Joseph H. Plona
Site Vice President

6400 N. Dixie Highway, Newport, MI 48166
Tel: 734.586.5910 Fax: 734.586.4172

DTE Energy

10 CFR 50.90
10 CFR 50.82(a)(9)

March 25, 2009
NRC-09-0017

U.S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, DC 20555

References: 1) Enrico Fermi Atomic Power Plant, Unit No. 1
NRC Docket No. 50-16
NRC License Number DPR-9

Subject: **Proposed License Amendment- License Termination Plan**

Pursuant to 10 CFR 50.82(a)(9) and 10 CFR 50.90, Detroit Edison hereby proposes to amend NRC License DPR-9 for the Fermi 1 facility by adding a license condition approving the License Termination Plan (LTP) for Fermi 1. The LTP demonstrates that the remaining decommissioning activities will be performed in accordance with the regulations in 10 CFR Part 50, will not be adverse to the common defense and security or to the health and safety of the public, and will not have a significant adverse effect on the quality of the environment.

Upon NRC approval of the LTP, the amendment to the operating license adds a license condition that establishes the criteria for determining when changes to the LTP require prior NRC approval.

Enclosure 1 provides a description and evaluation of the proposed change, the No Significant Hazards Consideration, and an environmental impact consideration determination. Enclosure 2 provides a copy of the revised affected pages to the operating license. Included after the proposed license amendment, is the Fermi 1 License Termination Plan.

Detroit Edison has evaluated the proposed License Amendment against the criteria of 10 CFR 50.92 and determined that no significant hazards consideration is involved. The Fermi 1 Review Committee has approved the proposed License Amendment and concurs

NMSS01
FSME

with the enclosed determinations. In accordance with 10 CFR 50.91, Detroit Edison is providing a copy of this letter to the State of Michigan.

If you have any questions, please contact Lynne S. Goodman, Manager, Fermi 1, at (734) 586-1205.

Sincerely,

Joseph H. Plona

Joseph H. Plona
Site Vice President, Nuclear Generation

JHP/ME/ljd
Enclosures (2)
Attachment

cc: NRC Regional Administrator, Region III (w/attachment)
T. Smith, NRC (Washington, D.C.) (w/attachment)
NRC Resident Inspector- Fermi 2
P. Lee, NRC Region III (w/attachment)
T. Strong (Michigan Dept of Environmental Quality) (w/attachment)

I, Joseph H. Plona, do hereby affirm that the foregoing statements are based on facts and circumstances which are true and accurate to the best of my knowledge and belief.

Joseph H. Plona

Joseph H. Plona
Site Vice President, Nuclear Generation

On this 25th day of March, 2009 before me personally appeared Joseph H. Plona being first duly sworn and says that he executed the foregoing as his free act and deed.

Stacy Oakes

Notary Public

STACY OAKES
NOTARY PUBLIC, STATE OF MI
COUNTY OF MONROE
MY COMMISSION EXPIRES Jul 28, 2012
ACTING IN COUNTY OF MONROE, MI

Enclosure 1

Description of the Proposed Change Evaluation
No Significant Hazards Consideration
And,
Environmental Impact Consideration

Enclosure 1

Description of the Proposed Change Evaluation, No Significant Hazards Consideration, and Environmental Impact Considerations

Background

Power Reactor Development Company (PRDC) shut down Fermi 1 (EF1) permanently in November 1972, and the decision to decommission EF1 was made. Initial decommissioning of EF1 was originally completed in December of 1975. Effective January 23, 1976 DPR-9 was transferred to Detroit Edison Company as a "possession only" 10 CFR 50 license.

The fuel and blanket subassemblies were shipped offsite in 1973. The secondary sodium system was drained and the sodium sent offsite. The radioactive primary sodium was stored in storage tanks and in 55 gallon drums until the sodium was shipped offsite in 1984.

DTE is currently conducting decontamination and dismantlement (D&D) activities at the EF1 site in accordance with EF1 procedures and approved work packages. This will complete the last phase of SAFSTOR. Final decommissioning activities are being coordinated with the appropriate Federal and State regulatory agencies.

Reason for the Proposed Change

Pursuant to 10 CFR 50.82(a)(9), nuclear power reactor licensees are required to submit a License Termination Plan (LTP) prior to or along with their application for termination of license. This LTP is a supplement to the EF1 Safety Analysis Report. The LTP is required to be submitted at least 2 years before termination of the license.

Pursuant to 10 CFR 50.82 (a)(10), the Commission's approval of the plan shall be executed by license amendment, subject to such conditions and limitations, as it deems appropriate and necessary. The LTP shall be approved if it will not be inimical to the common defense and security or to the health and safety of the public, and will not have a significant effect on the quality of the environment, and after notice to interested persons. This approval will authorize the implementation of the LTP and allows the implementation of the method outlined in Chapter 5 of the LTP for site compliance with dose-based release criteria.

Detroit Edison is submitting a proposed amendment to the EF1 license to satisfy the requirements of 10 CFR 50.82(a)(10) for approval of the EF1 License Termination Plan by license amendment. The change to the license will authorize the implementation of the LTP and provides appropriate and necessary conditions for when changes can be made to it without prior NRC review and approval.

Description of the Proposed License Change

As discussed in LTP Section 1.6, Detroit Edison may make changes to the LTP, without prior NRC approval, under the provisions in 10 CFR 50.59, 10 CFR 50.82(a)(6), and 10 CFR 50.82(a)(7). The proposed license condition amends the EF1 operating license to include the criteria for when changes to the LTP require prior NRC approval.

New License Condition C.2 is proposed as follows:

> *(2) License Termination Plan (LTP)*
>
> *NRC License Amendment No. XX approves the License Termination Plan. In addition to the criteria specified in 10 CFR 50.59 and 10 CFR 50.82(a)(6), a change to the LTP requires prior NRC approval if the change:*
>
> *(a) Increases the probability of making a Type I decision error above the level stated in the LTP*
>
> *(b) Increases the radionuclide-specific derived concentration guideline levels (DCGL) and related minimum detectable concentrations*
>
> *(c) Increases the radioactivity level, relative to the applicable DCGL, at which investigation occurs*
>
> *(d) Changes the statistical test applied other than the Sign Test or Wilcoxon Rank Sum Test.*
>
> *Reclassification of survey areas from a less to a more restrictive classification (e.g., from a Class 3 to a Class 2 area) may be done without prior NRC notification; however, reclassification to a less restrictive classification (e.g., Class 1 to Class 2 area) will require NRC notification at least 14 days prior to implementation.*

Evaluation

Detroit Edison prepared the LTP using the guidance in:

- Regulatory Guide 1.179 "Standard Format and Contents for License Termination Plans for Nuclear Power Reactors,"
- NUREG-1575 "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),"
- NUREG-1700 "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans," and
- NUREG-1757 "Consolidated NMSS Decommissioning Guidance."

The LTP includes a discussion on the following:

- Site Characterization to ensure that Final Status Surveys (FSS) cover all areas where contamination existed, remains, or has the potential to exist or remain,
- Identification of remaining dismantlement activities,
- Plans for site remediation,
- A description of the FSS plan to confirm that EF1 will meet the release criteria in 10 CFR Part 20, Subpart E,
- Dose modeling scenarios that ensure compliance with the radiological criteria for license termination,
- An estimate of the remaining site-specific decommissioning costs, and
- A supplement to the F1SAR and the Final Generic Environmental Impact Statement describing any new information or significant environmental change associated with proposed license termination activities.

This proposal provides the NRC the opportunity to review the EF1 LTP to ensure EF1's planned activities and processes meet the criteria in 10 CFR 50.82(a)(9) and NUREG-1700. Additionally, the license condition requires NRC approval for changes to the methodology that could result in increasing the amount of plant-related activity remaining at the time of license termination compared to the methodology the NRC reviewed in the proposed LTP. The wording of the license change is based on NUREG-1700, Rev. 1, Appendix 2.

Since the LTP is based on NRC guidance and establishes the methodology Detroit Edison will use to meet license termination criteria, this proposal is appropriate to allow completion of the EF1 decommissioning project and license termination.

No Significant Hazards Consideration

Detroit Edison has reviewed the proposed license amendment against each of the criteria in 10 CFR 50.92 and has concluded that the amendment request involves no significant hazards consideration. The following provides Detroit Edison's analysis of the issue of no significant hazards consideration:

1. **Does the proposed license amendment involve a significant increase in the probability or consequences of an accident previously evaluated?**

   No. The change allows for the approval of the LTP and provides the criteria for when changes to the LTP require prior NRC approval. This change does not affect possible initiating events for the three postulated accidents previously evaluated in the Fermi 1 Safety Analysis Report F1SAR (as updated) or alter the configuration or operation of the facility. Safety limits, limiting safety system settings, and limiting control systems are no longer applicable to EF1 in the permanently defueled mode, and are therefore not relevant.

The proposed change does not affect the boundaries used to evaluate compliance with liquid or gaseous effluent limits, and has no impact on plant operations. Therefore, the proposed license amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. **Does the proposed license amendment create the possibility of a new or different kind of accident from any accident previously evaluated?**

No. The safety analysis for the facility remains accurate as described in the F1SAR (as updated) Section 8.4, Postulated Radiological Accidents. There are sections of the LTP that make reference to the decommissioning activities still remaining (e.g. removal of large components, decontamination, etc.), however these activities are performed in accordance with approved EF1 work packages/steps and undergo 10 CFR 50.59 screening prior to initiation. The proposed amendment merely makes mention of these processes and does not bring about physical changes to the facility. Therefore, the plant conditions for which the postulated accidents have been evaluated are still valid and no new accident scenarios, failure mechanisms, or single failures are introduced by this amendment. The system operating procedures are not affected. Therefore, the proposed changes will not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. **Does the proposed license amendment involve a significant reduction in a margin of safety?**

No. There are no changes to the design or operation of the facility resulting from this amendment. The proposed change does not affect the boundaries used to evaluate compliance with liquid or gaseous effluent limits, and has no impact on plant shutdown operations. Accordingly, neither the postulated accident assumptions in the F1SAR (as updated), nor the basis of the Technical Specifications are affected. Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Environmental Impact Consideration

This amendment request satisfies the criteria specified in 10 CFR 51.22(c)(9) for a categorical exclusion from the requirements to perform an environmental assessment or to prepare an environmental impact statement. The criteria of 10 CFR 51.22(c)(9) are addressed as follows:

(i) The amendment involves no significant hazards consideration.

As discussed in the No Significant Hazards Consideration section above, the proposed license amendment does not involve a significant hazards consideration.

(ii) There is no significant change in the types or significant increase in the amounts of effluents that may be released offsite.

The proposed license amendment is consistent with the plant activities described in the F1SAR. No changes in effluent system requirements or controls are proposed in this change. The environmental impacts associated with radiation dose to members of the public related to decommissioning activities and site release for unrestricted use were considered in NUREG- 0586 "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," NUREG-0586 Supplement 1, and NUREG-1496 "Generic Environmental Impact Statement in Support of the Rulemaking on Radiological Criteria for License Termination".

NUREG-0586 provides a generic environmental assessment of decommissioning a reference nuclear facility. When the NRC issued the Decommissioning Rule in 1988, and based on the findings in NUREG-0586, it concluded a generic finding of "no significant (environmental) impact." The NRC further concluded that no additional Environmental Impact Statement (EIS) would need to be prepared in connection with decommissioning a particular nuclear site unless the impacts of a particular plant have site-specific considerations significantly different from those studied generically. LTP Chapter 8 provides an updated assessment of the environmental effects of decommissioning EF1. The updated assessment also determined that the environmental effects from decommissioning EF1 are minimal and there are no adverse effects outside the bounds of NUREG-0586, Supplement 1. Based on the above, there will not be a significant change in the types or increase in the amounts of effluents released offsite for the remaining decommissioning activities.

(iii) There is no significant increase in individual or cumulative occupational exposure.

The attributes identified in NUREG-0586, Supplement 1 were compared with the remaining activities for EF1 and the following conclusions were made:

- Detroit Edison will maintain annual occupational radiation exposure to individuals as low as reasonably achievable (ALARA). These exposures will be at, or below, the estimated values in Table 4-1 of NUREG-0586, Supplement 1. Section 3.4 of the LTP provides a dose estimate for EF1 decommissioning.

- Detroit Edison will maintain exposure to onsite workers and the offsite public as a result of waste transportation well below the levels projected by NUREG-0586.

LTP Chapter 8 provides an updated assessment of the environmental effects of decommissioning EF1. The updated assessment also determined that the environmental effects from decommissioning EF1 are minimal and there are no adverse effects outside the bounds of NUREG-0586, Supplement 1.

Based on the above, there is no significant increase in individual or cumulative occupational exposure due to decommissioning EF1.

Conclusion

Based on the evaluations above: (1) there is reasonable assurance that the health and safety of the public will not be endangered by the conduct of activities in the proposed manner, and (2) such activities will be conducted in compliance with the Commission's regulations, and the proposed amendment will not be inimical to the common defense and security or the health and safety of the public.

Enclosure 2

Affected Facility Possession Only License Changes
The following is a hand markup of the affected pages and a typed version of proposed Section 2C
(Changes are noted with a revision bar in the right margin)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

DETROIT EDISON COMPANY
DOCKET NO. 50-16
ENRICO FERMI ATOMIC POWER PLANT, UNIT 1
AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 20
License No. DPR-9

1. The U.S. Nuclear Regulatory Commission (the Commission or the NRC) has found that:

    A. The application for amendment by Detroit Edison Company (the licensee) dated January 28, 2003, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's regulations set forth in 10 CFR Chapter I;

    B. The facility will operate in conformity with the application, as amended, the provisions of the Act, and the rules and regulations of the Commission;

    C. There is reasonable assurance: (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations set forth in 10 CFR Chapter 1;

    D. The licensee is technically and financially qualified to engage in the activities authorized by this amended license in accordance with the rules and regulations of the Commission;

    E. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

    F. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, Possession-Only License No. DPR-9 is hereby amended in its entirety to read as follows:

    A. This amended license applies to the Enrico Fermi Atomic Power Plant, Unit No. 1 (Fermi 1, or the facility) owned by the Detroit Edison Company. The facility is located at the Lagoona Beach, Frenchtown Township, Monroe, Michigan, and is described in the Fermi 1 Safety Analysis Report as amended.

B. Subject to the conditions and requirements incorporated herein, the Commission hereby licenses the Detroit Edison Company:

(1) Pursuant to Section 104(c) of the Act and 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities" to possess, but not to operate the facility.

(2) Pursuant to the Act and 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material" to possess, but not to separate, such byproduct material as may have been produced by operations of the reactor.

(3) Pursuant to the Act and 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material," to receive, acquire, possess, use and transfer byproduct material without restriction to chemical or physical form for sample analysis, instrument calibration, or associated with radioactive apparatus, hardware, tools, and equipment, provided the cumulative radioactive material quantity of the byproduct material does not exceed the criteria contained in Section 30.72, Schedule C, Quantities of Radioactive Materials Requiring Consideration of the Need for an Emergency Plan for Responding to a Release.

(4) Pursuant to the Act and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material" to receive, acquire, possess, use and transfer, but not separate, special nuclear material in a quantity not to exceed 15 grams of U-235, U-233, or plutonium, or any combination thereof and not to exceed plutonium activity of 2 curies. If special nuclear material in quantities exceeding 15 grams or more than 2 curies of plutonium are identified in plant contamination in the future, this license permits possession and transfer of special nuclear material and the additional applicable requirements of 10 CFR Part 70, Part 73, and Part 74 will apply for the amount possessed.

C. This license shall be deemed to contain and is subject to the conditions specified in Part 20, Section 50.59 of Part 50, Section 30.34 of Part 30 of 10 CFR Chapter 1; and is subject to all applicable provisions of the Act, and to the rules, regulations, and orders of the Commission now or hereafter in effect, and is subject to the additional ~~condition~~ conditions specified below:

(1) The Technical Specifications contained in Appendix A, as revised through Amendment No. 20, are hereby incorporated in this license. The licensee shall maintain the facility in accordance with the Technical Specifications.

(2) Insert new C.2 as written on page 2 of Enclosure 1 to NRC-09-0017

D. This license is effective as of the date of its issuance and shall expire on March 20, 2025.

3. This license amendment is effective as of the date of its issuance, and ~~must be fully implemented no later than 60 calendar days from the date of its issuance.~~

Dated at Rockville, Maryland, this 15th day of May 2003.

FOR THE NUCLEAR REGULATORY COMMISSION

Daniel M. Gillen, Chief
Decommissioning Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Attachment:
Changes to
the Technical Specifications

C. This license shall be deemed to contain and is subject to the conditions specified in Part 20, Section 50.59 of Part 50, Section 30.34 of Part 30 of 10 CFR Chapter 1; and is subject to all applicable provisions of the Act, and to the rules, regulations, and orders of the Commission now or hereafter in effect, and is subject to the additional conditions specified below:

(1) The Technical Specifications contained in Appendix A, as revised through Amendment No XX, are hereby incorporated in this license. The licensee shall maintain the facility in accordance with the Technical Specifications.

(2) License Termination Plan (LTP)

NRC License Amendment No. XX approves the License Termination Plan. In addition to the criteria specified in 10 CFR 50.59 and 10 CFR 50.82.(a)(6), a change to the LTP requires prior NRC approval if the change:

(a) Increases the probability of making a Type I decision error above the level stated in the LTP.
(b) Increases the radionuclide-specific derived concentration guideline levels (DCGL) and related minimum detectable concentrations.
(c) Increases the radioactivity level, relative to the applicable DCGL, at which investigation occurs.
(d) Changes the statistical test applied other than the Sign Test or Wilcoxon Rank Sum Test.

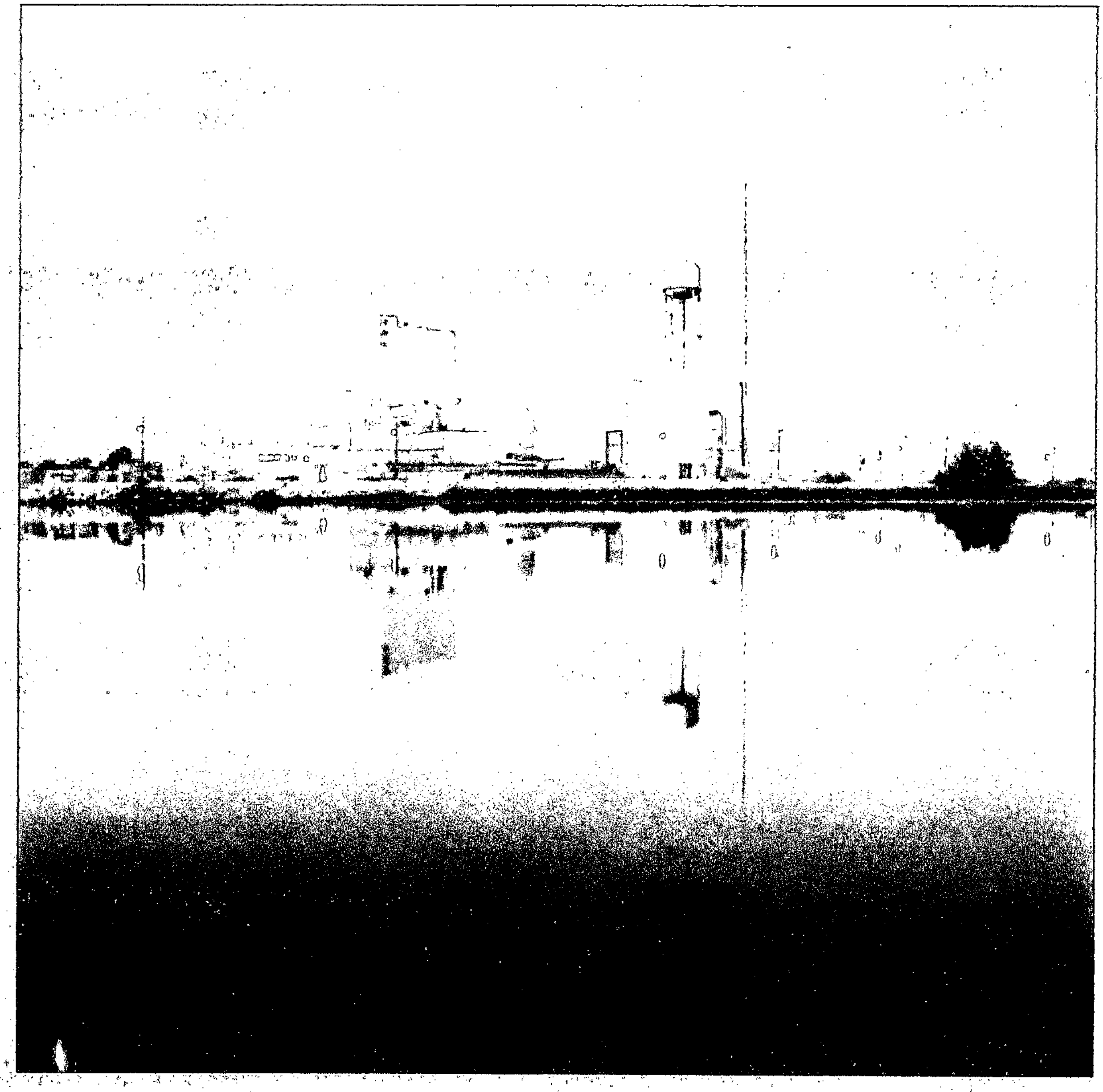
Reclassification of survey areas from a less to a more restrictive classification (e.g., from a Class 3 to a Class 2 area) may be done without prior NRC notification; however, reclassification to a less restrictive classification (e.g., Class 1 to Class 2 area) will require NRC notification at least 14 days prior to implementation.

