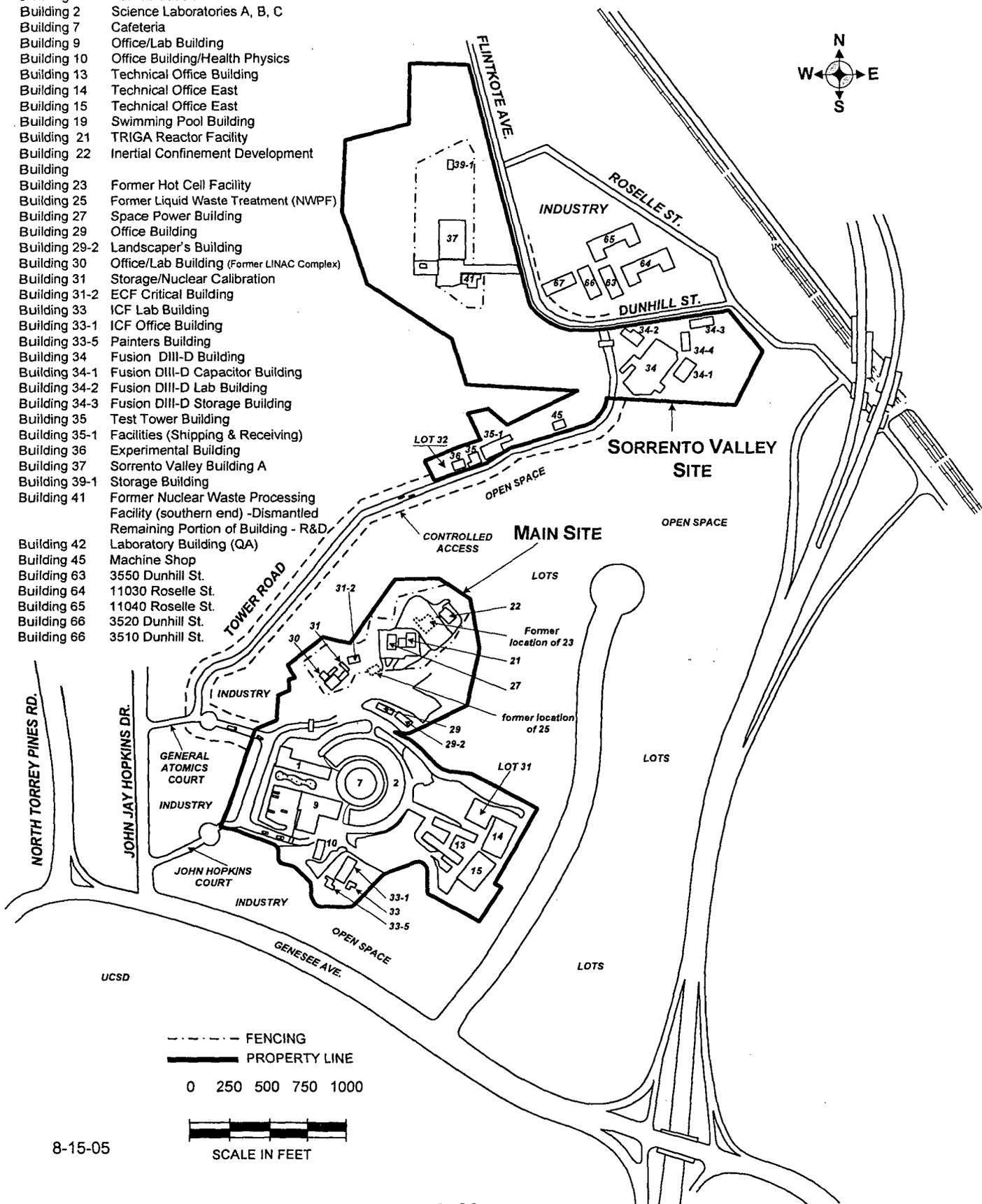
Final Radiological Surveys Planned for the TRIGA® Mark III Reactor Facility