D. This license is effective as of the date of its issuance and shall expire on March 20, 2025.

3. This license amendment is effective as of the date of its issuance.

License Termination Plan

Enrico Fermi Atomic Power Plant
Unit 1
License Termination Plan
March 2009



Fermi 1 License Termination Plan March 2009

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INTRODUCTION

Fermi 1 (EF1) was an experimental breeder reactor permanently shutdown in 1972. Detroit Edison is completing the final nuclear decommissioning cleanup of the reactor which is on the same site as the operational Fermi 2 reactor. The Fermi 1 fuel was shipped offsite in 1973, and some radioactive material remained onsite in safe storage. This License Termination Plan describes the remaining activities Detroit Edison will perform to complete the nuclear decommissioning. It covers how Detroit Edison will demonstrate to the Nuclear Regulatory Commission (NRC) that the Fermi 1 license for possession of radioactive material is ready to be terminated.

The NRC has established specific conditions and a process for terminating reactor licenses. The NRC requires that any radioactivity remaining from the operation of a nuclear power plant site be reduced to 25 millirem per year, or less, above background radiation levels, before terminating the license. The NRC regulations also require further reducing plant related radioactivity to levels "as low as reasonably achievable" considering other society and economic impacts associated with reducing site residual radioactivity. The NRC 25 millirem limit is well below the federal 100 millirem limit for yearly exposure due to non-medical, man-made radiation. To put this dose in perspective; the average person receives about 360 millirems per year from all natural and man-made sources. Of this total, the greatest single source of exposure (an average of 200 millirems per year) comes from naturally occurring radon gas. Certain activities increase exposure to radiation such as smoking (cigarette smoke contains radioactive particles) or airline travel (radiation exposure is higher at higher elevations). Radiation exposure occurs naturally in different amounts all over the world and is a normal part of our everyday lives. Background radiation is always present and comes from the earth and cosmic rays. Background radiation varies from location to location depending on several factors, including the type of the materials in the earth, elevation, whether there's snow on the ground or how much it rains.

This License Termination Plan (LTP) assumes that either workers will occupy the buildings or a hypothetical farmer will live on the site once cleanup is complete. To determine the hypothetical farmer's or worker's yearly radiation dose from residual plant related radioactivity, a computer model is used. The model includes the possible ways the hypothetical farmer could be exposed to residual plant related radioactivity while living on the site during the course of a year, including eating produce grown in a garden on the site, drinking water from a site well, drinking milk and eating meat from livestock raised on the site. The model also includes the possible ways a person working in the buildings could be exposed to the small amount of residual radioactivity. This calculated dose is translated to radiation levels that instruments can measure in the remaining soil and buildings to ensure the small amount of residual radioactivity is less than the calculated limits.

Detroit Edison is submitting this detailed LTP explaining how residual plant radioactivity on the site will be reduced to acceptable levels. The LTP describes how those levels will be measured and verified, and the radiation dose to an average hypothetical person living or working on the site after the NRC license is terminated. The NRC (or its independent contractor) conducts inspections and independent radiological surveys to verify the NRC's release criterion has been met. Detroit Edison will formally request termination of the EF1 license when the nuclear cleanup is complete.

1.0 GENERAL INFORMATION

Detroit Edison Company (DTE) is submitting this LTP for Enrico Fermi Atomic Power Plant Unit No. 1 (EF1). The following provides the licensee name, address, license number, and docket number for EF1:

Detroit Edison Company
One Energy Plaza
Detroit, MI 48226
Possession-Only License (POL) (as amended), No. DPR-9
Docket No. 50-16

1.1 Purpose

The objective of decommissioning EF1 is to reduce the level of residual radioactivity to levels that permit the release of the site for unrestricted use and allow for the termination of the 10 CFR Part 50 license. The EF1 LTP satisfies the requirement in 10 CFR 50.82(a)(9) to submit an LTP for Nuclear Regulatory Commission (NRC) approval. The LTP is a supplement to the Fermi 1 Safety Analysis Report (F1SAR) and is accompanied by a proposed license amendment that establishes the criteria for changes to the LTP that require prior NRC approval.

1.2 Scope

DTE prepared the LTP using the guidance in:

- Regulatory Guide 1.179 "Standard Format and Contents for License Termination Plans for Nuclear Power Reactors,"
- NUREG-1575 "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),"
- NUREG-1700 "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans," and
- NUREG-1757 "Consolidated NMSS Decommissioning Guidance."

The LTP includes a discussion on the following:

- Site Characterization to ensure that Final Status Surveys (FSS) cover all areas where contamination existed, remains, or has the potential to exist or remain,
- Identification of remaining dismantlement activities,
- Plans for site remediation,
- A description of the FSS plan to confirm that EF1 will meet the release criteria in 10 CFR Part 20, Subpart E,
- Dose modeling scenarios that ensure compliance with the radiological criteria for license termination,
- An estimate of the remaining site-specific decommissioning costs, and
- A supplement to the F1SAR and the Final Generic Environmental Impact Statement describing any new information or significant environmental change associated with proposed license termination activities.

Section 1.5 discusses the purpose and content of each chapter of the LTP. Section 1.6 discusses the process for making changes to the LTP.

1.3 Historical Background and Site Description

1.3.1 Historical Background

On May 10, 1963 the Atomic Energy Commission (AEC) granted an operating license, DPR-9, to Power Reactor Development Company (PRDC) a consortium specifically formed to own and operate a nuclear reactor at the EF1 site. Fermi 1 was a fast breeder reactor power plant cooled by sodium and operated at essentially atmospheric pressure. The reactor plant was designed for a maximum capability of 430 MWt; however, the maximum reactor power with the first core loading (Core A) was 200 MWt. The primary system was filled with sodium in December of 1960 and criticality was achieved in August 1963.

The reactor was tested at low power in its first couple years of operation. Power ascension testing above 1 MWt commenced in December 1965, immediately following receipt of the high power operating license. In October 1966, during power ascension, zirconium plates at the bottom of the reactor vessel became loose and blocked sodium coolant flow to some fuel subassemblies. Two subassemblies started to melt. Radiation monitors alarmed and the operators manually shut down the reactor. No abnormal releases to the environment occurred. Three years and nine months later, the cause had been determined, cleanup completed, fuel replaced, and Fermi 1 was restarted.

In 1972, the core was approaching the burnup limit. In November, 1972, PRDC made the decision to decommission Fermi 1. The fuel and blanket subassemblies were shipped offsite in 1973. The secondary sodium system was drained and the sodium sent offsite. The radioactive primary sodium was stored in storage tanks and in 55 gallon drums until the sodium was shipped offsite in 1984. Decommissioning of EF1 was originally completed in December of 1975. Effective January 23, 1976 DPR-9 was transferred to Detroit Edison Company as a "possession only" license.

1.3.2 Site Description

EF1 is located on the same site as Fermi 2, within the same owner controlled area and outside the Fermi 2 protected area. The site is on the western shore of Lake Erie, also referred to as Lagoona Beach, Frenchtown Township, Monroe County, Michigan. The plant is approximately 6 miles east-northeast of Monroe, Michigan; 30 miles southwest of downtown Detroit, Michigan; and 25 miles northeast of downtown Toledo, Ohio. Detroit Edison Company owns and controls all of the land located within the licensed site property boundary (see Figure 1-1). Fermi 1 Perimeter Road, located within Fermi 2 controlled area, encircles the EF1 site and forms the License Termination boundary. The Fermi 1 License Termination boundary consists of 27,200 square meters – including roads, a railroad spur, buildings, and land areas, a portion of which is occupied by an oily waste basin. The elevation of Fermi 1 is approximately 583.5 feet MSL outside the Controlled Area, and 590 feet MSL inside the current Controlled Area. During the early site history, rail spurs ran into the industrial area. The rail spurs facilitated construction of EF1. Currently, a small portion of rails remain within the EF1 site boundary; however these rails are not used.

The EF1 area surrounding the Controlled Area is mostly level with several structures and open land areas contained within. The Controlled Area is slightly elevated and contains most of the structures required for original nuclear plant operation. Figure 1-2 depicts the contours of the EF1 site. The soils are predominately composed of sandy loam.

The following paragraphs describe the features and uses of land within 8 miles of the plant. Included is a summary of the population centers within 10 miles of EF1.

<u>Public lands and Conservation Areas</u>:

Detroit River International Wildlife Refuge (DRIWR), DTE Fermi, resides within the Fermi 2 site. The 650 acre tract is part of a cooperative management agreement signed with the DRIWR. No portion of the wildlife refuge is within the Fermi 1 License Termination boundary.

Pointe Mouillee State Game Area is a 4,000 acre spit of land approximately 4 miles northeast of the Fermi 1 site at the northwest corner of Lake Erie, which jets into Lake Erie near the Huron River. It is owned by the Michigan Department of Natural Resources. Pointe Mouillee is one of the largest fresh water marsh restoration projects in the world, consisting of wetlands, diked marshes and river bayous. Most of Pointe Mouillee is open to public hunting.

Wm. C. Sterling State Park, the only Michigan state park on Lake Erie, consists of 1,300 acres of state-owned lands with recreational swimming, fishing, camping, hiking and wildlife viewing. Sterling State Park is approximately 5.2 miles southwest of the Fermi 1 site on Brest Bay. The bay sits just north of where the Raisin River spills into Lake Erie. The park is situated in Monroe County just south of Detroit Beach/Sandy Creek and north of the city of Monroe.

Bodies of Water: The Fermi 1 site sits on the western shore of Lake Erie. Lake Erie consists of 9,910 square miles of water surface area, 871 miles of shoreline. Lake Erie provides sport fishing, recreational boating, swimming, water skiing and scuba diving for the local and surrounding population. Lake Erie empties into the Niagara River and the Welland Canal.

Farms: Monroe County has an area of about 550 square miles of which approximately 70% is farmland. The majority of crops grown on the farms in the area are corn, winter wheat and soybeans.

Water Supplies: Currently potable water is supplied to the Fermi 1 complex from the Frenchtown public water supply. Chapter 8 of the LTP discusses water use and potential impact of decommissioning on water quality. Wells in the vicinity of EF1 are depicted in Figure 1-3.

Population: Monroe County, in which Fermi 1 is located, extends about 10 miles north, 25 miles west, and 20 miles south-west of the site and has a population of about 146,000. The only substantially populated communities within a 10 mile radius are Newport, which lies within Berlin Township, located approximately 3.5 miles away with a population of about 11,000 and Monroe (consisting of Frenchtown Township, the City of Monroe and Monroe Township) located approximately 8 miles away with a population of about 54,800. The closest residence to EF1 is located approximately 0.71 mile in a straight line.

1.4 Decommissioning Approach

1.4.1 Overview

The objective of decommissioning EF1 is to reduce the level of residual radioactivity to levels that permit unrestricted use of the site and allow for the termination of the 10 CFR Part 50 license. The EF1 license will be terminated with the buildings remaining. Decommissioning involves the systematic removal of Systems, Structures and Components that comprise the radioactive portions of the site. DTE conducts decommissioning activities in accordance with the EF1 10 CFR Part 50 license, approved work requests, and approved procedures.

Contaminated material may be released as non-contaminated material after decontamination, shipped to a licensed offsite processor for disposition, or shipped to an offsite low-level waste (LLW) disposal site (i.e., Clive Utah site). Qualified workers package LLW for transport and disposal in accordance with applicable NRC and Department of Transportation (DOT) regulatory requirements. EF1 continues to implement its Radiological Controls Program. The objectives of the Radiological Controls Program are to control radiation hazards, avoid accidental radiation exposures, maintain worker Total Effective Dose Equivalent (TEDE) to less than 1 Rem/year (in accordance with Fermi 2 Radiation Protection Manual MRP03, "Personnel Radiation Monitoring"), and maintain doses to workers and the public As Low As Reasonably Achievable (ALARA). The philosophies, policies, and objectives of the Radiological Controls Program are based on federal regulations and associated regulatory guidance. EF1's ALARA policy maintains management's commitment to control exposures to workers and the public ALARA. This commitment is contained in the F1SAR and is implemented by plant administrative procedures and Radiation Protection Department implementing procedures.

The integrated approach to decommissioning includes support from DTE employees and outside contractors, as required, to complete the project. The Decommissioning organization provides project management and has developed administrative work controls to implement decommissioning activities. The use of trained individuals, adherence to approved procedures and established institutional controls, will ensure that the risk to the public is minimal and risk to worker health and safety is minimized. Risks associated with the transportation of LLW are also minimal.

The environmental assessment, discussed in Chapter 8 of this LTP, determined that the environmental effects from decommissioning of EF1 are minimal, and there are no adverse effects outside the bounds of NUREG-0586 "Final Generic

Environmental Impact Statement (FGEIS) on Decommissioning of Nuclear Facilities". Additionally the conclusions contained in the F1SAR used as the original basis for the environmental assessment of radiological and non-radiological effects of decommissioning, are still valid. The DTE dose modeling objective is to develop Derived Concentration Guideline Levels (DCGLs) that will demonstrate compliance with the dose-based release criteria. DTE will then demonstrate, through the FSS, that the levels of residual radioactivity at the site are equal to or below the DCGLs (i.e., below the dose-based release criteria) with a pre-specified degree of confidence.

1.4.2 Approach to License Termination

In general, each survey area at EF1 will be released after the completion of the associated FSS. Once an area has been verified as ready for release, no additional surveys or decontamination of the subject area will be required, other than surveillance surveys, unless the controls (e.g., administrative or engineered) established to prevent re-contamination have been compromised. Following completion of an FSS for a given survey area, EF1 staff will develop an FSS Report to document the final radiological condition of the area and demonstrate that the criteria in 10 CFR 20.1402 are met. These reports will be compiled and submitted to the NRC.

Chapter 5 of this LTP, Final Status Survey Plan, describes the contents of the FSS Report.

1.5 Plan Summary

1.5.1 General Information

The EF1 LTP describes the process used to meet the requirements for terminating the EF1 10 CFR Part 50 license and release the site for unrestricted use. The LTP has been prepared in accordance with the requirements in 10 CFR 50.82(a)(9) and is submitted as a supplement to the EF1 F1SAR. The LTP submittal is accompanied by a proposed license amendment that establishes the criteria for when changes to the LTP require prior NRC approval.

The subsections below provide a brief summary of the seven chapters that address the requirements in 10 CFR 50.82(a)(9).

1.5.2 Site Characterization

LTP Chapter 2 discusses the site characterization that has been conducted to determine the extent and range of radioactive contamination on site prior to remediation, including structures, soils, and surface and ground water at EF1. Based on the results of the site characterization, EF1 staff will plan remediation and FSSs in impacted areas as applicable.

The Historical Site Assessment (HSA) provided the foundation for further site characterization. The HSA provided the preliminary information required to divide the site into survey areas. The survey areas were evaluated against the criteria specified in the MARSSIM guidelines for classification. Data from subsequent characterization may be used to change the original classification of an area, within the requirements of this LTP, up to the time of the Final Status Survey.

1.5.3 Identification of Remaining Site Dismantlement Activities

LTP Chapter 3 identifies the remaining site dismantlement and decontamination activities. The information provided in Chapter 3 includes:

- A description of the areas and equipment that need further remediation,
- A characterization of radiological conditions that may be encountered,
- Estimates of associated occupational radiation dose,
- An estimate of the types and quantities of radioactive material to be released in accordance with 10 CFR 20.2001, and
- Descriptions of proposed control mechanisms to ensure areas are not re-contaminated.

EF1 decommissioning activities are conducted in accordance with the EF1 Radiation Protection Program and plant approved work packages. The radiological risk associated with decommissioning activities is bounded by analyzing all risks associated with the task prior to performing the task. The information contained in Chapter 3 supports the assessment of impacts considered in other sections of the LTP and provides sufficient detail to identify resources needed during the remaining dismantlement activities.

1.5.4 Site Remediation Plans

LTP Chapter 4 discusses the various remediation techniques that may be used during decommissioning to reduce residual contamination to levels that comply with the release criteria in 10 CFR 20.1402. LTP Chapter 4 also discusses the ALARA evaluation and the Radiation Protection Program requirements that will be implemented during the remediation process.

The remediation method used is dependent on the contaminated material. The principal materials that may be subject to remediation are structural surfaces and soils.

Remediation techniques that may be used for structural surfaces include washing, wiping, pressure washing, vacuuming, scabbling, concrete shaving, chipping, and sponge or abrasive blasting. Washing, wiping, abrasive blasting, vacuuming and pressure washing techniques may be used for both metal and concrete surfaces. Scabbling, shaving and chipping are mechanical surface removal methods intended for concrete surfaces. Concrete removal, if required, may include using machines with hydraulic-assisted, remote-operated, articulating tools. These machines have the ability to exchange scabbling, shear, chisel and other tool heads.

Soil contamination above the site-specific DCGL will be removed and disposed of as radioactive waste. Operational constraints and dust control will be addressed in site excavation and soil control procedures. Soil remediation equipment will include, but not be limited to, back and track hoe excavators. As practical, when the remediation depth approaches the soil interface region for unacceptable and acceptable contamination, a squared edge excavator bucket design or similar technique may be used. This simple methodology minimizes the mixing of contaminated soils with acceptable lower soil layers as would occur with a toothed excavator bucket. Remediation of soils will include the use of established excavation safety and environmental control procedures. Additionally, soil handling procedures and work package instructions will augment the above guidance and procedural requirements to ensure adequate erosion, sediment, and air emission controls during soil remediation.

1.5.5 Final Status Survey Plan

LTP Chapter 5 discusses the Final Status Survey Plan. The FSS Plan has been prepared using applicable regulatory and industry guidance. This plan is in accordance with site procedures and work instructions designed to perform the FSS of the EF1 site.

The FSS Plan describes the final survey process used to demonstrate that EF1 complies with radiological criteria for unrestricted use specified in 10 CFR 20.1402 (i.e., annual dose limit of 25 mrem plus ALARA, for all dose pathways). NRC regulations applicable to radiation surveys are found in 10 CFR 50.82(a) (9)(ii)(D) and 10 CFR 20.1501(a) and (b). The FSS Plan describes the development of the survey plan, survey design and data quality objectives, survey methods and instrumentation, data collection and processing, data assessment and compliance, and the Quality Assurance Project Plan (QAPP). This FSS Plan addresses only structures and land areas that are identified as contaminated or potentially contaminated (impacted) resulting from activities associated with Fermi 1 plant operation or decommissioning activities.

1.5.6 Compliance with the Radiological Criteria for License Termination

LTP Chapter 6, along with Chapters 4 & 5, describes the methods used to demonstrate compliance with the radiological criteria for license termination and release of the site for unrestricted use. Chapter 6 discusses the site-specific inventory of radionuclides, future land use scenarios, exposure pathways, computational models used for dose modeling, sensitivity analysis, DCGLs and the derivation of area factors. Since Fermi 1 is within the Owner Controlled Area of Fermi 2, upon license termination of EF1, the EF1 site becomes a part of the Fermi 2 site. To bound future uses of the EF1 site, including building demolition in the future, the Building Occupancy scenario was used for modeling surface DCGLs with parameters modified to account for moderate to heavy work activities. LTP Chapter 6 provides justification for using this scenario.

1.5.7 Update of Site Specific Decommissioning Costs

LTP Chapter 7 provides an estimate of the remaining decommissioning costs for releasing the EF1 site for unrestricted use. This chapter also compares the estimated remaining cost with the funds currently available and decommissioning financial assurance provisions.

1.5.8 Supplement to the Environmental Report

LTP Chapter 8 updates the F1SAR and the Final Generic Environmental Impact Statement with new information and any significant environmental impacts associated with the site's decommissioning and license termination activities. This section of the LTP is prepared pursuant to 10 CFR 51.53(d) and 10 CFR 50.82(a)(9)(ii)(G).

1.6 License Termination Plan Change Process

DTE is submitting the LTP as a supplement to the F1SAR. Accordingly, DTE will update the LTP in accordance with 10 CFR 50.71(e). Once approved, DTE may make changes to the LTP, without prior NRC approval, in accordance with the criteria in 10 CFR 50.59, 10 CFR 50.82(a)(6), and 10 CFR 50.82(a)(7).

DTE intends to submit a proposed amendment to the EF1 License that adds a license condition establishing the criteria for determining when changes to the LTP require prior NRC approval. Changes to the LTP require prior NRC approval when the change:

1. Increases the probability of making a Type I decision error above the level stated in the LTP,
2. Increases the radionuclide-specific DCGLs,
3. Increases the radioactivity level, relative to the applicable DCGL, at which investigation occurs, and
4. Changes the statistical test applied other than the Sign Test or Wilcoxon Rank Sum Test.

Re-classification of survey areas from a less to a more restrictive classification (e.g., from a Class 3 to a Class 2 area) may be done without prior NRC notification; however, re-classification to a less restrictive class (e.g., Class 1 to Class 2 area) will require NRC notification at least 14 days prior to implementation.

1.7 License Termination Plan Information Contacts

Lynne Goodman	Kenneth Lindsey	Martin Erickson
EF1 Custodian	EF1 Health Physicist	License Termination Mgr.
Fermi 1	Fermi 1	Fermi 1
6400 N. Dixie Hwy.	6400 N. Dixie Hwy.	6400 N. Dixie Hwy.
Newport, MI 48166	Newport, MI 48166	Newport, MI 48166
734-586-1205	734-586-4455	734-586-5467

1.8 References

1.8.1 Fermi 2, *Fermi 2 Updated Final Safety Analysis Report*

1.8.2 Enrico Fermi Atomic Power Plant, Unit 1, *Fermi 1 Manual*

1.8.3 U.S. Census Bureau, American Fact Finder

1.8.4 U.S. Nuclear Regulatory Commission Regulatory Guide 1.179 "Standard Format and Contents for License Termination Plans for Nuclear Power Reactors"

1.8.5 U.S. Nuclear Regulatory Commission NUREG-1575 "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)"

1.8.6 U.S. Nuclear Regulatory Commission NUREG-1700 "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans" Revision 1

1.8.7 U.S. Nuclear Regulatory Commission NUREG-1757 "Consolidated NMSS Decommissioning Guidance"

1.8.8 U.S. Nuclear Regulatory Commission NUREG-0586 "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities"

Figure 1-1 EF1 Aerial View

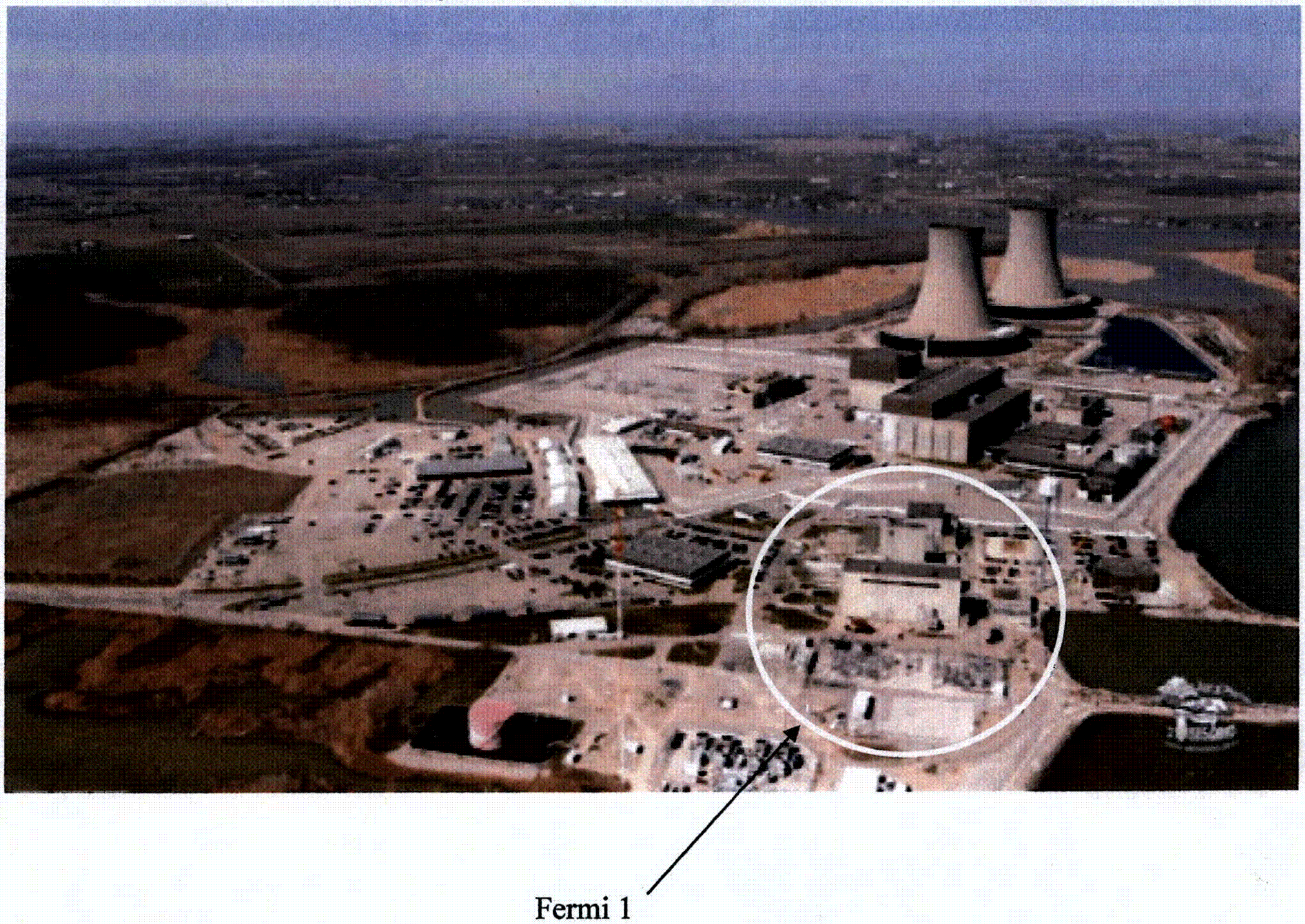


Figure 1-2 EF1 Contour Map

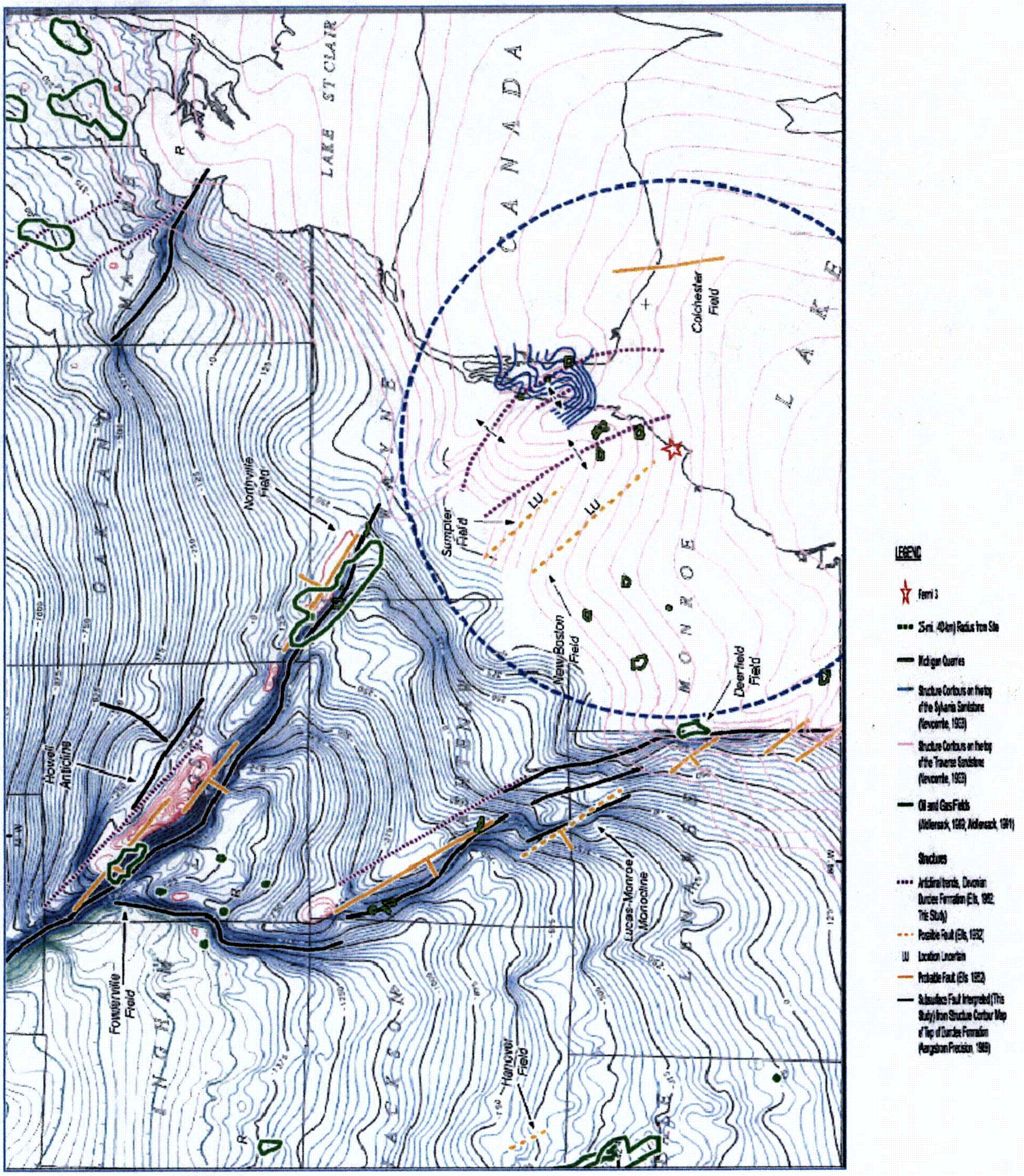
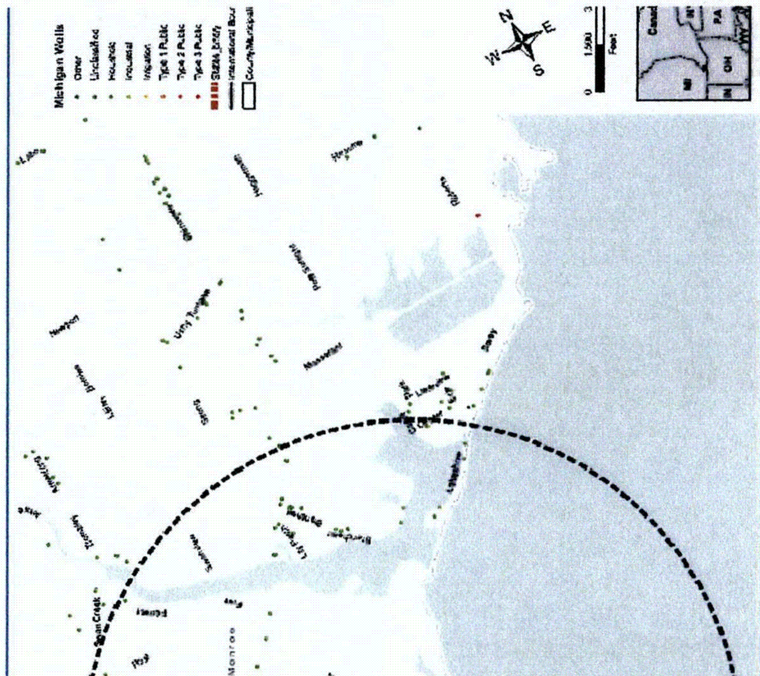


Figure 1-3 Potable Water Supplies in the Vicinity of EF1



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2.0 SITE CHARACTERIZATION

2.1 Historical Site Assessment Summary

2.1.1 Introduction

The Historical Site Assessment (HSA) describes the site's physical configuration, identifies the radioactive constituents of site contamination, assesses the migration of contaminants, identifies contaminated media and classifies impacted areas.

Detroit Edison (DECo) has conducted the HSA of its Fermi 1 (EF1) site in accordance with the guidance of NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," in support of the ultimate decommissioning and license termination of the facility. The HSA formally began in 2007, following several preliminary assessments of the impact of facility operations on the remediation required prior to the performance of the Final Status Survey(s) (FSS). These preliminary surveys were conducted beginning in 1997 with the meeting of previous employees followed by another meeting in 2002. An initial characterization survey was performed in 2004. The HSA was formally compiled in 2008. The purpose of the HSA is to document a comprehensive investigation identifying, collecting, organizing and evaluating historical information relevant to the EF1 site. The HSA focuses on open land areas and those structures that will remain at the time of final status survey.

The HSA consisted of a review of:

- License and Technical Specifications
  - Technical Specification Changes
  - License Amendments and Revisions
  - Fermi 1 Manual
  - F1SAR
- Original Plant Design
  - Function and purpose of systems and structures
  - Plant operating parameters
  - Plant operating procedures
  - PRDC Technical Information and Hazards Summary Report
- Original Plant Construction Drawings and Photographs
  - Specifications for systems and structures
  - Field Changes/as built drawings
  - Site Conditions
- Plant Operating History
  - Reports
  - Plant Operating Procedures Regarding Spills and Unplanned Releases
  - Shift Supervisor Logbooks
  - Radiological Environmental Monitoring Program and Golder Report on Groundwater Characterization

- Monthly Plant Operational Reports
- EF1 Alumni Questionnaires

- Work Control Documents and Site Modifications
  - Work Packages
  - Plant Alterations
  - Engineering Design Change Requests (EDCR)
  - Plant Modifications
  - Maintenance Reports
- Radiological Surveys and Assessments
  - Radiological surveys performed in support of normal plant operations and maintenance
  - Radiological surveys performed in support of special plant operations and maintenance
  - Radiological assessments performed in response to radioactive spills or events
  - Scoping and characterization surveys performed
  - Remediation support surveys conducted during decommissioning activities
- The EF1 Retirement Report
- Documentation of remediation area stabilization and restoration activities
- Fermi 1 Decommissioning Evaluation Report
- Enrico Fermi 1 History of Underground Systems, Pipes and Structures

Concurrent with the performance of the HSA was the initial segregation of the facility into individual specific, uniquely identified, survey areas. This provides the basis for development of area specific site drawings and survey maps required to document the characterization, remediation, and final release survey process. A major output from the HSA process was the information used as the basis for the preliminary MARSSIM classifications of the initial survey areas.

The initial classification of the site areas was based on the historical information and site characterization data. Data from subsequent characterization may be used to change the original classification of an area up to the time of the FSS as long as the classification reflects the level of residual activity existing prior to any remediation in the area.

2.1.2 Objectives of Historical Site Assessment

DECo conducted the Historical Site Assessment of the EF1 site to:

- Identify known and potential sources of radioactive material and radioactively contaminated areas including systems, structures and environmental media based on the investigation and evaluation of existing information;
- Identify areas of the site with no conceivable or likely potential for radioactive or hazardous materials contamination and assign a preliminary classification of Non-Impacted while assigning a preliminary classification of Impacted to all remaining portions of the site;
- Develop the records to be utilized during the design of subsequent scoping, characterization, remediation, and the FSS; and
- Provide preliminary information necessary to identify and segregate the site into survey areas evaluated against the criteria specified in the MARSSIM guidelines for classification. This classification will designate the need for and level of remedial action required within a particular survey unit as well as the level of survey intensity required during the FSS.

2.1.3 Property Identification

A description of the EF1 site and environs is contained in Section 8 of this LTP.

2.1.4 HSA Methodology

The methodology used for the EF1 Historical Site Assessment is that found in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)". Portions of HSA related information were gathered from the EF1 library.

2.1.4.1 Approach and Rationale

The primary objective of the HSA records search process was the identification of those events posing a significant probability of impacting the radiological characterization of the site. These included system, structure, or area contamination from system failures resulting in airborne releases, liquid spills or releases, or the loss of control over solid material management. Each event identified that posed a realistic potential to impact the characterization of the site was further investigated. This investigation focused on the scope of contaminant sampling and analysis, remedial actions taken to mitigate the situation, and any post-remedial action sampling, survey, and analysis in an attempt to identify the "as left" condition of the event location. The EF1 library provided the source of a vast majority of the documents inspected. Also included in the research associated with the development of the HSA were:

- Relevant excerpts from written reports and correspondences;

- Personnel interviews, including the use of questionnaires of former and retired plant personnel to confirm documented incidents and identify undocumented incidents; and

- Site inspection, utilizing historic site drawings, photographs, prints, and diagrams to identify, locate, confirm, and document areas of concern.

Information from this research was used in the HSA development, including the compilation of data, evaluation of results, documentation of findings, and the characterization and identification of survey areas.

2.1.4.2 Documents Reviewed

Records maintained to satisfy the requirements of 10 CFR Part 50.75(g)(1) provided a major source of documentation for the HSA records review process. Additional documentation (e.g. shift operating logs, etc.) maintained in the EF1 library were reviewed. Information reviewed during the course of performing the HSA is listed in Section 2.1.1.

2.1.4.3 Site Reconnaissance

As allowed by MARSSIM Section 3.5, a formal site reconnaissance was not performed, based on the continuous occupancy of the site by the licensees, their orderly turnover at the conclusion of initial decommissioning, the detailed information available through the records and other documents, and the personnel interviews performed. Investigations were performed to verify locations and current conditions of questionable items or issues (radioactive liquid spills or spread of contamination) discovered during review of historical records or the conduct of personal interviews.

2.1.4.4 Personnel Interviews

In February of 1997 a reunion was held comprised of Fermi 1 alumni. As part of the reunion, questionnaires were passed out consisting of discussion topics for the gathering. The purpose of the questionnaires was to glean any additional information from former employees that would be of benefit in the historical site assessment. A total of fifteen responses were received with the following quoted items of interest:

- Mention was made of an explosion/fire in the cold-trap room in the FARB.
- Mention of the partial fuel melting event in October, 1966.
- Mention of an explosion of the #1 S/G rupture disc in Steam Generator Building.
- No mention of spills of contaminated material.

On October 29, 2002 during a Fermi 1 Alumni gathering the following items of interest were mentioned during a group discussion:

- The ring header embedded around the perimeter of the building is the air intake for the ventilation system.
- Pipe was washed in the overflow canal (not radioactive).
- Sodium barrel dropped on ground north of the FARB. Left in the rain and some reacted.
- Fuel pools had good integrity. No indications of leakage.
- Potential sodium leakage from Cask Car. Need to be diligent when performing final surveys.
- Transfer Tank cold trap pump explosion – no additional details given.

In response to the questionnaire distributed during the October gathering, 14 individuals responded by November 29, 2002, with the following items of interest:

- Check Peaking Boiler House oil supply line for leakage.
- Debris was dumped into the quarry including a 30 or 55 gallon drum of non-radioactive sodium.
- Lots of cables and wires are buried at Fermi 1 – probably not on drawings.
- Mercury spill in the Waste Gas building during preoperational testing. Area was cleaned up.
- Chlorine spill at Screen House – possibly in 1962.

- Na/water and NaK/water experiments at Sibley quarry (non-radioactive).

An exit interview of a Fermi 1 employee who was retiring was performed in 2007. The interview made mention of a spill that occurred in the "Uranium Room" of the FARB. Additionally, there was mention of a number of small contaminated sodium spills in the Trestle-way that were remediated.

2.1.4.5 Historical Construction Photograph Review

Collections of historical photographs were reviewed to assess their contribution to this HSA. A selection of historical photographs is included as Appendix 2-A.

2.1.5 Operational History

The following summary of the facility's history was determined through a review of site records, documents and personnel interviews.

2.1.5.1 Introduction

On May 10, 1963 the Atomic Energy Commission (AEC) granted an operating license, DPR-9, to Power Reactor Development Company (PRDC) a consortium of corporations specifically formed to own and operate a nuclear reactor at the EF1 site. Detroit Edison Company owned the power generating portion of the plant and the surrounding land. This area is now part of the larger Fermi 2 owner controlled area.
The reactor was tested at low power in its first years of operation. Power ascension testing above 1 MWt commenced in December 1965, immediately following receipt of the high power operating license. In October 1966, during a power ascension, zirconium plates at the bottom of the reactor vessel became loose and blocked sodium coolant flow to some fuel subassemblies, two subassemblies sustaining significant damage. Radiation monitors alarmed and the operators manually shut down the reactor. No abnormal releases to the environment occurred. The cause was subsequently determined, cleanup completed, fuel replaced, and three years and nine months later, Fermi 1 was restarted.

In 1972, the core was approaching the fuel design limit. In November, 1972, PRDC made the decision to decommission Fermi 1. The fuel and blanket subassemblies were shipped offsite in 1973. The non-radioactive secondary sodium system was drained and the sodium sent off-site. The radioactive primary sodium was stored in storage tanks and in 55 gallon drums until the sodium was shipped offsite in 1984. Decommissioning of EF1 was originally completed in December of 1975. Effective January 23, 1976 DPR-9 was transferred to Detroit Edison Company as a "possession only" license. Based on current regulatory requirements, EF1 is identified as being in a SAFSTOR status. In November 2000 the announcement was made that the last phase of SAFSTOR, deferred decontamination, would be initiated.

A summary of the operational/ post-operational history is provided in Table 2-1 below.

Table 2-1
Operational/Post-operational Chronological Summary

Formation of Dow-Detroit Study Group	1950
Submittal of Proposal to USAEC under Round 1 of Power Reactor Demonstration Program	March 30, 1955
Proposal to the AEC Accepted during First Geneva Conference	August 8, 1955
EF1 Groundbreaking	August 8, 1956
Sodium Fill of Primary System	December 1, 1960
First Criticality and Start of Low Power Tests	August 23, 1963
Start of High-Power Testing	December 1965
100-Hour Operation at 100 MWt	August 1966
Partial Subassembly Event	October 5, 1966
Resumption of Operation Following Repairs	July 18, 1970
Completion of Nuclear and Plant Test Program at Increased Power of 200 MWt	October 16, 1970
10-Day High-Power Operation Logging	November 20 to December 1, 1971
Last Plant Operation at Low Power for Operator Licensing Examinations	October 1972
Decision to Decommission the Plant	November 27, 1972
Initial EF1 decommissioning completed	December 1975
Last stage of SAFSTOR initiated	November 2000

2.1.5.2 Regulatory Overview

NRC inspectors from Region III offices perform routine onsite inspections of EF1 site activities. Periodic calls are also held with NRC headquarters and Region III staff to monitor plant status and decommissioning progress. The NRC is notified of any incidents on site per the existing protocol established with NRC Region III and NRC reporting regulations. The NRC headquarters staff reviews all license amendment requests and other submittals. Periodic meetings are being held with the NRC headquarter staff relative to license termination planning.

The Michigan Department of Environmental Quality provides oversight of Fermi 1 decommissioning and license termination activities.

2.1.5.3 Waste Handling Procedures

Waste materials generated at EF1 are generally described as radioactive, hazardous, mixed (radioactive/hazardous), universal, or non-regulated. To ensure the conformance with prescribed regulatory requirements, waste handling evolutions are controlled through various administrative and operational procedures.

2.1.5.4 Current Site Usage

2.1.5.4.1 Description of Operations

In 1973, EF1 completed transferring all of its fuel and blanket assemblies off-site. Current operations focus primarily on tasks and activities required to complete the dismantlement and decontamination of the facility.

2.1.5.4.2 Recent Site Characterization

The recent characterization of the EF1 site resulted from the review and evaluation of surveys and evaluations previously conducted to determine the extent and nature of residual contamination. In accordance with MARSSIM guidance, this site characterization (as to the Impacted or Non-Impacted nature of the site) was completed in 2008. The HSA including the initial and recent site characterizations is the product of the evaluations and investigation necessary to define the current condition at the site and assign preliminary area classifications. The methodology employed for the recent characterization effort at EF1 is explained in Section 2.3 of this document.