Type of Survey/Activity	Suspect Affected Area
Gridding Required?	Yes, 1m x 1m grids
α and β Surface Scan Measurements	Scan 100% of floors and walls up to 2m with an α and a β 434 cm ² gas flow proportional detector held within 1" of the surface. Scan 10% of surfaces above 2m.
Fixed Measurements	Alternately, take one (1) α , β , or wipe survey measurement every 4 m ² (every 2m). Include measurements on light fixtures, pipes, vent ducts, etc. All wipe samples should be analyzed for α & β activity at the Health Physics laboratory.
Soil Samples	Take one (1) surface (0-6") soil sample every one (1) meter in the pipe excavation trench that runs from room #113 through rooms #114 and #115. This also applies to the accessible trenches uncovered in room #111. The trench in rooms #109 and #110 are NOT part of this survey.
Exposure rate Surface Scan Measurements	Scan 100% of floors and walls up to 2m with a 2" x 2" NaI(Tl) detector held within 1" of the surface. Scan 10% of surfaces above 2m.
Fixed Exposure Rate Measurements @ 1m from surface	Take one (1) exposure rate measurement with a 2" x 2" NaI(Tl) detector held 1m from the surface every 2m (one measurement every 4m ²) on floors and walls up to 2m and one (1) measurement every meter in the center of excavation trenches.

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

Building Numbers Names

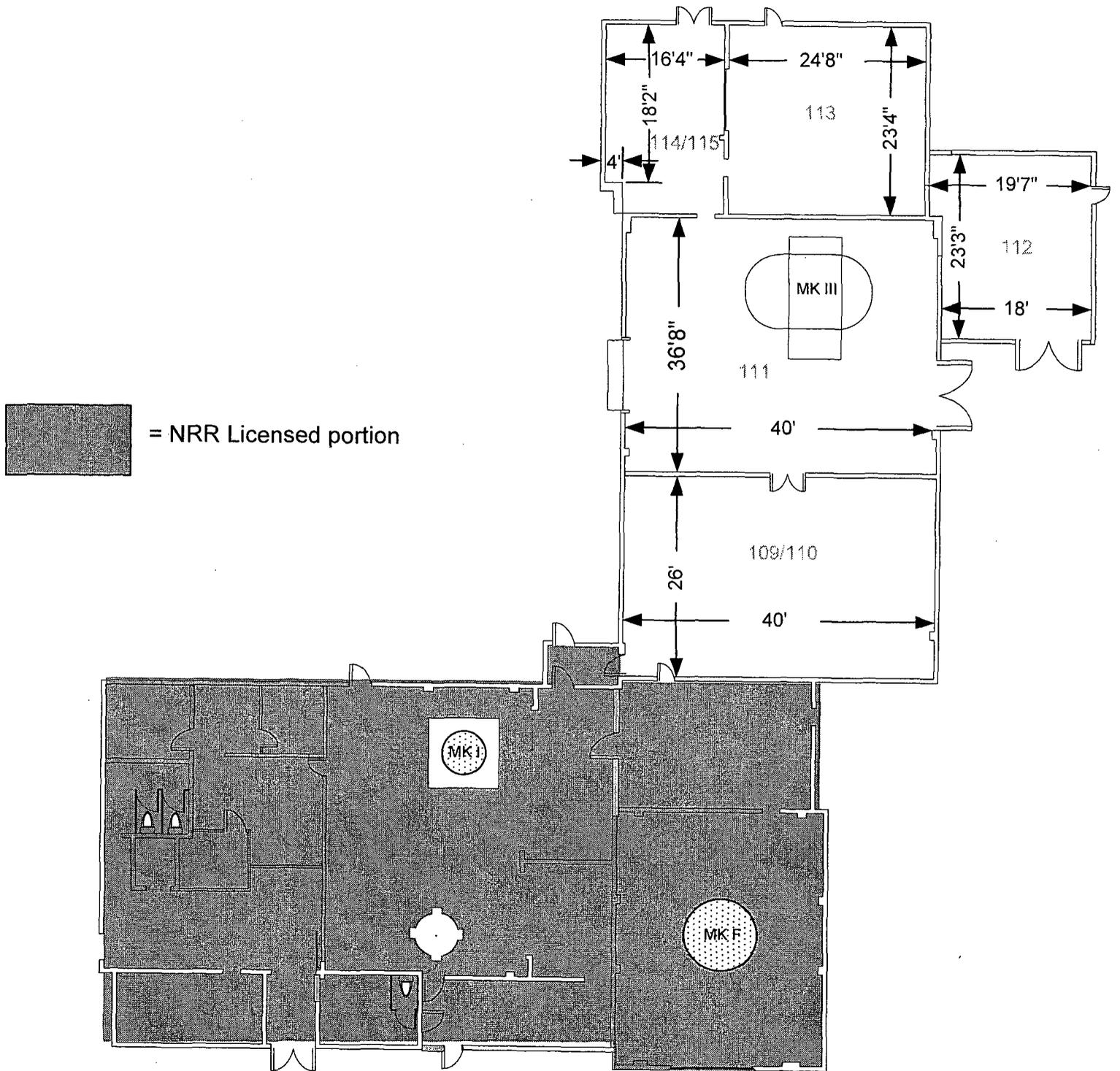
- Building 1 Administration
- Building 2 Science Laboratories A, B, C
- Building 7 Cafeteria
- Building 9 Office/Lab Building
- Building 10 Office Building/Health Physics
- Building 13 Technical Office Building
- Building 14 Technical Office East
- Building 15 Technical Office East
- Building 19 Swimming 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 Laboratory Building (QA)
- 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.