2.1.5.5 Site Dismantlement

2.1.5.5.1 Dismantlement activities within the Controlled Area

The machinery dome and above floor portions of the primary shield tank, fuel handling and control rod drives mechanisms have been removed. All the graphite blocks and "chinkers" have been removed from the upper section of the Reactor Vessel. The Reactor Vessel and primary loops have undergone processing of the remaining residual sodium. The primary sodium service system and some of the primary sodium piping have been removed. The fuel handling equipment has been removed. The transfer tank, cold-trap heat exchange equipment, fuel storage racks and ventilation system equipment have been removed in the Fuel and Repair Building (FARB). The majority of original equipment and piping in the Sodium Potassium (NaK) room, valve room and cold-trap room have been removed in the Sodium Building. All ventilation components have been removed from the ventilation building. The Fission Product Detector (FPD) vapor trap, some of the piping and associated equipment was removed from the FPD building. The majority of original components have been removed from inside the Waste Gas Building as well as the Inert Gas Building. The Health Physics/Chemistry Building has been removed as well as the asbestos tile from the Health Physics/Chemistry building footprint. Asbestos abatement has been performed in the East and West Sodium Galleries, Sodium Tunnel, Sodium Building, FARB and Reactor Building.

2.1.5.5.2 Dismantlement Activities outside the Controlled Area

The steam generators, sodium storage tanks, secondary sodium pumps, supporting piping and portions of walls have been removed in the Steam Generator Building. Removal of the diesel generator, compressor and considerable electrical equipment along with many of the components has occurred in the Control Building. Portions of the turbine generator system were salvaged for spare parts. Acid and caustic tanks have been removed from the west side of the facility. The transformer has been removed from the south side. The stack has been removed.

2.1.5.6 Radiological Sources

2.1.5.6.1 Controlled Area Contamination

All areas within the Controlled Area have been identified as having been radiologically impacted by the operation of the facility and subsequent decommissioning activities.

2.1.5.6.2 Areas Outside the Controlled Area Contamination

While current characterization data has not identified contamination greater than background concentrations, all survey areas outside the Controlled Area (see Figure 2-2) have been classified as impacted as a conservative measure. Surveys have been performed on the interior surfaces of the ancillary systems (e.g. condensate, feedwater, steam, etc.) in the Turbine Building. No survey result has indicated the presence of contamination within these systems; therefore, the ancillary systems have been classified as non-impacted.

2.1.6 Event Descriptions

Because of the very nature of a sodium cooled facility, spills of sodium were not tolerated due to the explosive/flammable nature of sodium when it contacts moisture.

Table 2-2 provides a summary of unplanned events that impacted various EF1 survey areas.

Table 2-2 List of Unplanned Events

Impacted Survey Area	Date	Description
NOL-01	8/1/67	Leak in Waste Gas drain line
NOL-01	4/30/68	Leak in Waste Gas discharge line
NOL-01 and OOL-01	5/6/68	Leak in the Health Physics/Chemistry Bldg. Waste Discharge line
FRB-01	Unknown	Spill in the Uranium Room
RXB-01, TRW-01, VNB-01 and FRB-01	5/20/08	Fire in the Reactor Building Basement
RXB-01	2008 multiple	Processing liquid leaks in the Reactor Building Basement
TRW-01	Unknown	Minor leaks in Trestle way
FRB-01	Unknown	Explosion in FARB cold-trap room

2.1.7 Survey Unit Identification and Classification

2.1.7.1 Survey Areas

The entire EF1 site is divided into areas. Areas are typically larger physical sections of the site that may contain one or more survey units depending on their classification.

2.1.7.2 Survey Units

A Survey Unit is a physical area consisting of buildings, structures, or land areas of specifically defined shapes and sizes, for which a unique decision will be made regarding whether the presence of any residual radioactive material meets or exceeds predetermined release criteria. A Survey Unit is a single contiguous area, whose size is dependent upon its physical characteristics (open land vs. structural building), radiological conditions and whose operational conditions are reasonably consistent with the exposure modeling used to determine the classification.

2.1.7.3 Initial Designation of Areas

Using reasonable and available physical and documented references, seventeen areas were identified and assigned a unique Survey Area identification. Current area designations (Areas of the site are depicted in Figure 2-2, Area Designations) are summarized in Table 2-3:

Table 2-3
Survey Area Summary Information

Survey Area Designator	Name/Building	Total Area Footprint (Square Feet)	Total Area Footprint (Square Meters)	Classification
OOL	Open Land Area	80495	7478	Class 3
SGB	Steam Generator Building	16434	1527	Class 3
CTB	Control Building	22332	2075	Class 3
TBN	Turbine Building	67113	6235	Class 3 and Class 2
OFB	Office Building	12595	1170	Class 3
NOL	Open Land Area (impacted)	25753	2392	Class 2
RXB	Reactor Building	8144	757	Class 1, Class 2 and Class 3
FRB	Fuel and Repair Building	29561	2746	Class 1 and Class 2
TRW	Trestleway	5862	545	Class 1 and Class 2
NAB	Sodium Building	12016	1116	Class 1 and Class 2
VNB	Ventilation Building	1880	175	Class 1 and Class 2
NAT	Sodium Tunnel	540	50	Class 2
ESG	East Sodium Gallery (including FPD Bldg)	1055	98	Class 2
WSG	West Sodium Gallery	721	67	Class 2
WGB	Waste Gas Building	3264	303	Class 2
IGB	Inert Gas Building	5021	466	Class 2

2.1.8 Area Radiological Impact Summaries

The methodology employed for the recent characterization effort at EF1 is explained in Section 2.3 of this document.

2.1.8.1 OOL-01 – Open Land Area Outside the Controlled Area

Survey area OOL-01 represents the primary travel path for personnel and equipment entering and leaving EF1. Survey area OOL-01 consists of the open land area outside the EF1 Controlled Area. Survey area

OOL-01 contains about 7,478 square meters of surface area made up of soils, asphalt, gravel and concrete.

Systems present in survey area OOL-01 that may contain residual radioactivity are the Health Physics/Chemistry Building waste discharge and the FARB liquid discharge line.

Survey area OOL-01 was not used for storing radioactive material or processing radioactive waste, except in waste containers.

Contamination of survey area OOL-01 may have resulted from run-off of low levels of radioactive contamination present on the Controlled Area yard surface or from contaminated personnel, equipment, and material traffic. Contamination may have resulted as well from the failure of the Health Physics/Chemistry Building waste discharge line. The line was replaced and capped.

Events and activities that may have contaminated survey area OOL-01 include:

- Leak in the Health Physics/Chemistry Building waste discharge line (5/6/68).
- Transport of radwaste through the survey area.

Characterization data from past surveys proved to be insufficient for FSS planning activities. Few soil samples were taken in this survey area and no samples taken were analyzed for HTD radionuclides. Characterization plan EF1-CHAR-OOL-01 was implemented on June 23, 2008. Fifteen samples were collected with two split samples sent to an off-site lab to be analyzed for Hard-to-Detect (HTD) radionuclides.

Characterization plan EF1-CHAR-OOL-01-02 was implemented on September 30, 2008 at the two sites excavated (within the original OOL-01 footprint) in support of cable vaults. This characterization was performed to the rigors of a FSS and was designated EF1-CHAR-OOL-01-02 and the results are included in Table 2-4 below.

Table 2-4
OOL-01 Characterization Data

Location	Cs-137 (pCi/g)	Location	Cs-137 (pCi/g)
CHAR-OOL-01-001	0.18	CHAR-OOL-01-02-001	ND[1]
CHAR-OOL-01-002	0.45	CHAR-OOL-01-02-002	ND[1]
CHAR-OOL-01-003	ND[1]	CHAR-OOL-01-02-003	ND[1]
CHAR-OOL-01-004	0.38	CHAR-OOL-01-02-004	ND[1]
CHAR-OOL-01-005	0.09	CHAR-OOL-01-02-005	ND[1]
CHAR-OOL-01-006	ND[1]	CHAR-OOL-01-02-006	0.006
CHAR-OOL-01-007	0.13	CHAR-OOL-01-02-007	ND[1]
CHAR-OOL-01-008	0.06	CHAR-OOL-01-02-008	ND[1]
CHAR-OOL-01-009	0.13	CHAR-OOL-01-02-004-RC[2]	ND[1]
CHAR-OOL-01-010	ND[1]	CHAR-OOL-01-02-008-S[3]	ND[1]
CHAR-OOL-01-010-RC[2]	0.06		
CHAR-OOL-01-011	0.17		
CHAR-OOL-01-012	0.10		
CHAR-OOL-01-013	0.06		
CHAR-OOL-01-013-RC[2]	0.08		
CHAR-OOL-01-014	ND[1]		
CHAR-OOL-01-015	ND[1]		
CHAR-OOL-01-005-S[3]	0.14		
CHAR-OOL-01-008-S[3]	0.16		
Ct. Mean	0.16	**Ct. Mean**	0.006
Ct. Median	0.12	**Ct. Median**	0.006
Ct. Std. Dev.	0.13	**Ct. Std. Dev.**	N/A

[1] ND indicates no activity >MDA.
[2] RC indicates a QC recount.
[3] S indicates a Split sample sent to an offsite lab.

The sample results show soil samples that contained concentrations of plant related nuclides above minimum detectable activity (MDA) indicated the presence of only Cs-137 in a range 0.006 to 0.45 pCi/g which is in line with the range of Cs-137 found in the soil due to man-made fallout (see Section 2.3.4 for the Cs-137 in background determination). Split sample results, from the off-site lab indicated that no plant-related HTD radionuclides were present above the MDA.

Based upon the findings of materials reviewed, personnel interviews and of data acquired during characterization, the majority of OOL-01 is classified as a Class 3 area. The area of the excavation where the radwaste piping will be removed will be classified as a Class 1 area prior to backfilling.

2.1.8.2 SGB-01 – Steam Generator Building

The Steam Generator Building is located south of the Reactor Building and north of the Detroit Edison turbine structure. The building housed the steam generators, secondary sodium pumps and piping components of the secondary coolant system. The equipment components were located at the operating floor at elevation 590'-0". The basement of the building housed the storage tanks and miscellaneous piping and equipment components of the Secondary Sodium Services System. The structure and equipment components were supported through a system of structural steel columns to a reinforced concrete base slab resting on bedrock. The basement floor of the building is divided into five sectors. An east-west concrete block firewall was installed the full length of the building extending between the basement floor and the operating floor. The remaining structure is of conventional design, that is, steel and corrugated asbestos walls.

Modes and vectors for transmigration of contaminants include:

- Movement or removal of radioactive material for shipment.
- Tritium in some residual sodium
- Movement into and out of the RRA of personnel and equipment at the RRA entrance from the Steam Generator Building.

Survey area SGB-01 has an area footprint of approximately 1527 square meters.

Characterization data from past surveys proved to be insufficient for FSS planning activities.

A Characterization effort was implemented on August 21, 2008 to include smears, scans and fixed-point measurements in SGB-01. An ambient correction[1] was achieved by taking shielded readings at five locations on each level and the Mean of those data was calculated for each fixed-point location. Smears indicated no smear result greater than MDA.

Table 2-5 represents the results of the fixed-point readings taken on the floors, walls and ceiling during this survey effort. Smears were taken at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in the general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated greater than background.

[1] Ambient readings were taken in structures to evaluate the gamma influence of the operation of Fermi 2 on the readings taken at EF1. A discussion of the methodology for taking the ambient readings is found in Section 2.3.4

Table 2-5
SGB-01 Characterization Data

Location	Result (dpm/100cm^2)	Location	Result (dpm/100cm^2)	Location	Result (dpm/100cm^2)
BASEMENT		1st FLOOR		2nd FLOOR	
CHAR-SGB-01-001-F-M	1377	CHAR-SGB-01-016-F-M	1621	CHAR-SGB-01-031-F-M	2082
CHAR-SGB-01-002-F-M	1458	CHAR-SGB-01-017-F-M	1465	CHAR-SGB-01-032-F-M	1982
CHAR-SGB-01-003-F-M	1465	CHAR-SGB-01-018-F-M	1632	CHAR-SGB-01-033-F-M	1270
CHAR-SGB-01-004-F-M	1580	CHAR-SGB-01-019-F-M	1609	CHAR-SGB-01-034-F-M	1203
CHAR-SGB-01-005-F-M	1443	CHAR-SGB-01-020-F-M	1676	CHAR-SGB-01-035-F-M	1288
CHAR-SGB-01-006-F-M	1403	CHAR-SGB-01-021-F-M	1609	CHAR-SGB-01-036-F-M	1192
CHAR-SGB-01-007-F-M	1366	CHAR-SGB-01-022-F-M	1536	CHAR-SGB-01-037-F-M	1155
CHAR-SGB-01-008-F-M	1325	CHAR-SGB-01-023-F-M	1824	CHAR-SGB-01-038-F-M	1071
CHAR-SGB-01-009-F-M	1543	CHAR-SGB-01-024-F-M	1705	CHAR-SGB-01-039-F-M	1211
CHAR-SGB-01-010-F-M	1473	CHAR-SGB-01-025-F-M	1521	CHAR-SGB-01-040-F-M	1429
CHAR-SGB-01-011-F-M	1491	CHAR-SGB-01-026-F-M	1639	CHAR-SGB-01-041-F-M	1244
CHAR-SGB-01-012-F-M	1469	CHAR-SGB-01-027-F-M	1639	CHAR-SGB-01-042-F-M	1196
CHAR-SGB-01-013-F-M	941	CHAR-SGB-01-028-F-M	1661	CHAR-SGB-01-043-F-M	1436
CHAR-SGB-01-014-F-M	1517	CHAR-SGB-01-029-F-M	1436	CHAR-SGB-01-044-F-M	1735
CHAR-SGB-01-015-F-M	1329	CHAR-SGB-01-030-F-M	1513	CHAR-SGB-01-045-F-M	1465
Mean Ambient	1135	**Mean Ambient**	678	**Mean Ambient**	1065
Ct. Mean	1412	**Ct. Mean**	1606	**Ct. Mean**	1397
Ct. Median	1458	**Ct. Median**	1621	**Ct. Median**	1270
Ct. Std. Dev.	150	**Ct. Std. Dev.**	99	**Ct. Std. Dev.**	305

F-M = Fixed measurement

Based on the fixed-point measurements the average measurement was 300 to 1000 dpm/100cm^2 greater than the ambient levels. These measurements are on a factor of 11 lower as compared to the most restrictive radionuclide Derived Concentration Guideline Level(DCGL) present, (Co-60).

Based upon the findings of materials reviewed, personnel interviews and of data acquired during characterization, SGB-01 is classified as a Class 3 area.

2.1.8.3 CTB-01 – Control Building

This structure had, as its primary purpose, the protection of personnel working inside, from the elements of weather and radioactive streaming. In addition, it served as protection for the equipment installed to control the operation of the whole plant. In order for the shielding function to be performed, the walls adjacent to the Containment Building are 40 inch thick, reinforced concrete, and the roof was designed to eliminate the effect of sky shine on the control room located on the third floor of the building.

Modes and vectors for transmigration of contaminants include:

- Migration of contamination from the radwaste storage area on the 3rd level of the Turbine Building to the Control Building.

Survey area CTB-01 has an area footprint of approximately 2,075 square meters.

Characterization data from past surveys proved to be insufficient for FSS planning activities. A Characterization effort was implemented on August 11, 2008 to include smears, scans and fixed-point measurements in CTB-01. An ambient correction was achieved by taking shielded readings at five locations on each floor and the Mean of those data was calculated. Table 2-6 represents the results of the fixed-point readings taken on the floors, walls and ceiling during this survey effort. Smears were taken at each fixed-point location. Smears indicated no smear result greater than MDA. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in the general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated greater than background.

Table 2-6
CTB-01 Characterization Data

Location	Result (dpm/100cm^2)	Location	Result (dpm/100cm^2)	Location	Result (dpm/100cm^2)
1st FLOOR		2nd FLOOR		3rd FLOOR	
CHAR-CTB-01-001-F-M	1370	CHAR-CTB-01-016-F-M	1469	CHAR-CTB-01-031-F-M	1200
CHAR-CTB-01-002-F-M	1377	CHAR-CTB-01-017-F-M	1152	CHAR-CTB-01-032-F-M	993
CHAR-CTB-01-003-F-M	1314	CHAR-CTB-01-018-F-M	1052	CHAR-CTB-01-033-F-M	997
CHAR-CTB-01-004-F-M	975	CHAR-CTB-01-019-F-M	1118	CHAR-CTB-01-034-F-M	986
CHAR-CTB-01-005-F-M	1322	CHAR-CTB-01-020-F-M	1122	CHAR-CTB-01-035-F-M	1052
CHAR-CTB-01-006-F-M	1469	CHAR-CTB-01-021-F-M	1034	CHAR-CTB-01-036-F-M	1288
CHAR-CTB-01-007-F-M	1333	CHAR-CTB-01-022-F-M	1178	CHAR-CTB-01-037-F-M	1111
CHAR-CTB-01-008-F-M	1370	CHAR-CTB-01-023-F-M	1063	CHAR-CTB-01-038-F-M	1034
CHAR-CTB-01-009-F-M	1192	CHAR-CTB-01-024-F-M	1093	CHAR-CTB-01-039-F-M	1214
CHAR-CTB-01-010-F-M	1299	CHAR-CTB-01-025-F-M	1004	CHAR-CTB-01-040-F-M	1082
CHAR-CTB-01-011-F-M	1358	CHAR-CTB-01-026-F-M	1026	CHAR-CTB-01-041-F-M	1115
CHAR-CTB-01-012-F-M	1425	CHAR-CTB-01-027-F-M	735	CHAR-CTB-01-042-F-M	1000
CHAR-CTB-01-013-F-M	1314	CHAR-CTB-01-028-F-M	661	CHAR-CTB-01-043-F-M	1037
CHAR-CTB-01-014-F-M	1403	CHAR-CTB-01-029-F-M	1340	CHAR-CTB-01-044-F-M	904
CHAR-CTB-01-015-F-M	1292	CHAR-CTB-01-030-F-M	1307	CHAR-CTB-01-045-F-M	1122
Mean Ambient	1014	**Mean Ambient**	1005	**Mean Ambient**	985
Ct. Mean	1321	**Ct. Mean**	1090	**Ct. Mean**	1076
Ct. Median	1333	**Ct. Median**	1093	**Ct. Median**	1052
Ct. Std. Dev.	116	**Ct. Std. Dev.**	206	**Ct. Std. Dev.**	102

F-M = Fixed measurement

Fixed-point measurements were at or slightly above the ambient radiation levels in the building. A maximum of 464 dpm/100cm^2 above ambient reading was observed from this survey which is 4.2% of the most restrictive site specific DCGL.

Based upon the findings of materials reviewed, personnel interviews and of data acquired during characterization, CTB-01 is classified as a Class 3 area.

2.1.8.4 TBN-01 – Turbine Building

Steam once produced in the three steam generators located within the Steam Generator Building passed to the adjacent Turbine Building and was used to operate the turbine. The turbine was a tandem-compound, single flow machine. Four stages of feed water heating were used. The turbine and support equipment, feedwater heaters, main condenser and associated piping and pumps are/were located in the Turbine Building. The Turbine Building is a steel frame structure which is tied together with standard riveted or bolted connections. Steel beams support the concrete or grating floors. The exterior walls consist of a 4-foot high apron wall constructed of 8-inch cinder block except in the region behind the transformer and the hydrogen storage platform, where reinforced concrete is used to provide a positive fire barrier. Non-insulated, corrugated, asbestos-cement siding which is fastened to steel channel girts that run the full height of the building is installed above the apron wall. Open web steel joists support the standard ribbed galvanized steel roof deck.

Modes and vectors for transmigration of contaminants include:

- Movement and storage of Radwaste on the 1st and 3rd floors of TBN-01.

Survey area TBN-01 has an area footprint of approximately 6235 square meters.

Characterization data from past surveys proved insufficient for FSS planning activities. A Characterization effort was implemented on August 13, 2008 to include smears, scans and fixed-point measurements in TBN-01. An ambient measurement was achieved by taking shielded readings at five locations on each floor and the Mean of those data was calculated. Tables 2-7 and 2-8 represent the results of the fixed-point readings taken on the floors, walls and ceiling during this survey effort. Smears were taken at each fixed-point location. Smears indicated no smear result greater than MDA. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in the general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated greater than background with the exception of the areas on the 3rd floor that were attributed to the presence of waste boxes awaiting shipment.

Table 2-7
TBN-01 Characterization Data (1st, 2nd & 3rd Floors)

Location	Result ($dpm/100cm^2$)	Location	Result ($dpm/100cm^2$)	Location	Result ($dpm/100cm^2$)
1st FLOOR		2nd FLOOR		3rd FLOOR	
CHAR-TBN-01-001-F-M	1579	CHAR-TBN-01-016-F-M	1242	CHAR-TBN-01-031-F-M	1375
CHAR-TBN-01-002-F-M	1401	CHAR-TBN-01-017-F-M	1390	CHAR-TBN-01-032-F-M	1235
CHAR-TBN-01-003-F-M	1250	CHAR-TBN-01-018-F-M	1689	CHAR-TBN-01-033-F-M	1427
CHAR-TBN-01-004-F-M	1316	CHAR-TBN-01-019-F-M	1582	CHAR-TBN-01-034-F-M	1564
CHAR-TBN-01-005-F-M	1198	CHAR-TBN-01-020-F-M	1238	CHAR-TBN-01-035-F-M	1582
CHAR-TBN-01-006-F-M	1368	CHAR-TBN-01-021-F-M	1375	CHAR-TBN-01-036-F-M	1593
CHAR-TBN-01-007-F-M	1242	CHAR-TBN-01-022-F-M	1390	CHAR-TBN-01-037-F-M	1449
CHAR-TBN-01-008-F-M	1290	CHAR-TBN-01-023-F-M	1457	CHAR-TBN-01-038-F-M	1601
CHAR-TBN-01-009-F-M	1309	CHAR-TBN-01-024-F-M	1213	CHAR-TBN-01-039-F-M	1756
CHAR-TBN-01-010-F-M	1279	CHAR-TBN-01-025-F-M	2085	CHAR-TBN-01-040-F-M	1778
CHAR-TBN-01-011-F-M	1087	CHAR-TBN-01-026-F-M	1900	CHAR-TBN-01-041-F-M	1590
CHAR-TBN-01-012-F-M	1349	CHAR-TBN-01-027-F-M	1649	CHAR-TBN-01-042-F-M	1516
CHAR-TBN-01-013-F-M	1390	CHAR-TBN-01-028-F-M	1689	CHAR-TBN-01-043-F-M	1575
CHAR-TBN-01-014-F-M	1357	CHAR-TBN-01-029-F-M	1020	CHAR-TBN-01-044-F-M	1438
CHAR-TBN-01-015-F-M	1275	CHAR-TBN-01-030-F-M	983	CHAR-TBN-01-045-F-M	1468
Mean Ambient	929	**Mean Ambient**	860	**Mean Ambient**	1248
Ct. Mean	1313	**Ct. Mean**	1460	**Ct. Mean**	1530
Ct. Median	1309	**Ct. Median**	1390	**Ct. Median**	1564
Ct. Std. Dev.	109	**Ct. Std. Dev.**	309	**Ct. Std. Dev.**	139

F-M = Fixed measurement

Table 2-8
TBN-01 Characterization Data (4th, 5th & 6th Floors)

Location	Result (dpm/100cm²)	Location	Result (dpm/100cm²)	Location	Result (dpm/100cm²)
4th FLOOR		5th FLOOR		6th FLOOR	
CHAR-TBN-01-046-F-M	1494	CHAR-TBN-01-061-F-M	1738	CHAR-TBN-01-076-F-M	1719
CHAR-TBN-01-047-F-M	1364	CHAR-TBN-01-062-F-M	1715	CHAR-TBN-01-077-F-M	1593
CHAR-TBN-01-048-F-M	1590	CHAR-TBN-01-063-F-M	1689	CHAR-TBN-01-078-F-M	1616
CHAR-TBN-01-049-F-M	1431	CHAR-TBN-01-064-F-M	1616	CHAR-TBN-01-079-F-M	1811
CHAR-TBN-01-050-F-M	1405	CHAR-TBN-01-065-F-M	1878	CHAR-TBN-01-080-F-M	1564
CHAR-TBN-01-051-F-M	1290	CHAR-TBN-01-066-F-M	1878	CHAR-TBN-01-081-F-M	1623
CHAR-TBN-01-052-F-M	1364	CHAR-TBN-01-067-F-M	1800	CHAR-TBN-01-082-F-M	1604
CHAR-TBN-01-053-F-M	1331	CHAR-TBN-01-068-F-M	1730	CHAR-TBN-01-083-F-M	1671
CHAR-TBN-01-054-F-M	1494	CHAR-TBN-01-069-F-M	1630	CHAR-TBN-01-084-F-M	1719
CHAR-TBN-01-055-F-M	1445	CHAR-TBN-01-070-F-M	1848	CHAR-TBN-01-085-F-M	1652
CHAR-TBN-01-056-F-M	1445	CHAR-TBN-01-071-F-M	1819	CHAR-TBN-01-086-F-M	1800
CHAR-TBN-01-057-F-M	1275	CHAR-TBN-01-072-F-M	1645	CHAR-TBN-01-087-F-M	1778
CHAR-TBN-01-058-F-M	1331	CHAR-TBN-01-073-F-M	1738	CHAR-TBN-01-088-F-M	1896
CHAR-TBN-01-059-F-M	1353	CHAR-TBN-01-074-F-M	1804	CHAR-TBN-01-089-F-M	1586
CHAR-TBN-01-060-F-M	1349	CHAR-TBN-01-075-F-M	1612	CHAR-TBN-01-090-F-M	1693
Mean Ambient	996	**Mean Ambient**	1125	**Mean Ambient**	1114
Ct. Mean	1397	**Ct. Mean**	1743	**Ct. Mean**	1688
Ct. Median	1364	**Ct. Median**	1738	**Ct. Median**	1671
Ct. Std. Dev.	86	**Ct. Std. Dev.**	93	**Ct. Std. Dev.**	98

F-M = Fixed measurement

Fixed-point measurements were at or slightly above the ambient radiation levels in the building. The maximum measurement was approximately 11% of the most restrictive site-specific DCGL. Based upon the findings of information reviewed, personnel interviews and data acquired during characterization, TBN-01 is classified as a Class 3 area. The radwaste storage area on the 3rd floor and the rollup door area on the 1st floor are classified as Class 1 areas because of the presence of stored radwaste.

2.1.8.5 OFB-01 – Office Building

The Office Building is located on the west side of the Control Building and is outside the confines of the Controlled Area. This structure housed the offices, conference rooms and dining room for the project. The structure is of reinforced concrete and structural steel design. The outer walls are made of lightweight concrete block and the remainder of corrugated cement asbestos siding backed up by gypsum board and hard board.

Characterization data from past surveys proved insufficient for FSS planning activities. A Characterization effort was implemented on October 28, 2008 to include smears, scans and fixed-point measurements in OFB-01. This characterization was performed to the rigors of FSS so the data could be utilized for survey area release if the result supported the release. An ambient measurement was achieved by taking shielded readings at five locations on each floor and five locations on the roof; and the Mean of those data was calculated. Tables 2-9 and 2-10 represent the results of the fixed-point readings taken on the floors, walls and ceiling during this survey effort. Smears were taken at each fixed-point location. Smear results indicated no smear result greater than MDA. One-square meter beta scans were taken at each fixed-point location. No beta scan indicated results greater than background. Gamma scans were taken in the general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated results greater than background.

Table 2-9
OFB-01 Characterization Data

Location	Result (dpm/100cm^2)	Location	Result (dpm/100cm^2)
1st FLOOR		1st FLOOR (Cont'd)	
CHAR-OFB-01-003-F-M	683	CHAR-OFB-01-032-F-M	934
CHAR-OFB-01-004-F-M	742	CHAR-OFB-01-033-F-M	1676
CHAR-OFB-01-005-F-M	1067	CHAR-OFB-01-034-F-M	1030
CHAR-OFB-01-006-F-M	683	CHAR-OFB-01-035-F-M	963
CHAR-OFB-01-007-F-M	890	CHAR-OFB-01-036-F-M	879
CHAR-OFB-01-008-F-M	856	CHAR-OFB-01-037-F-M	915
CHAR-OFB-01-009-F-M	827	CHAR-OFB-01-038-F-M	1259
CHAR-OFB-01-010-F-M	768	CHAR-OFB-01-039-F-M	867
CHAR-OFB-01-011-F-M	978	CHAR-OFB-01-040-F-M	919
CHAR-OFB-01-012-F-M	864	CHAR-OFB-01-041-F-M	1100
CHAR-OFB-01-013-F-M	853	CHAR-OFB-01-042-F-M	808
CHAR-OFB-01-014-F-M	1473	CHAR-OFB-01-043-F-M	1764
CHAR-OFB-01-015-F-M	735	CHAR-OFB-01-044-F-M	1037
CHAR-OFB-01-016-F-M	1259	CHAR-OFB-01-045-F-M	775
CHAR-OFB-01-017-F-M	923	CHAR-OFB-01-046-F-M	1133
CHAR-OFB-01-018-F-M	1082	CHAR-OFB-01-047-F-M	701
CHAR-OFB-01-019-F-M	1082	CHAR-OFB-01-048-F-M	709
CHAR-OFB-01-020-F-M	823	CHAR-OFB-01-049-F-M	912
CHAR-OFB-01-021-F-M	1543	CHAR-OFB-01-050-F-M	886
CHAR-OFB-01-022-F-M	1713	CHAR-OFB-01-051-F-M	860
CHAR-OFB-01-023-F-M	1196	CHAR-OFB-01-052-F-M	1067
CHAR-OFB-01-024-F-M	1351	CHAR-OFB-01-053-F-M	1196
CHAR-OFB-01-025-F-M	1742	CHAR-OFB-01-054-F-M	941
CHAR-OFB-01-026-F-M	1045	CHAR-OFB-01-055-F-M	971
CHAR-OFB-01-027-F-M	1406	CHAR-OFB-01-056-F-M	963
CHAR-OFB-01-028-F-M	1178	CHAR-OFB-01-057-F-M	949
CHAR-OFB-01-029-F-M	945	CHAR-OFB-01-058-F-M	808
CHAR-OFB-01-030-F-M	724	CHAR-OFB-01-059-F-M	864
CHAR-OFB-01-031-F-M	709	CHAR-OFB-01-060-F-M	1082
		Mean Ambient	938
		Ct. Mean	1019
		Ct. Median	943
		Ct. Std. Dev.	275

F-M = Fixed measurement

Table 2-10
OFB-01 Characterization Data

Location	Result (dpm/100cm²)	Location	Result (dpm/100cm²)	Location	Result (dpm/100cm²)
2nd FLOOR		2nd FLOOR (Cont'd)		ROOF	
CHAR-OFB-01-001-F-M	1104	CHAR-OFB-01-018-F-M	1528	CHAR-OFB-01-001-F-M	1292
CHAR-OFB-01-002-F-M	1270	CHAR-OFB-01-019-F-M	1148	CHAR-OFB-01-002-F-M	1517
CHAR-OFB-01-003-F-M	952	CHAR-OFB-01-020-F-M	1111	CHAR-OFB-01-003-F-M	1550
CHAR-OFB-01-004-F-M	816	CHAR-OFB-01-021-F-M	875	CHAR-OFB-01-004-F-M	1318
CHAR-OFB-01-005-F-M	1170	CHAR-OFB-01-022-F-M	997	CHAR-OFB-01-005-F-M	1728
CHAR-OFB-01-006-F-M	1133	CHAR-OFB-01-023-F-M	997	CHAR-OFB-01-006-F-M	2019
CHAR-OFB-01-007-F-M	1325	CHAR-OFB-01-024-F-M	963	CHAR-OFB-01-007-F-M	1709
CHAR-OFB-01-008-F-M	1067	CHAR-OFB-01-025-F-M	716	CHAR-OFB-01-008-F-M	1569
CHAR-OFB-01-009-F-M	1277	CHAR-OFB-01-026-F-M	1074	CHAR-OFB-01-009-F-M	1757
CHAR-OFB-01-010-F-M	842	CHAR-OFB-01-027-F-M	1406	CHAR-OFB-01-010-F-M	1650
CHAR-OFB-01-011-F-M	915	CHAR-OFB-01-028-F-M	1030		
CHAR-OFB-01-012-F-M	934	CHAR-OFB-01-029-F-M	1059		
CHAR-OFB-01-013-F-M	1473	CHAR-OFB-01-030-F-M	890		
CHAR-OFB-01-014-F-M	1229	CHAR-OFB-01-031-F-M	1056		
CHAR-OFB-01-015-F-M	1251	CHAR-OFB-01-032-F-M	1011		
CHAR-OFB-01-016-F-M	963	CHAR-OFB-01-033-F-M	1425		
CHAR-OFB-01-017-F-M	993				
		Mean Ambient	1200	**Mean Ambient**	1361
		Ct. Mean	1091	**Ct. Mean**	1611
		Ct. Median	1059	**Ct. Median**	1609
		Ct. Std. Dev.	195	**Ct. Std. Dev.**	215

F-M = Fixed measurement

Fixed-point measurements were at, slightly below or slightly above the ambient radiation levels in the office building. A maximum of approximately 700 dpm/100cm^2 reading was observed from this survey which is about 6% of the most restrictive site-specific DCGL.

Based upon the findings of information reviewed, personnel interviews and of data acquired during characterization, OFB-01 is classified as a Class 3 area. Based upon the result of the Data Quality Assessment (DQA) this characterization may be used as the FSS for this survey area.

2.1.8.6 NOL-01 – Open Land Area Inside the Controlled Area

Survey Area NOL-01 consists of the open land area inside the EF1 Controlled Area. Survey area NOL-01 contains about 2392 square meters of surface area made up of soils, asphalt, gravel and concrete.

NOL-01 is bounded by the Controlled Area fence and OOL-01 on the north and west and a portion of the eastern boundary. FRB-01 forms a portion of the eastern boundary and NAB-01, IGB-01 form a portion of the western boundary. NOL-01 lies entirely within the open land Class 3 survey area OOL-01. Survey Area NOL-01 is designated a Class 2 area acting as a buffer between the Class 1 and Class 3 areas.

Subsurface systems that traverse or connect within NOL-01 include:

- Health Physics/Chemistry Building drain system
- Underground vent ducts
- Waste gas lines
- Sump pump system

Survey area NOL-01 represents the secondary travel path for personnel and equipment entering and leaving EF1. NOL-01 included the primary travel path for personnel and equipment until approximately 10 years ago when the existing path was created. Systems present in survey area NOL-01 that may contain residual radioactivity are the Health Physics/Chemistry Building waste discharge, vent lines, gas lines and the FARB liquid discharge line. Contamination of survey area NOL-01 may have resulted from traffic of contaminated personnel, equipment and material.

Events and activities that may have contaminated survey area NOL-01 include:

- Leak in Waste Gas drain line (8/01/67).
- Leak in Waste Gas discharge line (4/30/68).
- Fire in the Reactor Building Basement (5/20/08).

Characterization data from past surveys proved insufficient for FSS planning activities. Few soil samples had been taken in this survey area and no samples were analyzed for HDT radionuclides.

Characterization plan EF1-CHAR-NOL-01 was implemented on June 25, 2008. Seventeen samples were collected with two split samples sent to an off-site lab to be analyzed for HTD radionuclides. Table 2-11 represents the sample results for NOL-01. Because of ambient levels associated with the operation of Fermi 2, gamma scans were not performed in survey area NOL-01 at the time of the characterization survey.

Table 2-11
NOL-01 Characterization Data

Location	Result (pCi/g)
CHAR-NOL-01-001	0.007
CHAR-NOL-01-002	0.007
CHAR-NOL-01-003	0.008
CHAR-NOL-01-004	ND[1]
CHAR-NOL-01-005	ND[1]
CHAR-NOL-01-006	ND[1]
CHAR-NOL-01-007	0.017
CHAR-NOL-01-008	0.019
CHAR-NOL-01-009	ND[1]
CHAR-NOL-01-010	ND[1]
CHAR-NOL-01-010-RC[2]	ND[1]
CHAR-NOL-01-011	0.014
CHAR-NOL-01-012	0.05
CHAR-NOL-01-013	0.14
CHAR-NOL-01-013-RC[2]	0.13
CHAR-NOL-01-014	ND[1]
CHAR-NOL-01-015	ND[1]
CHAR-NOL-01-016	0.016
CHAR-NOL-01-017	ND[1]
CHAR-NOL-01-005-S[3]	ND[1]
CHAR-NOL-01-008-S[3]	0.24
Ct. Mean	0.06
Ct. Median	0.02
Ct. Std. Dev.	0.08

[1]ND indicates no activity >MDA.
[2] RC indicates a QC recount.
[3] S indicates a Split sample sent to an offsite lab.

As can be seen from the sample results, soil samples that contained concentrations of plant-related nuclides above MDA indicated the presence of Cs-137 only in a range 0.007 to 0.24 pCi/g. These results are in line with the range of Cs-137 found in the soil due to man-made fallout. Split sample results from the off-site laboratory indicate that no plant-related HTD radionuclides were present above the MDA.
Based upon the information reviewed, personnel interviews and data acquired during characterization, NOL-01 would support a classification as a Class 3 area, however, NOL-01 is acting as a buffer between Class 1 and Class 3 areas, and therefore NOL-01 is classified as a Class 2 area.

2.1.8.7 RXB-01 – Reactor Building

Survey Area RXB-01 consists of the Reactor Building, a cylindrical vertical steel vessel, 72 feet in diameter and 120 feet high with the lower 51 feet below finished grade elevation. The inside of the Reactor Building is divided into two regions by a 5-foot thick steel and concrete operating floor. The above floor region is normally accessible to personnel and houses the containment crane. The below floor region housed the reactor vessel and internals, the primary shield tank, the secondary shield, the intermediate heat exchangers, primary sodium pumps, the decay tanks, the primary sodium overflow tank and associated equipment and piping for the primary and secondary sodium coolant systems. The Reactor Building is surrounded by an approximately 3 foot wide annulus that is located below floor level to a depth of about 3 feet below the concrete pedestal on which the steel Reactor Building stands. The annulus contains an access hole to the northwest sodium gallery and four floor drains that empty into a collection tank and sump pump system in the basement of the Steam Generator Building. During operation sealed areas within the reactor building consisted of the lower level outside the Secondary Shield Wall and the lower level inside the Secondary Shield Wall. The area outside the Secondary Shield Wall is accessible via a manhole located on the northwest side of the Reactor Building floor near the overflow tank pumps. The area inside the Secondary Shield wall is accessible via a welded manhole cover on the Reactor Building floor, north-northwest of the primary shield tank. Additional openings to the lower level were made during the decommissioning project. RXB-01 has a total floor area of 757 m^2.

Modes and vectors for transmigration of contaminants include:

- Reactor vessel and associated piping cut-up and removal.
- Transport of radioactive material associated with decommissioning of the Reactor building.
- Sodium fire that occurred on May 20th 2008 in the basement of the Reactor Building.
- Equipment handling during plant operation and maintenance.
- Leaks in the Reactor Building basement during processing

Characterization data from past surveys proved insufficient for FSS planning activities.

Characterization plan EF1-CHAR-RXB-01-01 was implemented on July 2, 2008. One pulverized concrete sample was collected from the Reactor Building basement on the inner shield wall to a depth of 6 inches, and sent to an off-site lab for analysis of Easy-to-Detect and

HTD radionuclides with the focus on Co-60, Cs-137, Sr-90 and H-3. Additional characterization was performed in September through October of 2008 to include smears, scans and fixed-point measurements on the operating floor (590' elevation) of RXB-01. An ambient correction was achieved by taking shielded readings at five locations around the inner annulus and operating floor (on the floor and up to 6 feet on the walls) and the Mean of those data was calculated. Table 2-12 provides a summary of the survey results for the fixed-point readings taken on the floors and walls during this survey effort. Smears were taken at each fixed-point location. Smears indicated no smear result greater than MDA. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in the general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated results greater than background.

Table 2-12
RXB-01-01 Characterization Data

Location	Result (dpm/100cm²)	Location	Result (dpm/100cm²)	Location	Result (dpm/100cm²)
590' FLOOR		590' <6' WALLS		590' >6' WALLS	
CHAR-RXB-01-01-001-F-M	1220	CHAR-RXB-01-01-011-F-M	710	CHAR-RXB-01-01-021-F-M	666
CHAR-RXB-01-01-002-F-M	1183	CHAR-RXB-01-01-012-F-M	652	CHAR-RXB-01-01-022-F-M	888
CHAR-RXB-01-01-003-F-M	4081	CHAR-RXB-01-01-013-F-M	681	CHAR-RXB-01-01-023-F-M	779
CHAR-RXB-01-01-004-F-M	1289	CHAR-RXB-01-01-014-F-M	673	CHAR-RXB-01-01-024-F-M	724
CHAR-RXB-01-01-005-F-M	1027	CHAR-RXB-01-01-015-F-M	772	CHAR-RXB-01-01-025-F-M	703
CHAR-RXB-01-01-006-F-M	1776	CHAR-RXB-01-01-016-F-M	739	CHAR-RXB-01-01-026-F-M	848
CHAR-RXB-01-01-007-F-M	1434	CHAR-RXB-01-01-017-F-M	728	CHAR-RXB-01-01-027-F-M	954
CHAR-RXB-01-01-008-F-M	1387	CHAR-RXB-01-01-018-F-M	615	CHAR-RXB-01-01-028-F-M	841
CHAR-RXB-01-01-009-F-M	1249	CHAR-RXB-01-01-019-F-M	648	CHAR-RXB-01-01-029-F-M	863
CHAR-RXB-01-01-010-F-M	1354	CHAR-RXB-01-01-020-F-M	786	CHAR-RXB-01-01-030-F-M	866
				CHAR-RXB-01-01-031-F-M	732
				CHAR-RXB-01-01-032-F-M	819
				CHAR-RXB-01-01-034-F-M	877
				CHAR-RXB-01-01-035-F-M	965
Mean Ambient	1038	**Mean Ambient**	1038	**Mean Ambient**	997
Ct. Mean	1627	**Ct. Mean**	700	**Ct. Mean**	820
Ct. Median	1289	**Ct. Median**	695	**Ct. Median**	841
Ct. Std. Dev.	943	**Ct. Std. Dev.**	56	**Ct. Std. Dev.**	89

F-M = Fixed measurement

Characterization plan EF1-CHAR-RXB-01-02 was implemented on October 20, 2008 to survey the reactor building 552' elevation annulus. Table 2-13 provides a summary of the survey results for the fixed-point readings taken on the floors and walls during this survey effort. Smears were taken at each fixed-point location. Smears indicated no smear result greater than MDA. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in the general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated results greater than background.

Table 2-13
RXB-01-02 Characterization Data

Location	Result (dpm/100cm^2)
ANNULUS	
CHAR-RXB-01-02-001-F-M	1181
CHAR-RXB-01-02-002-F-M	476
CHAR-RXB-01-02-003-F-M	1218
CHAR-RXB-01-02-004-F-M	554
CHAR-RXB-01-02-005-F-M	1536
CHAR-RXB-01-02-006-F-M	1477
CHAR-RXB-01-02-007-F-M	1370
CHAR-RXB-01-02-008-F-M	1325
CHAR-RXB-01-02-009-F-M	631
CHAR-RXB-01-02-010-F-M	1037
CHAR-RXB-01-02-011-F-M	738
CHAR-RXB-01-02-012-F-M	620
CHAR-RXB-01-02-013-F-M	971
CHAR-RXB-01-02-014-F-M	568
CHAR-RXB-01-02-015-F-M	975
Mean Ambient	587
Ct. Mean	978
Ct. Median	975
Ct. Std. Dev.	363

F-M = Fixed measurement

Fixed-point measurements were at, slightly above or below the ambient radiation levels in the floor areas and walls to a height of 6 feet on the 590' elevation, however, since considerable decommissioning work has yet to be completed (reactor vessel removal) the basement, floor and walls up to a height of 6' on the 590' elevation remain Class 1 areas. The fixed-point readings on the walls 6' and above on the 590' elevation were at approximately ambient levels and therefore are classified as Class 2 areas. Characterization survey performed in the reactor annulus provided data at approximately ambient levels. Therefore, the results show the annulus was minimally impacted during operations and decommissioning activities. The reactor building 552' annulus is classified as a Class 3 area.