8-15-05

SCALE IN FEET

FIGURE 2: Building 21 (TRIGA) Non-NRR Dimensions



General Atomics'

**Final Radiological Survey Report for the Non-Reactor
Portion of the TRIGA[®] (Building 21) Site**

Appendix B

Confirmatory Survey Plan and Summary

CONFIRMATORY SURVEY PLAN

Prepared By: W. T. LaBonte

Date: August 2, 2006

Approved By:

L.Q. Gonzales

Building 27, Non-Reactor Portion of the TRIGA® Complex, Confirmatory Survey Plan

The purpose of this Confirmatory Survey Plan is to verify the radiological conditions identified during the performance of radiological surveys in accordance with the Final Survey Plan(s). This confirmatory Radiological Survey Plan is for the portion of the TRIGA® facility that is not under the NRC, NRR branch, license. This includes Room 112 and the interior building structures formerly known as Rooms 109, 110, 111, 113, 114, and 115. This plan also includes the portion of land that is not identified as being associated with the reactor license as identified in the TRIGA® Decommissioning Plan. This space (building and land area) housed the former Mark III TRIGA® reactor, supporting facilities and equipment which have been dismantled, surveyed and accordingly disposed of. See Figure-1 for the building layout and Figure 2 for the non-reactor land area.

Background

TRIGA® Mark III reactor achieved initial criticality in 1996. The TRIGA® Mark III was a 2000 kW(t) reactor that primarily was operated for thermionics experiments. It was shutdown, it's fuel was removed and stored in the TRIGA® Mark F fuel pool, and it's license was terminated in 1975.

Following license termination, the facility was converted to laboratory and test facilities for HTGR fuel.

Classification

During the final survey, no elevated soil activity or radiation levels were detected on the land areas. Inside of the building, small isolated areas of elevated activity were detected. These were successfully decontaminated as indicated by post-decontamination surveys. However, due to the extensive work with/use of radioactive materials in this facility, the entire facility is classified as **Suspect Affected Area** for final radiological purposes.

Survey Objectives and Responsibility

The purpose of performing this confirmatory survey is to demonstrate that the radiological conditions within the Service Corridor satisfy the NRC and State of CA guidelines for release to unrestricted use. The objectives include (1) to show that the average surface contamination

levels for each survey unit are within the authorized value, (2) to show that the maximum residual activity (“hot spot” area) do not exceed three times the average value in an area up to 100 cm² and (3) that a reasonable effort has been made to clean removable contamination and fixed contamination. Samples will be counted in the Health Physics laboratory (onsite). Surveys will be taken only by qualified Health Physics Technicians having a minimum of 3 years Health Physics Technician experience.

Release Criteria (per GA Site Decommissioning Plan)

Soil Criteria

The release criteria for soil are specified in the Site Decommissioning Plan and summarized below. The values presented below are above background levels.