2.1.8.8 FRB-01 – Fuel and Repair Building (FARB)

The FARB, located approximately 100 feet north of the Reactor Building, is connected to the Reactor Building by a covered transport car track (trestle). The substructure of the FARB consists of heavy reinforced concrete walls and rests on bedrock. The superstructure consists of two different types of construction. The walls above the operating floor in the new fuel receiving and storage area and the irradiated fuel decay and cut-up pool areas are reinforced concrete. All other superstructure walls consist of structural steel with corrugated asbestos siding.

The FARB contained process cells, water-filled decay and cut-up pools, a new fuel handling and storage area, a central control room for fuel handling and waste system operations, a 75-ton crane, and a transport car access area for the performance of fuel handling functions. Space was provided for a repair and cleaning facility for maintenance of contaminated equipment. The fuel transport machine, or cask car, unloaded irradiated fuel from the reactor via the transfer rotor, transported the irradiated fuel in finned pots from the Reactor Building to the FARB via the trestle and unloaded the pots into the transfer tank rotor. The pot was transferred to a position under a steam cleaning machine that removed the fuel from the pot and positioned the fuel so that the sodium was cleaned from the subassembly by steaming, followed by a water rinse using an automatically programmed cycle. The subassembly was then placed in a container in the cut-up pool, tested for fission product leakage, and transferred to the decay pool for a decay period of approximately 180 days per design before further processing. The liquid waste and sump pump system within the FARB has been deactivated, but left intact until 2009 so any potential groundwater leakage can be pumped from the sumps to the FARB liquid waste storage tanks for later disposition. The waste gas stack and its associated equipment were dismantled and removed from the FARB.

The FARB contained a cold trap system (purification system) for the transfer tank sodium in a separate substructure room diagonally adjacent to the fuel transfer tank room. The sodium lines and equipment were shrouded in a welded carbon steel secondary structure, which was inert with nitrogen. The piping outside the walled areas was in the repair pit area and was contained in a concrete vault with a removable cover slab.

Modes and vectors for transmigration of contaminants include:

- Transport of radioactive material associated with decommissioning of the FARB and adjacent buildings.
- Sodium fire that occurred on May 20th 2008 in the basement of the Reactor Building.
- Spill that allegedly occurred in the uranium room.

- Explosion in the FARB cold trap room

FRB-01 has an area footprint of approximately 2746 square meters.

Characterization data from past surveys proved insufficient for FSS planning activities.
A Characterization effort was performed in September of 2008 to include smears, scans and fixed-point measurements in FRB-01. An ambient correction was achieved by taking shielded readings at five locations on each level and the Mean of those data was calculated. Table 2-14 represents represent the results of the fixed-point readings taken on the floors, walls and ceiling during this survey effort. Smears were taken at each fixed-point location. Smears indicated no result greater than MDA. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated results greater than background.

Table 2-14
FRB-01 Characterization Data

Location	Result (dpm/100cm^2)	Location	Result (dpm/100cm^2)
MAINTENANCE PIT		590' <6' FLOORS AND WALLS	
CHAR-FRB-01-001-F-M	1242	CHAR-FRB-01-016-F-M	2514
CHAR-FRB-01-002-F-M	5176	CHAR-FRB-01-017-F-M	2092
CHAR-FRB-01-003-F-M	1213	CHAR-FRB-01-018-F-M	2765
CHAR-FRB-01-004-F-M	1922	CHAR-FRB-01-019-F-M	1457
CHAR-FRB-01-005-F-M	1224	CHAR-FRB-01-020-F-M	1738
CHAR-FRB-01-006-F-M	2237	CHAR-FRB-01-021-F-M	1549
CHAR-FRB-01-007-F-M	1250	CHAR-FRB-01-022-F-M	2200
CHAR-FRB-01-008-F-M	2007	CHAR-FRB-01-023-F-M	1604
CHAR-FRB-01-009-F-M	1294	CHAR-FRB-01-024-F-M	1619
CHAR-FRB-01-010-F-M	1575	CHAR-FRB-01-025-F-M	1497
CHAR-FRB-01-011-F-M	1105	CHAR-FRB-01-026-F-M	1227
CHAR-FRB-01-012-F-M	1471	CHAR-FRB-01-027-F-M	1738
CHAR-FRB-01-013-F-M	1131	CHAR-FRB-01-028-F-M	1357
CHAR-FRB-01-014-F-M	1416	CHAR-FRB-01-029-F-M	1815
CHAR-FRB-01-015-F-M	1057	CHAR-FRB-01-030-F-M	4913
Mean Ambient	703	**Mean Ambient**	1942
Ct. Mean	1688	**Ct. Mean**	2006
Ct. Median	1294	**Ct. Median**	1738
Ct. Std. Dev.	1028	**Ct. Std. Dev.**	911
MEZZANINE		**590'>6' WALLS**	
CHAR-FRB-01-031-F-M	2240	CHAR-FRB-01-046-F-M	1442
CHAR-FRB-01-032-F-M	2603	CHAR-FRB-01-047-F-M	1475
CHAR-FRB-01-033-F-M	2961	CHAR-FRB-01-048-F-M	2044
CHAR-FRB-01-034-F-M	2366	CHAR-FRB-01-049-F-M	1797
CHAR-FRB-01-035-F-M	2218	CHAR-FRB-01-050-F-M	1564
CHAR-FRB-01-036-F-M	1678	CHAR-FRB-01-051-F-M	1553
CHAR-FRB-01-037-F-M	2129	CHAR-FRB-01-052-F-M	2787
CHAR-FRB-01-038-F-M	2266	CHAR-FRB-01-053-F-M	2407
CHAR-FRB-01-039-F-M	3482	CHAR-FRB-01-054-F-M	4577
CHAR-FRB-01-040-F-M	2152	CHAR-FRB-01-055-F-M	3128
CHAR-FRB-01-041-F-M	3409	CHAR-FRB-01-056-F-M	1220
CHAR-FRB-01-042-F-M	5967	CHAR-FRB-01-057-F-M	1464
CHAR-FRB-01-043-F-M	3538	CHAR-FRB-01-058-F-M	1800
CHAR-FRB-01-044-F-M	2580	CHAR-FRB-01-059-F-M	1349
CHAR-FRB-01-045-F-M	2052	CHAR-FRB-01-060-F-M	1379
Mean Ambient	2247	**Mean Ambient**	1942
Ct. Mean	2828	**Ct. Mean**	1999
Ct. Median	2473	**Ct. Median**	1564
Ct. Std. Dev.	1066	**Ct. Std. Dev.**	905

F-M = Fixed measurement

Fixed-point measurements were less than 50% of the most restrictive site-specific DCGL. Therefore, based upon the information reviewed, personnel interviews and data acquired during characterization, the classifications of FRB-01 are as follows:

1. The floor and walls of the decay and cut-up pools are Class 1 areas.
2. The floors, walls and ceiling of the transfer tank room and steam cleaning chamber are Class 1 areas.
3. The floors and walls, up to a height of 6 feet, in all other areas of FRB-01 are Class 1 areas.
4. The walls greater than 6 feet in the areas referenced in #3 are Class 2 areas.

2.1.8.9 TRW-01 – Trestle way

The trestle way is located to the north and adjacent to the Reactor Building and functioned as a connection between the Reactor Building and the FARB. The substructure consists of reinforced concrete. The superstructure consists of structural steel with corrugated asbestos siding and a corrugated steel roof. The fuel transport machine, or cask car, unloaded irradiated fuel from the reactor via the transfer rotor, transported the irradiated fuel in finned pots from the Reactor Building to the FARB via the trestle way and unloaded the pots into the transfer tank rotor.

Modes and vectors for transmigration of contaminants include:

- Transport of radioactive material associated with decommissioning of the trestle way and adjacent buildings.
- Sodium fire that occurred on May 20th 2008 in the basement of the Reactor Building.
- Minor leaks in the Trestle way which occurred at unknown dates during operation.

Characterization data from past surveys proved insufficient for FSS planning activities.

A Characterization effort was implemented on September 15, 2008 to include smears, scans and fixed-point measurements in TRW-01. An ambient correction was achieved by taking shielded readings at five locations in the Trestle way, and the Mean of the data was calculated. Table 2-15 represents the results of the fixed-point readings taken on the floors, walls and ceiling during this survey effort. Smears were taken at each fixed-point location. Smears indicated no result greater than MDA. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in the general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated results greater than background. There is a section of the TRW-01 where there is contamination that is painted over. This section will require the paint removed and that area surveyed.

Table 2-15
TRW-01 Characterization Data

Location	Result (dpm/100cm^2)	Location	Result (dpm/100cm^2)
CHAR-TRW-01-001-F-M	2200	CHAR-TRW-01-013-F-M	1704
CHAR-TRW-01-002-F-M	2041	CHAR-TRW-01-014-F-M	1194
CHAR-TRW-01-003-F-M	1686	CHAR-TRW-01-015-F-M	1264
CHAR-TRW-01-004-F-M	2377	CHAR-TRW-01-016-F-M	1198
CHAR-TRW-01-005-F-M	1970	CHAR-TRW-01-017-F-M	1220
CHAR-TRW-01-006-F-M	1985	CHAR-TRW-01-018-F-M	1290
CHAR-TRW-01-007-F-M	1749	CHAR-TRW-01-019-F-M	1420
CHAR-TRW-01-008-F-M	1689	CHAR-TRW-01-020-F-M	1449
CHAR-TRW-01-009-F-M	2092	CHAR-TRW-01-021-F-M	1257
CHAR-TRW-01-010-F-M	1985	CHAR-TRW-01-022-F-M	1542
CHAR-TRW-01-011-F-M	2285	CHAR-TRW-01-023-F-M	2004
CHAR-TRW-01-012-F-M	2540	CHAR-TRW-01-024-F-M	3438
		Mean Ambient	1652
		Ct. Mean	1816
		Ct. Median	1726
		Ct. Std. Dev.	532

F-M = Fixed measurement

Fixed-point measurements were less than 10% of the most restrictive site-specific DCGL. Therefore, based on the information reviewed, personnel interviews and data acquired during characterization, the floors and walls up to a height of 6 feet are Class 1 areas and the walls greater than 6 feet are Class 2 areas.

2.1.8.10 NAB-01 – Sodium Building

The Sodium Building is adjacent to the Reactor Building and is connected by an underground concrete tunnel. The Sodium Building housed the equipment used for storing and purifying the primary sodium. The Sodium Building, Waste Gas Building and the Inert Gas Building form one structural complex. The Sodium Building is divided into four sections:

1. The primary sodium storage tank room is a concrete structure comprised of 30 inch thick cast concrete walls and a 30 inch thick combination pre-cast and poured concrete roof. The room contains the three 15,000 gallon primary sodium storage tanks.

2. The cold trap room has 6-foot thick external concrete walls as well as a 6-foot thick concrete ceiling. Additionally, the cell has a 4-foot thick internal wall separating it from the storage tank room. This room contained the equipment necessary to determine and maintain the purity of the primary sodium.

3. The sodium-potassium (NaK) room is comprised of reinforced concrete floor, walls and ceiling and access is provided via a steel door located in the west wall of the room and a stairway on the east side. The NaK room contained the ventilation equipment and the air-to-NaK heat exchanger equipment for the cold trap.

4. The valve control room occupies the second story region of the Sodium Building and is constructed of concrete block walls and a steel roof deck structure. The valve control room contained the sodium service hand wheels and motors for the valves, electric panels supporting the induction heating for the piping, and the control panel.

Additionally, the mezzanine level and secondary portion of the Inert Gas Building are covered in this section since they are open to the Sodium Building areas and are separate from the Inert Gas Tank Room

Survey area NAB-01 has an area footprint of approximately 1,116 square meters.

Modes and vectors for transmigration of contaminants include:

- Transport of radioactive material associated with decommissioning of the Sodium Building.
- Processing activities performed in the cold trap room.

Characterization data from past surveys proved insufficient for FSS planning activities.

A Characterization effort was implemented on September 23, 2008 to include smears, scans and fixed-point measurements in NAB-01. An ambient correction was achieved by taking shielded readings at five locations in each room and the Mean of those data was calculated. Tables 2-16 and 2-17 represent the results of the fixed-point readings taken on the floors, walls and ceiling during this survey effort. Smears were taken at each fixed-point location. Smears indicated no result greater than MDA. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in the general areas (except the tank room) as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated results greater than background.

Because of ambient levels associated with the sodium storage tanks, gamma scan surveys were not performed in the tank room at the time of the characterization survey.

Table 2-16
NAB-01 Characterization Data

Location	Result (dpm/100cm^2)	Location	Result (dpm/100cm^2)	Location	Result (dpm/100cm^2)
TANK ROOM		NaK ROOM		VALVE ROOM	
CHAR-NAB-01-001-F-M	1560	CHAR-NAB-01-021-F-M	2022	CHAR-NAB-01-041-F-M	1878
CHAR-NAB-01-002-F-M	5128	CHAR-NAB-01-022-F-M	3039	CHAR-NAB-01-042-F-M	1642
CHAR-NAB-01-003-F-M	4765	CHAR-NAB-01-023-F-M	1527	CHAR-NAB-01-043-F-M	1806
CHAR-NAB-01-004-F-M	5937	CHAR-NAB-01-024-F-M	1815	CHAR-NAB-01-044-F-M	1787
CHAR-NAB-01-005-F-M	4333	CHAR-NAB-01-025-F-M	1353	CHAR-NAB-01-045-F-M	1744
CHAR-NAB-01-006-F-M	17420	CHAR-NAB-01-026-F-M	1372	CHAR-NAB-01-046-F-M	1649
CHAR-NAB-01-007-F-M	9231	CHAR-NAB-01-027-F-M	2011	CHAR-NAB-01-047-F-M	1613
CHAR-NAB-01-008-F-M	22980	CHAR-NAB-01-028-F-M	2462	CHAR-NAB-01-048-F-M	1791
CHAR-NAB-01-009-F-M	7542	CHAR-NAB-01-029-F-M	1431	CHAR-NAB-01-049-F-M	1715
CHAR-NAB-01-010-F-M	13338	CHAR-NAB-01-030-F-M	1305	CHAR-NAB-01-050-F-M	1791
CHAR-NAB-01-011-F-M	6743	CHAR-NAB-01-031-F-M	1150	CHAR-NAB-01-051-F-M	1835
CHAR-NAB-01-012-F-M	19926	CHAR-NAB-01-032-F-M	1726	CHAR-NAB-01-052-F-M	1671
CHAR-NAB-01-013-F-M	7054	CHAR-NAB-01-033-F-M	1342	CHAR-NAB-01-053-F-M	1249
CHAR-NAB-01-014-F-M	11567	CHAR-NAB-01-034-F-M	1501	CHAR-NAB-01-054-F-M	1376
CHAR-NAB-01-015-F-M	7645	CHAR-NAB-01-035-F-M	1394	CHAR-NAB-01-055-F-M	1383
CHAR-NAB-01-016-F-M	15789	CHAR-NAB-01-036-F-M	1238	CHAR-NAB-01-056-F-M	1220
CHAR-NAB-01-017-F-M	7675	CHAR-NAB-01-037-F-M	1327	CHAR-NAB-01-057-F-M	1260
CHAR-NAB-01-018-F-M	19490	CHAR-NAB-01-038-F-M	1900	CHAR-NAB-01-058-F-M	979
CHAR-NAB-01-019-F-M	5634	CHAR-NAB-01-039-F-M	1394	CHAR-NAB-01-059-F-M	1325
CHAR-NAB-01-020-F-M	5590	CHAR-NAB-01-040-F-M	1601	CHAR-NAB-01-060-F-M	1624
Mean Ambient	6266	**Mean Ambient**	1150	**Mean Ambient**	1206
Ct. Mean	9967	**Ct. Mean**	1645	**Ct. Mean**	1567
Ct. Median	7593	**Ct. Median**	1466	**Ct. Median**	1645
Ct. Std. Dev.	6094	**Ct. Std. Dev.**	463	**Ct. Std. Dev.**	256

F-M = Fixed measurement

Table 2-17
NAB-01 Characterization Data (Mezzanine)

Location	Result (dpm/100cm^2)
MEZZANINE	
CHAR-NAB-01-061-F-M	1494
CHAR-NAB-01-062-F-M	1623
CHAR-NAB-01-063-F-M	1512
CHAR-NAB-01-064-F-M	1482
CHAR-NAB-01-065-F-M	1516
CHAR-NAB-01-066-F-M	1538
CHAR-NAB-01-067-F-M	1346
CHAR-NAB-01-068-F-M	1312
CHAR-NAB-01-069-F-M	1438
CHAR-NAB-01-070-F-M	1305
Mean Ambient	972
Ct. Mean	1457
Ct. Median	1488
Ct. Std. Dev.	105

F-M = Fixed measurement

Fixed-point measurements were less than 18% of the most restrictive site-specific DCGL in the NaK room, valve room and the mezzanine. Fixed-point readings in the tank room were as high as the most restrictive DCGL. The cold trap room is still posted as a contaminated area and has a great deal of equipment removal left therefore the cold trap room has not been surveyed. Therefore, based upon the information reviewed, personnel interviews and data acquired during characterization the classifications for NAB-01 are as follows:

1. The cold trap room and also the storage tank room are classified as Class 1.

2. The valve room, NaK room and the mezzanine are classified as Class 2.

2.1.8.11 VNB-01 – Ventilation Building

The Ventilation Building consists of a steel reinforced concrete floor with concrete block walls. The roof consists of a structural steel framework covered by corrugated steel. The Ventilation Building housed equipment for the Reactor Building Ventilation System including the supply and exhaust blowers, valves for water supply to the under floor cooling heat exchangers, a control panel, Freon refrigeration equipment for above floor cooling, and space for future equipment additions, such as dehumidifiers. The restricted area fence has been modified to extend past the east doors of the building.

Modes and vectors for transmigration of contaminants include:

- Transport of radioactive material associated with decommissioning of the adjoining structures.
- Sodium fire that occurred on May 20th 2008 in the basement of the Reactor Building.

Characterization data from past surveys proved insufficient for FSS planning activities.

A Characterization effort was implemented on September 16, 2008 to include smears, scans and fixed-point measurements in VNB-01. An ambient correction was achieved by taking shielded readings at five locations within the survey area and the Mean of those data was calculated. Table 2-18 represent the results of the fixed-point readings taken on the floors, walls and ceiling during this survey effort. Smears were taken at each fixed-point location. Smears indicated no result greater than MDA. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in the general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated results greater than background.

Table 2-18
VNB-01 Characterization Data

Location	Result ($dpm/100cm^2$)	Location	Result ($dpm/100cm^2$)
CHAR-VNB-01-001-F-M	1471	CHAR-VNB-01-011-F-M	1142
CHAR-VNB-01-002-F-M	1098	CHAR-VNB-01-012-F-M	1431
CHAR-VNB-01-003-F-M	1712	CHAR-VNB-01-013-F-M	1778
CHAR-VNB-01-004-F-M	1357	CHAR-VNB-01-014-F-M	1527
CHAR-VNB-01-005-F-M	1494	CHAR-VNB-01-015-F-M	1187
CHAR-VNB-01-006-F-M	1290	CHAR-VNB-01-016-F-M	1268
CHAR-VNB-01-007-F-M	1235	CHAR-VNB-01-017-F-M	1120
CHAR-VNB-01-008-F-M	1109	CHAR-VNB-01-018-F-M	1616
CHAR-VNB-01-009-F-M	1471	CHAR-VNB-01-019-F-M	1445
CHAR-VNB-01-010-F-M	1165	CHAR-VNB-01-020-F-M	1401
		Mean Ambient	1130
		Ct. Mean	1366
		Ct. Median	1379
		Ct. Std. Dev.	203

F-M = Fixed measurement

Fixed-point measurements were less than 5% of the most restrictive site-specific DCGL. Therefore, based upon information reviewed, personnel interviews and data acquired during characterization the floor and walls up to a height of 6 feet are Class 1. The walls above 6 feet are Class 2.

2.1.8.12 NAT-01 – Sodium Tunnel

The Sodium Tunnel consists of a subsurface reinforced concrete structure lined with a ¼" thick carbon steel plate. The tunnel runs from the northwest corner of the Reactor Building annulus to the Cold Trap Room of the Sodium Building. The structure contained some of the primary sodium service system piping and was heated by a 60 cycle induction heating system replacing heat losses when the piping was at 400 degrees Fahrenheit with a 100 degree Fahrenheit ambient temperature. Access to this tunnel is via one of two manholes located between the Cold Trap Room and the Trestleway.

The area of the footprint of NAT-01 is approximately 50 square meters.

Modes and vectors for transmigration of contaminants include:

- Any contamination encountered during the removal or modification of piping within NAT-01.

Characterization data from past surveys proved insufficient for FSS planning activities.

A Characterization effort was implemented on October 6, 2008 to include smears, scans and fixed-point measurements in NAT-01. An ambient correction was achieved by taking shielded readings at five locations in the sodium tunnel and the Mean of those data was calculated. Table 2-19 represent the results of the fixed-point readings taken on the floors, walls and ceiling during this survey effort. Smears were taken at each fixed-point location. Smears indicated no result greater than MDA. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in the general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated results greater than background.