Cs-137	15 pCi/g
Co-60	8 pCi/g
Enriched Uranium (U-234 plus U-235)	30 pCi/g
Thorium (Th-232 plus Th-228)	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.**

Concrete/Asphalt Surface Release Criteria

The NRC release criteria for most beta, gamma and Alpha activity is:

5,000 dpm /100 cm², averaged over a 1 m² area
 15,000 dpm /100 cm², total, maximum in a 100 cm² area
 1,000 dpm/100 cm², removable activity

Alert Levels

Beta Monitoring

>250 cpm above the appropriate background using the 434 cm² probe.

>100 cpm above the appropriate background using the 100 cm² probe.

>40 cpm above background using a portable GM detector. (**Note: this meter should ONLY be used in areas the 434cm² or 100 cm² probes will not fit).**

Minimum Survey Requirements

Type of Survey/Activity	Suspect Affected Area
Soil Samples	Take five (5) random Surface (0-6") soil samples
Internal Building Surfaces (¹) Beta Scan (Scan w/ 434 cm ² beta probe).	Scan 10% of floor surfaces inside of building
Minimum number of Measurements (²), fixed beta measurements ONLY.	Randomly, take five (5) fixed measurements in each room (Rm 109 & 110, as well as Rm 114 & 115, as considered 1 room)

(1) Clean surfaces, debris or dirt removed.

(2) For the fixed measurements:

- For β measurements; take a 2 minute count using the 100 cm² gas flow proportional detector (beta) with the Model 2221 ratemeter. Document all readings and mark on a drawing the locations the readings were taken.

Figure 1: NON-NRR Portion of TRIGA Reactor Facility

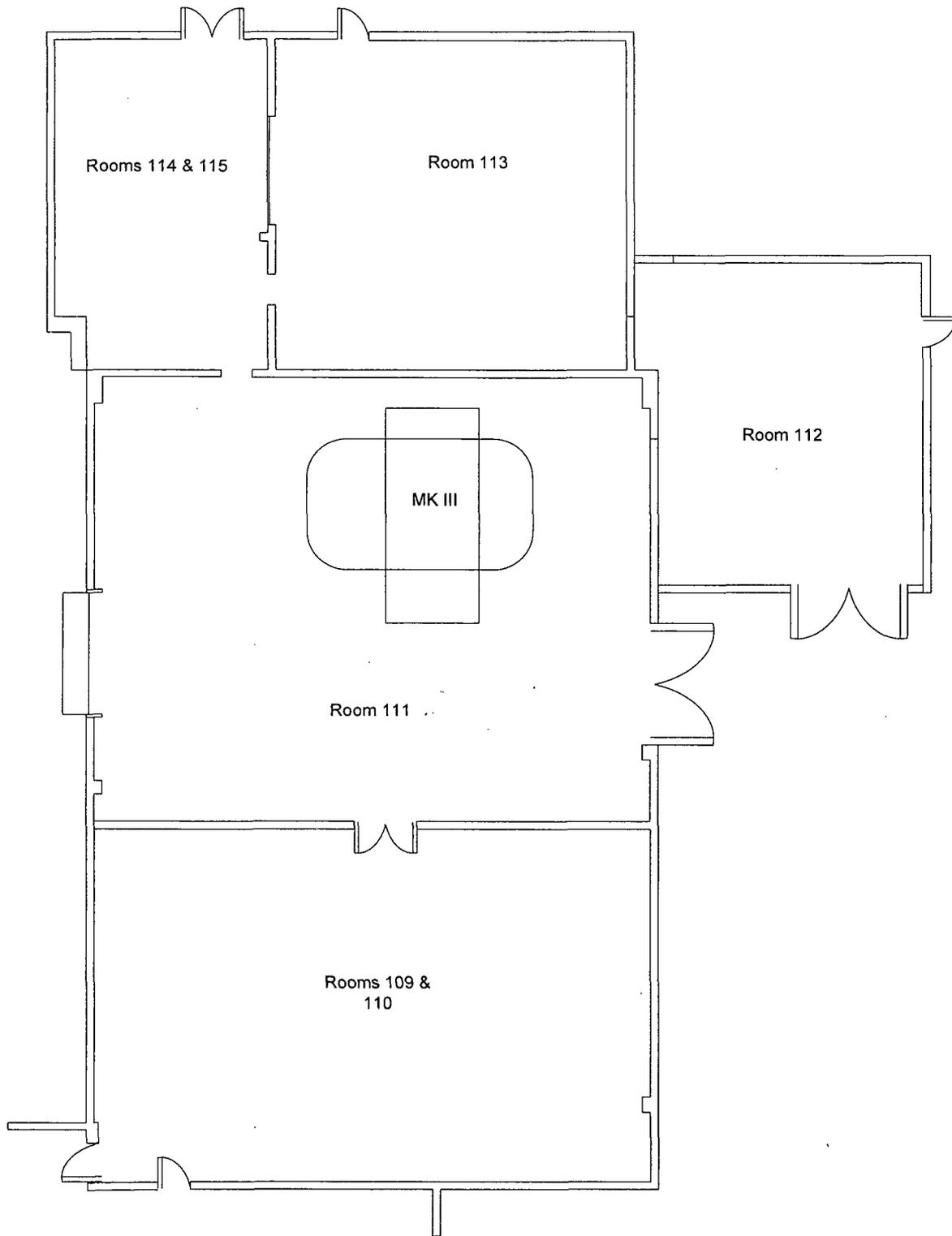


Figure 2: TRIGA Non-NRR Land Area



- = Non-NRR Land (19,600 ft²)
- = NRR Land (~9620 ft²)
- = Building structure

Note: Drawing Not to scale

CONFIRMATORY SURVEY SUMMARY

Appendix B

Confirmatory Survey Summary - Non-Reactor Portion of the TRIGA® (Building 21) Site

Description

Following the performance of the Final Radiological Survey for the non-reactor portion of the TRIGA® (Building 21) Site, an internal confirmatory survey was completed by a GA Health Physics technician in accordance with a Confirmatory Survey Plan.

The results of the confirmatory survey are as follows:

Land Area Surveys

Soil Samples

Eight (8) surface soil samples (0-6") were taken in the non-reactor portion of the TRIGA® Site land area, one (1) sample was taken of the silt that had accumulated in a supply water utility pit located on the southeastern portion of the land area, and, three (3) were taken in the Non-Reactor portion of the Make Up Tank Pit for a total of twelve (12) surface soil samples.

All samples were analyzed by gamma spectroscopy. Co-60 was identified in one (1) sample at a concentration of 1.02 ± 0.18 pCi/g and Cs-137 was identified in seven (7) out of twelve (12) samples. The highest concentration was 0.31 ± 0.08 pCi/g. These results are far below the NRC- and State- approved release criteria. See Figure 2 for locations and Table 1 for the gamma spectroscopy results.

Fixed Exposure Rate Surveys

Fixed exposure rate measurements were taken using a 2" x 2" NaI detector approximately in contact with the surface and at approximately 1 meter from the surface at each soil sample location. All measurements were not discernable from normal background radiation levels. See Figure 2 for locations and results.

Exposure Rate Scan Surveys

Exposure rate scan measurements were taken using a 0.5" x 1" NaI detector that was threaded through each of the buried storm drain lines in the southern portion of this land area. All results were at natural background levels. See Figure 2 for locations and results.

Removable Contamination Surveys

Large area wipes of the internal surfaces of the buried storm drain lines were taken and analyzed in the field with hand held instruments for alpha and beta radiation. All results were at natural background. See Figure 2 for locations and results.

Building 21 Surveys

Beta Scanning

10% of the flooring in all non-reactor related rooms were scanned with 434 cm² gas flow proportional beta detector held within ~1" of the surface. The highest beta result was 3,000 cpm, which is approximately 905 dpm/100 cm². This level is far below the NRC- approved release criteria. See Figure 1 for locations and results.

Fixed Beta Measurements

A total of twenty-five (25) beta measurements were taken using a 434 cm² gas flow proportional beta detector held within ~1" of the surface. Five measurements were taken in each of the following rooms: Room 109/110, Room 111, Room 112, room 113, and Room 114/115).

The highest measurement was 1,642 cp2m in Room 109/110. This measurement is less than the minimum detectable activity for the instrument used (222 dpm/100 cm²). See Figure 1 for locations and results.

Conclusion

All of the Confirmatory Survey results indicated that the activity and radiation levels were all below approved release criteria for the Non-Reactor portion of the TRIGA[®] (Building 21) Site are in agreement with the results of the Final Survey performed at this site.