Table 2-19
NAT-01 Characterization Data

Location	Result (dpm/100cm²)	Location	Result (dpm/100cm²)
CHAR-NAT-01-001-F-M	2754	CHAR-NAT-01-011-F-M	5423
CHAR-NAT-01-002-F-M	1616	CHAR-NAT-01-012-F-M	4255
CHAR-NAT-01-003-F-M	1641	CHAR-NAT-01-013-F-M	4721
CHAR-NAT-01-004-F-M	1116	CHAR-NAT-01-014-F-M	2030
CHAR-NAT-01-005-F-M	898	CHAR-NAT-01-015-F-M	3508
CHAR-NAT-01-006-F-M	643	CHAR-NAT-01-016-F-M	2033
CHAR-NAT-01-007-F-M	2281	CHAR-NAT-01-017-F-M	3804
CHAR-NAT-01-008-F-M	3619	CHAR-NAT-01-018-F-M	1782
CHAR-NAT-01-009-F-M	2643	CHAR-NAT-01-019-F-M	3538
CHAR-NAT-01-010-F-M	1641	CHAR-NAT-01-020-F-M	1885
		Mean Ambient	3030
		Ct. Mean	2592
		Ct. Median	2157
		Ct. Std. Dev.	1320

F-M = Fixed measurement

Fixed-point measurements were less than 11% of the most restrictive site-specific DCGL. As a result of historical information, decommissioning activities performed and planned, and characterization data, NAT-01 is classified as a Class 2 area.

2.1.8.13 ESG-01 – East Sodium Gallery

The east sodium gallery consists of three chambers (North, Center and South) which held the secondary sodium lines. Access to the three east sodium gallery chambers is via horizontal steel doors just above ground level. The east sodium gallery's walls and base slab are of conventional reinforced concrete construction resting on concrete filled pilasters. The roof is constructed of an 8 inch thick precast concrete slab covered with a 10 inch thick concrete layer all of which is beneath approximately 5 feet of earth. Included in this area is the Fission Product Detector (FPD) Building. The FPD building is located due east of the reactor building, directly above the East Sodium gallery (north chamber). This is a small partially buried room; a portion of it below ground level, which contained the gaseous fission product detector and piping. Access to the FPD building is through a manhole in the roof of the building. The building is constructed of steel reinforced concrete.

The area of the footprint of ESG-01, including the FPD building, is approximately 98 square meters.

Modes and vectors for transmigration of contaminants include:

- Any contamination encountered during the removal of piping within ESG-01.

Characterization data from past surveys proved insufficient for FSS planning activities.

A Characterization effort was implemented on October 13, 2008 to include smears, scans and fixed-point measurements in ESG-01. An ambient correction was achieved by taking shielded readings at five locations inside the east sodium gallery and the Mean of those data was calculated. Additionally, an ambient correction was achieved by taking shielded readings at five locations in the FPD building and the Mean of those data was calculated. Table 2-20 represent the results of the fixed-point readings taken on the floors and walls during this survey effort. Smears were taken at each fixed-point location. Smears indicated no result greater than MDA. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated results greater than background.

Table 2-20
ESG-01 Characterization Data

Location	Result (dpm/100cm^2)	Location	Result (dpm/100cm^2)
EAST SODIUM GALLERY		FISSION PRODUCT DETECTOR (FPD) BLDG.	
CHAR-ESG-01-001-F-M	1124	CHAR-ESG-01-021-F-M	1009
CHAR-ESG-01-002-F-M	1098	CHAR-ESG-01-022-F-M	983
CHAR-ESG-01-003-F-M	1046	CHAR-ESG-01-023-F-M	965
CHAR-ESG-01-004-F-M	1031	CHAR-ESG-01-024-F-M	1113
CHAR-ESG-01-005-F-M	950	CHAR-ESG-01-025-F-M	1020
CHAR-ESG-01-006-F-M	1043	CHAR-ESG-01-026-F-M	987
CHAR-ESG-01-007-F-M	1216	CHAR-ESG-01-027-F-M	773
CHAR-ESG-01-008-F-M	1468	CHAR-ESG-01-028-F-M	1227
CHAR-ESG-01-009-F-M	1338	CHAR-ESG-01-029-F-M	1320
CHAR-ESG-01-010-F-M	1357	CHAR-ESG-01-030-F-M	1486
CHAR-ESG-01-011-F-M	1194		
CHAR-ESG-01-012-F-M	1068		
CHAR-ESG-01-013-F-M	1153		
CHAR-ESG-01-014-F-M	1201		
CHAR-ESG-01-015-F-M	1105		
CHAR-ESG-01-016-F-M	1187		
CHAR-ESG-01-017-F-M	1582		
CHAR-ESG-01-018-F-M	1364		
CHAR-ESG-01-019-F-M	1201		
CHAR-ESG-01-020-F-M	1209		
Mean Ambient	1107	**Mean Ambient**	768
Ct. Mean	1197	**Ct. Mean**	1088
Ct. Median	1190	**Ct. Median**	1015
Ct. Std. Dev.	158	**Ct. Std. Dev.**	205

F-M = Fixed measurement

Fixed-point measurements were less than 8% of the most restrictive DCGL. As a result of historical information, decommissioning activities performed and planned, and characterization surveys performed, ESG-01 is classified as a Class 2 area.

2.1.8.14 WSG-01 – West Sodium Gallery

The west sodium gallery consists of two chambers (north and south) which held the secondary sodium lines. The west gallery supplied the No. 3 steam generator. Access to the south compartment of the west sodium gallery chamber is via a horizontal steel door just above ground level. Access to the north compartment is via a tunnel from the Reactor Building annulus or a horizontal door which was sealed with a steel plate, concrete and stone fill to prevent water intrusion. The west sodium gallery's walls and base slab are of conventional concrete resting on concrete filled pilasters.

The area of the footprint of WSG-01 is approximately 67 square meters.

Modes and vectors for transmigration of contaminants include:

- Any contamination encountered during the removal of piping within WSG-01.

Characterization data from past surveys proved insufficient for FSS planning activities.

A Characterization effort was implemented on October 16, 2008 to include smears, scans and fixed-point measurements in WSG-01. An ambient correction was achieved by taking shielded readings at five locations inside the west sodium gallery and the Mean of those data was calculated. Table 2-21 represent the results of the fixed-point readings taken on the floors, walls and ceiling during this survey effort. Smears were taken at each fixed-point location. Smears indicated no result greater than MDA. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated results greater than background. Gamma scans were performed in the general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated results greater than background.

Table 2-21
WSG-01 Characterization Data

Location	Result (dpm/100cm^2)	Location	Result (dpm/100cm^2)
CHAR-WSG-01-001-F-M	1172	CHAR-WSG-01-011-F-M	1043
CHAR-WSG-01-002-F-M	1231	CHAR-WSG-01-012-F-M	1046
CHAR-WSG-01-003-F-M	1150	CHAR-WSG-01-013-F-M	1109
CHAR-WSG-01-004-F-M	1190	CHAR-WSG-01-014-F-M	1198
CHAR-WSG-01-005-F-M	1283	CHAR-WSG-01-015-F-M	1264
CHAR-WSG-01-006-F-M	1264	CHAR-WSG-01-016-F-M	909
CHAR-WSG-01-007-F-M	1253	CHAR-WSG-01-017-F-M	1153
CHAR-WSG-01-008-F-M	1238	CHAR-WSG-01-018-F-M	991
CHAR-WSG-01-009-F-M	1102	CHAR-WSG-01-019-F-M	1079
CHAR-WSG-01-010-F-M	1057	CHAR-WSG-01-020-F-M	1179
		Mean Ambient	654
		Ct. Mean	1146
		Ct. Median	1163
		Ct. Std. Dev.	102

F-M = Fixed measurement

Fixed-point measurements are less than 5% of the most restrictive site-specific DCGL. Based on the information reviewed, personnel interviews and data acquired during characterization, WSG-01 is classified as a Class 3 area.

2.1.8.15 WGB-01 – Waste Gas Building

The Waste Gas Building housed the waste gas disposal system that removed waste gases from the plant by a process which included storage until the gases decayed to a suitable level, dilution below the maximum permissible concentration in air and dispersion into the atmosphere through a stack. Piping, valves, and mechanical equipment were housed in chambers below grade; the holdup tanks were housed above grade in shielded cells of the building. Piping transported the waste gas to the FARB where it exited to the atmosphere via a waste gas stack. The holdup tank chambers are inside the Fermi 1 Controlled Area, while the below grade chamber and the grade level valve operating room are outside the Fermi 1 Controlled Area boundary. Construction of the Waste Gas Building includes reinforced concrete walls 12-18 inches thick, with the exception of the concrete block walled valve room. The roof is constructed of reinforced concrete 2 feet thick.

The area of the footprint of WGB-01 is approximately 303 square meters.

Modes and vectors for transmigration of contaminants include:

- Any contamination encountered during the removal of piping within WGB-01.

Characterization data from past surveys proved insufficient for FSS planning activities.

A Characterization effort was implemented on October 1, 2008 to include smears, scans and fixed-point measurements in WGB-01. An ambient correction was achieved by taking shielded readings at five locations in each room and the Mean of those data was calculated. Tables 2-22 and 2-23 represent the results of the fixed-point readings taken on the floors, walls and ceiling during this survey effort. Smears were taken at each fixed-point location. Smears indicated no results greater than MDA. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in the general areas as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated results greater than background.

Table 2-22
WGB-01 Characterization Data

Location	Result (dpm/100cm²)	Location	Result (dpm/100cm²)	Location	Result (dpm/100cm²)
TANK ROOM 1		TANK ROOM 2		VALVE ROOM	
CHAR-WGB-01-021-F-M	1571	CHAR-WGB-01-031-F-M	1601	CHAR-WGB-01-041-F-M	1360
CHAR-WGB-01-022-F-M	1667	CHAR-WGB-01-032-F-M	1608	CHAR-WGB-01-042-F-M	1564
CHAR-WGB-01-023-F-M	1630	CHAR-WGB-01-033-F-M	1604	CHAR-WGB-01-043-F-M	1287
CHAR-WGB-01-024-F-M	1630	CHAR-WGB-01-034-F-M	1689	CHAR-WGB-01-044-F-M	1409
CHAR-WGB-01-025-F-M	1590	CHAR-WGB-01-035-F-M	1571	CHAR-WGB-01-045-F-M	1231
CHAR-WGB-01-026-F-M	1538	CHAR-WGB-01-036-F-M	1516	CHAR-WGB-01-046-F-M	1120
CHAR-WGB-01-027-F-M	1708	CHAR-WGB-01-037-F-M	1453	CHAR-WGB-01-047-F-M	1213
CHAR-WGB-01-028-F-M	1682	CHAR-WGB-01-038-F-M	1497	CHAR-WGB-01-048-F-M	1287
CHAR-WGB-01-029-F-M	1128	CHAR-WGB-01-039-F-M	1564	CHAR-WGB-01-049-F-M	1231
CHAR-WGB-01-030-F-M	1379	CHAR-WGB-01-040-F-M	1549	CHAR-WGB-01-050-F-M	1227
Mean Ambient	959	**Mean Ambient**	948	**Mean Ambient**	850
Ct. Mean	1552	**Ct. Mean**	1565	**Ct. Mean**	1293
Ct. Median	1610	**Ct. Median**	1567	**Ct. Median**	1259
Ct. Std. Dev.	176	**Ct. Std. Dev.**	67	**Ct. Std. Dev.**	125

F-M = Fixed measurement

Table 2-23
WGB-01 Lower Level Characterization Data

Location	Result (dpm/100cm²)	Location	Result (dpm/100cm²)
572’ ROOM 1		572’ ROOM 2	
CHAR-WGB-01-001-F-M	1257	CHAR-WGB-01-011-F-M	1372
CHAR-WGB-01-002-F-M	1294	CHAR-WGB-01-012-F-M	1364
CHAR-WGB-01-003-F-M	1312	CHAR-WGB-01-013-F-M	1390
CHAR-WGB-01-004-F-M	1220	CHAR-WGB-01-014-F-M	1379
CHAR-WGB-01-005-F-M	1242	CHAR-WGB-01-015-F-M	1213
CHAR-WGB-01-006-F-M	1272	CHAR-WGB-01-016-F-M	1353
CHAR-WGB-01-007-F-M	1224	CHAR-WGB-01-017-F-M	1142
CHAR-WGB-01-008-F-M	1002	CHAR-WGB-01-018-F-M	1105
CHAR-WGB-01-009-F-M	1157	CHAR-WGB-01-019-F-M	1349
CHAR-WGB-01-010-F-M	1227	CHAR-WGB-01-020-F-M	1264
Mean Ambient	840	**Mean Ambient**	943
Ct. Mean	1221	**Ct. Mean**	1293
Ct. Median	1235	**Ct. Median**	1351
Ct. Std. Dev.	88	**Ct. Std. Dev.**	105

F-M = Fixed measurement

Fixed-point measurements were less than 7% of the most restrictive site-specific DCGL. As a result of historical information, decommissioning activities performed and planned, and characterization survey results, WGB-01 is classified as a Class 2 area.

2.1.8.16 IGB-01 – Inert Gas Building

The Inert Gas Building housed the compressors, vapor trap, hold-up and vacuum tanks, valves, piping and other associated equipment for the purification and distribution of the argon cover gas system to the primary, secondary, and FARB cover gas systems. The Inert Gas Building has a first story of concrete construction and a second story of cinder block construction located immediately adjacent to the Sodium Service Building valve room. The Inert Gas Tunnel is part of this Survey Area.

The area of the footprint of IGB-01(including the tunnel) is approximately 466 square meters.

Modes and vectors for transmigration of contaminants include:

- Any contamination encountered during the removal of piping and components within IGB-01.

Characterization data from past surveys proved insufficient for FSS planning activities.

A Characterization effort was implemented on October 7, 2008 to include smears, scans and fixed-point measurements in IGB-01. An ambient correction was achieved by taking shielded readings at five locations in the tank room and the Mean of those data was calculated. Additionally, an ambient correction was achieved by taking shielded readings at five locations inside the tunnel and the Mean of those data was calculated. Table 2-24 represent the results of the fixed-point readings taken on the floors, walls and ceiling during this survey effort. Smears were taken at each fixed-point location. Smears indicated no result greater than background. One-square meter beta scans were performed at each fixed-point location. No beta scan indicated greater than background. Gamma scans were performed in general areas (with the exception of the tunnel areas where gamma scans were inaccessible) as well as locations where cracks and wall-to-floor junctures were present. No gamma scan indicated results greater than background.

Table 2-24
IGB-01 Characterization Data

Location	Result (dpm/100cm^2)	Location	Result (dpm/100cm^2)
TANK ROOM		TUNNEL	
CHAR-IGB-01-001-F-M	2052	CHAR-IGB-01-021-F-M	1335
CHAR-IGB-01-002-F-M	1978	CHAR-IGB-01-022-F-M	1187
CHAR-IGB-01-003-F-M	1220	CHAR-IGB-01-023-F-M	1264
CHAR-IGB-01-004-F-M	1209	CHAR-IGB-01-024-F-M	1238
CHAR-IGB-01-005-F-M	1257	CHAR-IGB-01-025-F-M	1309
CHAR-IGB-01-006-F-M	1198	CHAR-IGB-01-026-F-M	1179
CHAR-IGB-01-007-F-M	1449	CHAR-IGB-01-027-F-M	1316
CHAR-IGB-01-008-F-M	1268	CHAR-IGB-01-028-F-M	1250
CHAR-IGB-01-009-F-M	1756	CHAR-IGB-01-029-F-M	1264
CHAR-IGB-01-010-F-M	1889	CHAR-IGB-01-030-F-M	1357
CHAR-IGB-01-011-F-M	1235	CHAR-IGB-01-031-F-M	1205
CHAR-IGB-01-012-F-M	1161	CHAR-IGB-01-032-F-M	1124
CHAR-IGB-01-013-F-M	1238	CHAR-IGB-01-033-F-M	1283
CHAR-IGB-01-014-F-M	1113	CHAR-IGB-01-034-F-M	1157
CHAR-IGB-01-015-F-M	1268	CHAR-IGB-01-035-F-M	1405
CHAR-IGB-01-016-F-M	1287	CHAR-IGB-01-036-F-M	1124
CHAR-IGB-01-017-F-M	1272	CHAR-IGB-01-037-F-M	1482
CHAR-IGB-01-018-F-M	1316	CHAR-IGB-01-038-F-M	1190
CHAR-IGB-01-019-F-M	1183	CHAR-IGB-01-039-F-M	1390
CHAR-IGB-01-020-F-M	1360	CHAR-IGB-01-040-F-M	1201
Mean Ambient	1125	**Mean Ambient**	995
Ct. Mean	1385	**Ct. Mean**	1263
Ct. Median	1268	**Ct. Median**	1257
Ct. Std. Dev.	287	**Ct. Std. Dev.**	97

F-M = Fixed measurement

Fixed-point measurements inside the Inert Gas Building and tunnel were less than 9% of the most restrictive site-specific DCGL. As a result of historical information, decommissioning activities performed and planned and characterization surveys performed, IGB-01 is classified as a Class 2 area.

2.1.9 HSA Findings

EF1, like all commercial U.S. nuclear power plants, was designed with multiple boundaries to contain the unit's radioactive contents within its many systems, components, and structures. Many of these systems and structures have been impacted due to routine operations and maintenance activities during the operational and post-operational history of the plant. All structures at EF1 have been impacted, however, due to the nature of a sodium cooled plant; the structures were minimally impacted during plant operations. Ancillary systems (feedwater, condensate, steam and oil) were essentially isolated from the primary sodium system by a double boundary during plant operations. Portions of these systems were surveyed and found to have no plant related activity; therefore these systems are classified as non-impacted and require no further survey effort. Since there is little evidence to suggest that plant-related activity is present in the interior areas of the structures above 6 feet in height (reinforced by the historical analysis and characterization surveys), the MARSSIM classification of these areas will be less restrictive.

2.1.10 HSA Conclusions

The EF1 HSA provides sufficient evidence to support an Impacted Area classification for all structures and open land areas. EF1 ancillary systems shall be classified as Non-Impacted Areas and excluded from further investigation and survey actions. Table 2-3 summarizes the classifications for each area.

2.2 Hydrogeological Investigations

The information contained in Section 2.2 of the LTP contains a summary description of the Golder Associates report "Report on Groundwater Characterization, Enrico Fermi 1 License Termination" and the studies that have been performed recently to investigate groundwater contamination resulting from the operation of EF1.

Detailed information on the Golder Report can be found in NRC Agency Document and Management System (ADAMS) ML081080041 and ML 081080043.

2.2.1 Methods

From November 2003 through December 2006, Golder Associates Inc. (Golder) and the Detroit Edison Company conducted a groundwater characterization program to test for possible historical radiological contamination in groundwater within Areas of Concern (AOC) at EF1. The characterization efforts included the following:

- installation of monitor wells;
- measurement of the hydraulic conductivity of the fill and natural geologic formations in which the monitor wells are set;
- measurements of groundwater elevations, and
- collection and analysis of groundwater samples for possible radionuclides of concern.

The work was performed in accordance with the "Work Plan for Groundwater Characterization", through Revision 2, August 2005 (Golder, 2005). The work plan specifies the following:

- Areas of Concern (AOC) with respect to possible historical releases of radioactive fluids and other possible contaminants to the subsurface based on former EF1 operations and waste routing systems.
- Locations of monitor wells in relation to the AOC.
- Field methods that included drilling, well installation, hydraulic testing, and groundwater sampling.
- The Quality Assurance and Quality Control methods that were used to conduct the characterization.
- Schedule.

2.2.2 Areas of Concern

During preparation of the work plan, Golder identified several areas of concern where groundwater characterization was warranted, based on the presence of circulating and/or waste fluids that are known to have contained radionuclides. These areas, and the groundwater monitor wells that were installed to test for possible impact from each area of concern, are described in Section 1.5 of the work plan. These areas of concern are summarized as follows:

- Reactor/Containment Building
- Sodium Tunnel
- Sodium Galleries (East and West)
- Fission Products Detection (FPD) Building
- Health Physics/Chemistry Building
- Liquid Radioactive Waste Line
- Fuel and Repair Building (FARB)
- Waste Gas Stack

2.2.3 Site Geology and Hydrology

2.2.3.1 Hydrogeologic Characteristics

1. The pre-construction geological profile at EF1 consists of the following unconsolidated native sediments and the bedrock sequence:

   - 0 - 7 feet: Soft black muck and peat.
   - 7 - 12 feet: Glaciolacustrine laminated gray clay and silt, with traces of humus.
   - 12 - 18 feet: Hard gray to yellowish sandy clay (glacial till).
   - 18 feet: Dolomitic bedrock of the Bass Islands Group.

   During construction of the reactor building in 1956, approximately 27 feet of clay and crushed stone fill was added to the top of the bedrock in order to bring the ground up to elevation of near 590 feet MSL. Outside the Controlled Area, approximately 10 feet of fill was added, bringing the existing ground elevation up to approximately 583.5 feet.

2. Each of the monitor well borings encountered native glacial lake clay beneath fill materials consisting primarily of clay, and to a lesser extend sand and crushed stone. Beneath the native clay, each of the deep zone borings penetrated hard glacial till consisting of unsorted sandy clay. The lower foot of this unit commonly contains fragments of the dolomite bedrock. The thickness of the glacial units agrees with the range that Golder had previously observed on EF1 and EF2 construction boring logs.

3. The dolomite bedrock is characteristically fine-grained and contains sporadic small vugs, stylolites, and occasional bedding plane fractures that do not appear to be zones of notable dissolution or secondary permeability.

4. Groundwater elevations (and conversely, the periodic occurrence of dry wells) in the shallow wells indicate that the groundwater table in the shallow zone is perched on top of the underlying native clay. As such, horizontal movement of the perched groundwater is highly localized and largely controlled by the elevation of the perching surface. Overall, the shallow zone groundwater elevations are higher than Lake Erie's and the site bedrock wells' water levels, indicating that the potential is for shallow groundwater to either infiltrate vertically to deeper zones or eventually migrate towards Lake Erie.