Table 1: Gamma Spectroscopy Results of Building 21 Non-Reactor Land Area Confirmatory Soil Samples

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>						
Non-NRR Con-1	0.31 ± 0.08	ND	1.00 ± 0.16	1.64 ± 0.43	2.64 ± 0.59	ND	0.21 ± 0.09
Non-NRR Con-2	ND	1.02 ± 0.18	1.03 ± 0.21	1.79 ± 0.46	2.82 ± 0.67	ND	0.21 ± 0.13
Non-NRR Con-3	ND	ND	0.57 ± 0.13	1.29 ± 0.35	1.86 ± 0.48	ND	ND
Non-NRR Con-4	ND	ND	0.62 ± 0.16	1.32 ± 0.37	1.94 ± 0.53	ND	0.10 ± 0.06
Non-NRR Con-5	0.19 ± 0.07	ND	1.08 ± 0.20	1.93 ± 0.42	3.01 ± 0.62	ND	0.16 ± 0.10
Non-NRR Con-6	ND	ND	1.43 ± 0.47	1.77 ± 0.42	3.20 ± 0.89	ND	0.16 ± 0.10
Non-NRR Con-7	0.08 ± 0.06	ND	1.61 ± 0.28	2.06 ± 0.48	3.67 ± 0.76	2.07 ± 1.65	0.10 ± 0.11
Non-NRR Con-8	0.03 ± 0.06	ND	0.85 ± 0.19	1.80 ± 0.48	2.65 ± 0.67	ND	0.14 ± 0.08
Non-NRR Con-9	0.27 ± 0.10	ND	1.10 ± 0.19	1.62 ± 0.45	2.72 ± 0.64	ND	0.11 ± 0.10
Non-NRR Con-10	ND	ND	1.45 ± 0.29	2.36 ± 0.49	3.81 ± 0.78	ND	0.09 ± 0.11
Non-NRR Con-11	0.07 ± 0.07	ND	1.83 ± 0.46	2.52 ± 0.52	4.35 ± 0.98	1.66 ± 1.41	0.18 ± 0.12
Non-NRR Con-12	0.11 ± 0.08	ND	1.40 ± 0.31	2.24 ± 0.45	3.64 ± 0.76	ND	0.17 ± 0.11

Notes: 1. ND means not detected.

2. Average Minimum Detectable Activities (MDAs):

U-238 = 1.58 pCi/g (63 keV peak)

U-235 = 0.14 pCi/g (186 keV peak)

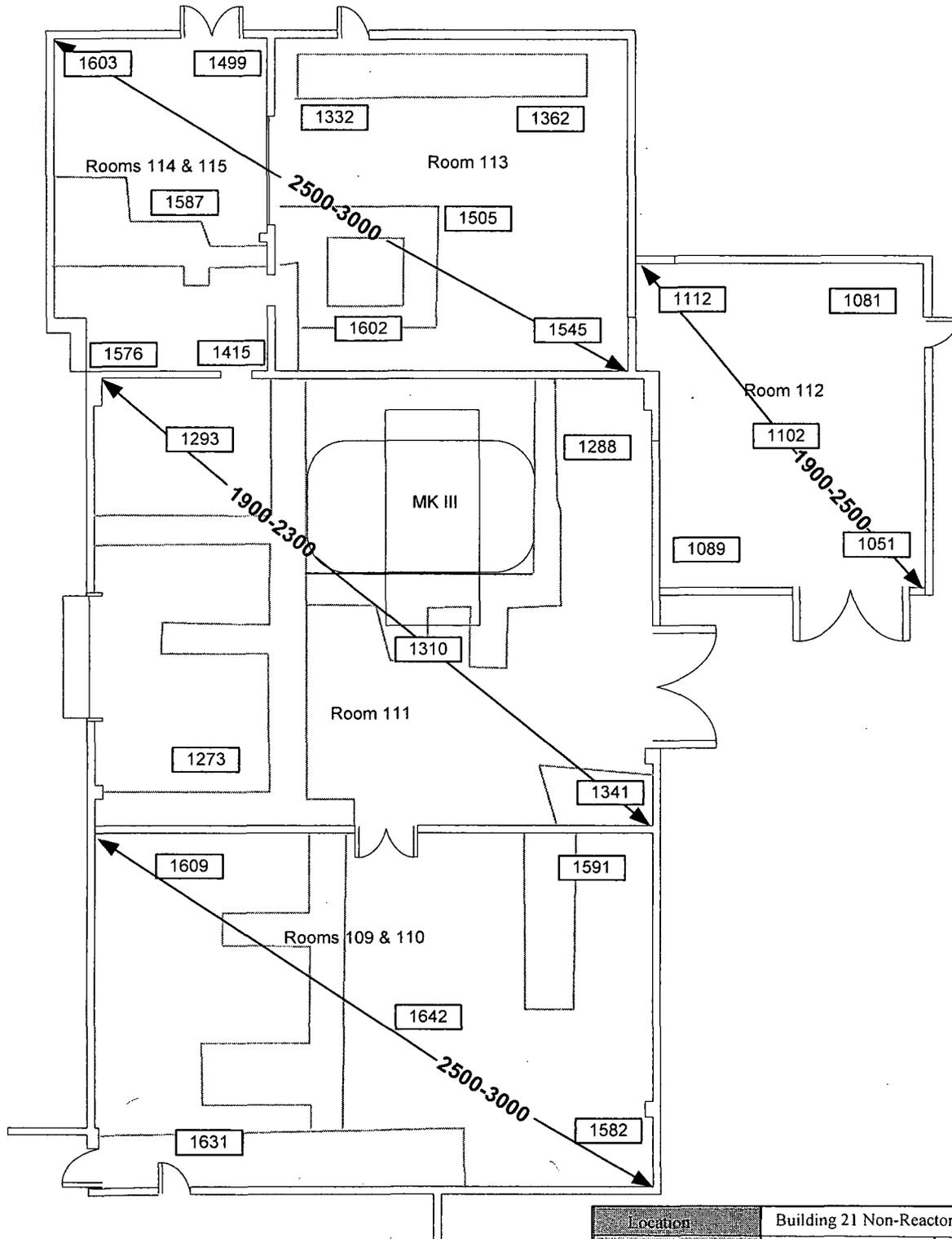
Cs-137 = 0.13 pCi/g (662 keV peak)

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)

Figure 1: TRIGA Reactor Facility, NON-NRR Portion, Confirmatory Survey Locations and Results



= Fixed Beta in cp2m

####-#### = 10% of Surface, Beta scan in cpm

Location	Building 21 Non-Reactor	
Instruments	Ludlum 2221	Ludlum 2221
Serial Number	86302	154202
Calibration Due	10/28/06	11/23/06
Efficiency	34.36%	30.39%
α β γ	β	β
Probe Number	142547	149017
Probe	100 cm ² Beta	434 cm ² Beta
Typical Background	1042 \pm 90 c/2min (Con) 1371 \pm 55 c/2min (Asph.)	1300-2000 cpm(Con)
MDA in dpm/ 100 cm ²	222 (conc.) 254 (asphalt)	375 (conc.)
Surveyors : S. Cowan Date: 08/17&18/06		

Figure 2: Building 21, TRIGA Complex, Land Area Confirmatory Survey



All Buried Storm Drain Lines were swabbed with cloth which were scanned with Alpha and Beta hand held detectors. All scans were at, or below, natural background.

Sample ID	μR/hr Contact	μR/hr @ 1 m
1	16	14
2	18	17
3	15	14
4	16	15
5	17	16
6	18	17
7	18	17
8	18	17
9	19	20

Location	Building 21 Non-Reactor, Confirmatory			
Instruments	Ludlum Model 3	Ludlum Model 12	Ludlum Model 3	Ludlum Model 3
Serial Number	138880	138738	151348	131601
Calibration Due	10/28/06	01/30/07	10/04/06	09/06/06
Efficiency	26.14%	22.52%	NA	NA
α β γ	β	α	γ	γ
Probe Number	117851	145696	163169	158626
Probe	15 cm ² Beta	50 cm ² Alpha	2" X 2" NaI	0.5" X 1" NaI
Typical Background	50-80 cpm	0-20 cpm	12-21 μR/hr (c) 12-19 μR/hr @ 1m	7-17 μR/hr
MDA in dpm/ 100 cm ²	2550	160	NA	NA
Surveyors: S. Cowan		Date: 07/28 - 09/04/06		