5. The calculated geometric mean value for hydraulic conductivity of the native sediments that underlie the shallow zone wells is 5.4 x 10-6 cm/sec, or approximately 0.015 feet/day. The low magnitude is consistent with grain size analyses that indicate an abundance of clay in the native glacial sediments. In areas where horizontal movement of the perched water may occur, the estimated maximum groundwater flow velocity in the shallow zone is 0.003 feet/day, or approximately 1 foot/year. This magnitude suggests that the shallow wells are placed close enough to the respective adjacent areas of concern to have detected a possible release during the 1960s.

6 Since 2005, the groundwater flow direction in the bedrock zone has been predominantly to the south, and has never been directly toward Lake Erie, as anticipated prior to the installation of the bedrock wells. Based on the available data, Golder could not positively identify what is controlling the hydraulic gradient in the bedrock. Based on potentiometric groundwater elevations in REMP wells W-1, W-2, and W-3, which are located south and/or southwest of EF1, and where water elevations are lower than at EFT-6D, Golder

inferred that quarrying elsewhere in Monroe County, and possibly irrigation well pumping stresses, to the south or southwest of EF1, influenced the hydraulic gradient in the bedrock. The calculated groundwater flow velocity in the bedrock at EF1 is 0.8 feet/day, or approximately 290 feet/year. This magnitude suggests that the bedrock wells are placed close enough to the respective adjacent AOCs to have detected a possible release, assuming that impacted groundwater penetrated through the clay-rich fill and native sediments into the bedrock.

2.2.4 Groundwater Analytical Results

1. For each of the EF1 sample sets that have been analyzed to date by Detroit Edison's Fermi 2 on-site laboratory, all tritium activity was less that the laboratory's Minimum Detectable Activity (MDA) of 1.1 to 1.2 x 10-6 μCi/ml. As summarized by EF2 Radiation Protection Engineering, the results of all gamma spectroscopic analyses performed to date indicate that no licensed radioactive material was detected. Based on these data, Golder found that there is no evidence of radiological impact to groundwater from historical EF1 operations.

2. The 2004-2006 EF2 laboratory analytical results are supported by the analysis of the June 2006 sample set by Fermi 1's subcontracted laboratory. This sample set produced no detectable liquid scintillation activity and no gamma activity.

3. Some of the June 2006 samples, including the Fermi 2 REMP wells, exhibited detectable alpha activity by one or more uranium isotopes. A comparison of the alpha activity in the Fermi 1 wells with the Fermi 2 REMP wells suggested that the reported activity did not result from an impact due to EF1 operations.

4. None of the calculated total uranium concentrations exceed the USEPA's Maximum Contaminant Level (MCL) of 30 μg/L. The highest value, at Fermi 1 shallow zone well EFT-9S, also did not exceed the background Upper Tolerance Limit (UTL).

5. Detectable radium activity is higher in the bedrock wells than in the shallow wells. This is consistent with the common substitution of naturally occurring radium for the major cations in carbonate rocks. For the June 2006 samples, the UTL for total radium activity in the Fermi 2 REMP wells was not exceeded by any of the sample results. The highest measurement occurred at bedrock well EFT-1D, which also effectively equaled the USEPA's MCL of 5 pCi/L. Because the highest radium activity occurred at EFT-1D, the bedrock background well at EF1, and did not exceed the background UTL, Golder concluded that its source is naturally occurring radium in the bedrock.

6. Collectively, the groundwater sample results to date have shown neither indications of detectable fission products nor of tritium (i.e., via liquid scintillation) or naturally occurring activity above background. All detectable activity is comparable in magnitude to measurements for samples obtained from the REMP monitor wells. These observations indicate that detectable activity in EF1 monitor well samples is consistent with the normally occurring radioactive materials in area groundwater. Based on this data, Golder found that there is no evidence of radiological impact to groundwater from EF1 operations to date.

   Based on current and historic sample results from the EF1 Radiological Environmental Monitoring Program (REMP), there is no indication that surface waters on the facility boundary or the ground water beneath the EF1 boundary have been affected by the licensed operation of the facility. There were periods of liquid effluent releases during operation of the plant where it was determined that calculated dose to a maximally exposed individual via the liquid effluent pathway did not exceed the concentration limits of 10 CFR Part 20. The dose from planned liquid effluent releases has already been accounted for in accordance with the regulation governing radioactive effluent from power plants and no remediation is required. The radiological effluent pathway is outside of the EF1 footprint and is impacted by Fermi 2; therefore it falls under the EF2 operating license.

2.3 Site Characterization Survey

2.3.1 Initial Characterization Surveys

In support of the decommissioning activities at the Fermi 1 facility, radiological characterization surveys were contracted for selected areas in and around the facility, and performed during the months of October and November 2004. The purposes of these surveys were as follows:

a) evaluating the increase in ambient background radiation levels caused by Fermi 2 power operation and the resulting impact on detection levels and ability for performing decommissioning survey with Fermi 2 in operation, and

b) characterizing radiological conditions for selected areas in and around Fermi 1 that were more likely to exhibit little to no contamination, commonly referred to as non-impacted or Class 3 MARSSIM areas.

An initial set of surveys were performed at Fermi 1 in late October with Fermi 2 at essentially full power operations. This set of data was to baseline the levels that reflected the influence from Fermi 2, predominantly from the ^{16}N sky shine component. Following the Fermi 2 shutdown on November 6, 2004, follow-up surveys were performed for the same areas. These two data sets – one reflecting the impact from Fermi 2 operations and the second without – provide meaningful data for evaluating the overall impact that the increase in ambient radiation levels from Fermi 2 operations may have on performing the decommissioning surveys at Fermi 1. The type of surveys performed were those typical for a decommissioning project. Surface beta scans were performed for floor and roof areas. These scans predominantly examine surface contamination (within top few mm of the surface). Where volumetric contamination is the primary source of interest (such as top 15 cm for surface soil contamination), gamma walkover scans were performed. Outside grassy and gravel areas were surveyed for gamma radiation levels.

The areas included in the surveys were:

- Fuel and Repair Building (FARB) roofs (three total, beta surface scans),
- Steam Generator Building roof (beta surface scans)
- Waste Gas Decay Tank Room (general floor area beta surface scans)
- Sodium Building roof (beta surface scans)
- Turbine Building roof (beta surface scans)
- Outside areas, within the Radiologically Restricted Area (RRA) (gamma walkover scans)
- Outside areas, outside the RRA (gamma walkover scans)
- Turbine Building (general floor area beta surface scans)
- Fuel and Repair Building Interior
  - Fuel Pools (general floor area beta surface scans)
  - Truck Bay (general floor area beta surface scans)
  - Trestle-way (cast car corridor between reactor building and FARB, general floor area beta surface scans)
  - Warm Room (Radiation Protection count room) exterior walls (beta surface scans)
  - Vent Room interior walls (beta surface scans)

Tables 2-25 and 2-26 provide a summary of the results of this characterization effort. Appendix 2-C provides detailed results of this survey effort.

Table 2-25
Comparison of Ambient Levels for Beta Scans

Building/Surface	Fermi-2 Operating (cpm)	Fermi-2 Shutdown (cpm)	Net Increase (power over shutdown)	
			(cpm)	(percent)
FARB 1st Floor Roof	4773 ± 542	3285 ± 304	1488 ± 621	45 ±19%
FARB 2nd Floor Roof	6371 ± 783	3257 ± 275	3114 ± 830	96 ± 25%
FARB 3rd Floor Roof	6429 ± 845	2964 ± 392	3465 ± 932	117 ± 31%
Steam Generator Bldg. Roof	3660 ± 294	1741 ± 112	1910 ± 315	110 ± 18%
Waste Gas Tank Room Floor	2160 ± 147	1952 ± 121	208 ± 190	11 ± 9.7%
Sodium Bldg. Roof	3874 ± 465	2685 ± 217	1189 ± 513	44 ± 19%
Turbine Bldg. Roof	2802 ± 227	1955 ± 129	847 ± 261	43 ± 13%
Turbine Bldg. Driveway	2347 ± 227	1249 ± 180	1098 ± 290	88 ± 23%
Turbine Bldg. 3rd Floor, HP Turbine	1963 ± 114	1571 ± 145	392 ± 184	25% ± 12%
FARB East Fuel Pool Area	2602 ± 335	2530 ± 244	72 ± 414	2.8 ± 16%
FARB West Fuel Pool Area	2407 ± 139	2344 ± 161	63 ± 213	2.7 ± 9.1%
FARB Truck Bay	4006 ± 767	2867 ± 1039	1139 ± 1291*	40 ± 45%
Trestle-way	3430 ± 353	2987 ± 1430	443 ± 1473*	15 ± 49%

* The area with elevated measurements for the shutdown survey results in a relatively high standard deviation value. These elevated measurements were not detected during the at-power survey. Removing these elevated measurements would provide a better dataset for comparison.

Table 2-26
Comparison of Ambient Levels for Gamma Scans

Outside Area	Fermi-2 Operating (cpm)	Fermi-2 Shutdown (cpm)	Net Increase (power over shutdown)	
			(cpm)	(percent)
East Courtyard	23,245 ± 4734	4824 ± 813	18,421 ± 4803	380 ± 96%
Turbine Bldg. Lawn	19,667 ± 1797	6670 ± 945	12,997 ± 6908	190 ± 100%

2.3.2 Recent Characterization Surveys

2.3.2.1 Organization and Responsibilities

The site Radiation Protection Technicians, under the direction of the License Termination Manager, performed the site characterization. The Characterization Surveys were preformed in accordance with EF1 “Radiological Site Characterization Plan”. The EF1 Health Physicist is responsible to ensure that the Characterization Survey Plan is supported and implemented by the EF1 employees. The EF1 Health Physicist is responsible for ensuring that all decommissioning survey activities are performed by qualified personnel in accordance with approved procedures and implemented in coordination with, and support of, ongoing decommissioning activities. The Decommissioning Superintendent supplies the craft to support the Decommissioning Survey effort and coordinates activities with the Radiation Protection Supervisor (Operations). Figure 2-1 Depicts the EF1 Organizational Chart as it applies to the Characterization Survey.

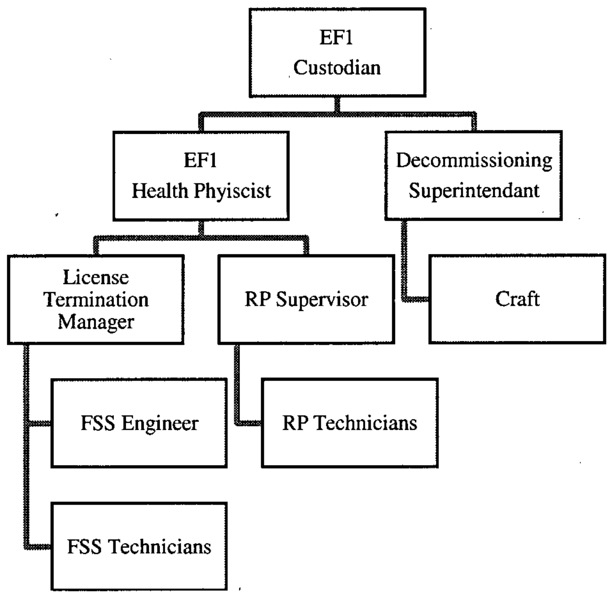


Figure 2-1 EF1 License Termination Org. Chart

2.3.2.2 Characterization Data Categories

One of the objectives of the characterization surveys was to be able to classify survey areas. As shown in Table 2-3 in Section 2.1.7.3 of this chapter, areas have been designated as: 1) Class 1 if residual radioactivity was greater than the DCGL or would likely be present based upon historical information, 2) Class 2 if residual radioactivity was present but less than the DCGL, and 3) Class 3 if residual radioactivity was not present or present at a small fraction of the DCGL.

2.3.2.3 Characterization Survey Design

The EF1 FSS Engineer designed the characterization surveys based on the Site Characterization Data Quality Objectives (DQOs) (see Appendix 2-B for the survey maps and results). Instrumentation used was identical to that which is planned to be used during FSS with similar MDCs. Gas proportional detectors were used for most of the surface measurements and scans. The detectors have a Mylar™ window which is sensitive to the average beta energy emitted from the radionuclide mixture found in the various media. Additionally, volumetric samples of soil and concrete were also collected and counted using HPGe detectors with MDCs set at 10% of the DCGLs. NaI detectors were used to perform scans and direct measurements of soil, asphalt and some concrete areas. These surveys were used to identify regions of potentially contaminated soil and surfaces.

The actual dispositioning of systems at EF1 occurs on a case-by-case basis, with additional data collected when necessary during dismantlement activities to support the dispositioning decision-making. This method of real-time waste management has proven to be cost-effective, much more so at EF1 than if an extensive characterization effort had been undertaken prior to beginning dismantlement. The decision was also made to begin the characterization effort to support the license termination process (remediation and eventually Final Status Survey) when areas were more accessible and could be directly surveyed (after system removal). Remediation and dismantlement tasks are scheduled and reviewed by EF1 personnel. Current and past radiological conditions that could affect the dismantlement or remediation processes are examined. Additionally, the area physical conditions that have or could have been affected radiologically are examined. Instructions and survey objectives are provided for adequate documentation of the characterization surveys and performance of dismantlement activities. The process data quality objectives include but are not limited to, instructions that delineate the types of surveys, samples and action levels for the tasks, and instructions and guidance for the remediation or dismantlement activities.

2.3.2.4 Instrument Selection, Use and Minimum Detectable Concentrations (MDCs)

Instrumentation used for characterization surveys were the same type that are planned to be used for FSS. Count times and scan rates were the same as those that will be used during FSS thus ensuring adequate MDCs. Table 2-27 lists the types of instruments that were used for characterization surveys along with the MDCs achieved. Table 2-28 provides the vendor laboratory minimum detectable activity (MDA) values.

Table 2-27
Typical Survey Instrumentation Sensitivities

Instruments and Detectors	Radiation	Background Count Time (minutes)	Background (cpm)	Instrument Efficiency	Count Time (minutes)	Static MDC	Scan MDC
Model 43-68	Alpha	1	2	0.087	1	26	N/A
Model 43-68	Beta-Gamma	1	243	0.2705	1	454	1082
Model 43-37	Beta-Gamma	1	607	0.2399	1	204	635
LN-177	Beta-Gamma	N/A	N/A	0.10	N/A	N/A	N/A
Model SPA-3	Gamma	1	8000	0.62	0.04	N/A	4.73
HPGe	Gamma	Up to 60	N/A	0.40 relative	10-60	0.05 pCi/g volumetric	0.15-0.30 pCi/g vol.
Tennelec Low Bkg. Counter	Alpha Beta	10 10	0.1 1.0	0.35 0.48	1-10	11 16	N/A N/A

Table 2-28
Vendor Lab. Methods and MDAs

Test	Technique	Method	MDA (pCi/g)
Gamma radionuclides	Gamma Spectroscopy	LANL EM-9	0.1
Alpha	Gas Flow Proportional	EPA 900.0	4.0
Beta	Gas Flow Proportional	EPA 900.0	10.0
H-3	Liquid Scintillation	EPA 906.0 Mod	11-55
C-14	Liquid Scintillation	EPA EERF C	1.2-6.0
Fe-55	Liquid Scintillation	DOE RESL Fe-1	1000-5000
Ni-59	Low Energy Gamma Spectroscopy	DOE RESL Ni-1	1100-5500
Ni-63	Liquid Scintillation	DOE RESL Ni-1	210-1050
Sr-90	Gas Flow Proportional	EPA905.0 Mod	0.17-0.85
Tc-99	Liquid Scintillation	DOE EML HASL 300	1.90-9.50
Pu-238-240	Alpha Spectroscopy	DOE EML HASL 300	0.23-1.25
Pu-241	Liquid Scintillation	DOE EML HASL 300	7.2-36.00
Am-241	Alpha Spectroscopy	DOE EML HASL 300	0.21-1.05
Cm-242&243	Alpha Spectroscopy	DOE EML HASL 300	16-80
Cm-243	Alpha Spectroscopy	DOE EML HASL 300	0.32-1.60

2.3.2.5 Quality Assurance

Instrumentation used for characterization surveys was calibrated by an off-site vendor using NIST-traceable sources of energies similar to those emitted by the nuclide fractions for the various media surveyed.

Instrumentation was source checked before and after survey measurements were made in accordance with approved site procedures. The FSS Engineer, prior to accepting the data for characterization, evaluated instruments not passing a source check. Laboratory instruments were calibrated following the approved Fermi 2 Radiation Protection procedures. A fraction of the volumetric samples were collected as split samples for quality control purposes. 10% of the volumetric samples were designated as recounts. Split sampling and sample recounts were in accordance with EF1 procedure MEF201, "Final Status Survey Quality Assurance Project Plan (QAPP)."

2.3.2.6 Data Quality Objectives

Data Quality Objectives (DQOs) were implemented for Characterization surveys in a similar manner as anticipated for Final Status Surveys, however, the goal of the characterization is contamination quantification and delineation of the nuclide suite, whereas the FSS goal is comparison of data against the Null Hypothesis. Characterization surveys were designed to gather the appropriate data using the DQO process as outlined in MARSSIM, Appendix D. The seven steps in the DQO development process are:

1) State the problem,
2) Identify the decision,
3) Identify inputs to the decision,
4) Define the study boundaries,
5) Develop a decision rule,
6) Specify limits on decision errors, and
7) Optimize the design for obtaining data.

The DQOs for site characterization included identifying the types and quantities of media to collect. Since the scenarios used for dose modeling were the Building Occupancy and Resident Farmer scenarios, sample collection was concentrated on structure materials and surrounding soils. Building concrete was sampled by obtaining volumetric samples (additional volumetric sampling will be performed when the areas of interest become available). Soils were also sampled volumetrically. Enough measurements (typically 10 to 15 measurements per area) were obtained to achieve statistically significant results so that the mean and maximum activity as well as the sample standard deviation could be determined. Direct measurements and scans of concrete surfaces were also made using the same instruments and MDCs as those that are planned to be used for FSS. A percentage of samples of each type of media were sent for HTD radionuclide analysis. Samples were also collected from the interior surfaces of ancillary piping.

2.3.3 Survey Findings and Results

Survey categories consist of surfaces, structures and environs present at EF1. Several areas of the site were specifically targeted for detailed sampling and surveys. The areas were either known or suspected to have been contaminated by plant operations or decommissioning. The remainder of the site received general sampling and surveys to determine whether structures or soils were contaminated and to what extent. Appendix 2-B illustrates the survey areas and locations described in this chapter.

2.3.3.1 Surfaces, Structures and Soils

Surfaces and structures include building interiors and exteriors of the associated structures and if applicable, the exterior surfaces of systems or components because these surfaces have the same potential for residual levels of radioactive material as the building surfaces in which they are located. Land areas were surveyed and sampled to detect the presence and extent of soil contamination.

- Over 1332 beta scan and direct measurements have been taken in EF1 during the 2008 characterization survey.
- 40 soil samples were taken from open land areas within and outside of the EF1 Controlled Area. Five of these samples were sent off-site to a laboratory for analysis of HTD radionuclides.
- A concrete sample taken from the inner Biowall concrete was sent off-site for analysis of HTD nuclides as well as counted on site for activation.

All samples submitted to the vendor laboratory were analyzed for the entire nuclide suite. The nuclide suite includes those nuclides found in Chapter 6 of this LTP.

Groundwater analysis results from the site monitoring wells were provided in Section 2.2.4.

2.3.3.2 Ancillary Systems

Due to the nature of a Liquid Metal Fast Breeder Reactor (LMFBR) ancillary systems such as the feedwater, condensate, steam, and lubricating oil systems are not expected to be impacted by plant operations. In an effort to verify the non-impacted classification of these systems, a survey was performed consisting of scans, volumetric sampling and smears. The ancillary systems were accessed at various locations throughout the turbine building. No scan or volumetric sample identified the presence of plant-related contamination.

2.3.4 Ambient and Background

While there have been no studies in the general area of EF1 as to the Cs-137 levels due to fallout, Big Rock Point (BRP) performed a study in northern Michigan which would be reasonably representative of the levels found at EF1. As a result of the 2000 BRP study, Cs-137 average activity 0.48 pCi/g to 0.54 pCi/g with a log-normal standard deviation of 0.79 pCi/g would be expected in Michigan. Adjusting the reported data for radioactive decay to 2008 results in current background values of 0.39 pCi/g to 0.44 pCi/g.

Soil samples collected and analyzed during site characterization within or adjacent to the Controlled Area showed a mean Cs-137 activity 0.11 pCi/g and a maximum Cs-137 activity 0.45 pCi/g. For purposes of decommissioning, background Cs-137 activities in soil should be considered to be 0.39 pCi/g to 0.44 pCi/g.

Ambient radiation levels are present at EF1 due to the operation of Fermi 2. As can be seen by the data comparison shown in section 2.3.1, the ambient influence due to Fermi 2 operation can contribute significantly to the readings taken at EF1. Readings within the interior of buildings are not impacted as significantly as the reading taken exterior to the structures. As a result of this ambient contribution from Fermi 2 operation, beta scans and fixed-point measurements will be compensated by the use of ambient correction. A series of shielded beta readings will be taken at various locations within a room or building and the mean value will be subtracted from the unshielded readings taken. For gamma scans (with SPA-3 sodium iodide detector), portable shielding or other methods of reducing the ambient levels will be utilized as needed. Ambient gamma radiation from the operation of Fermi 2 and the methodology for the ambient correction are further explained in Section 5.4.3.1 of this LTP.

2.3.5 Waste Volumes and Activities

Chapter 3 of this LTP presents the waste volumes and activities.

2.4 Continuing Characterization

As previously stated, characterization data will be collected as necessary throughout the project. Results of future characterization sample analyses will be evaluated to determine the impact, if any, on the radionuclide identities, nuclide fractions and the classification of structures, soils and other site media.

2.5 Summary

The characterization data collected and analyzed to date are of sufficient quantity and quality to provide the basis for the initial classification of survey areas, planning remediation activities, estimating radiological waste types and volumes, and for the development of DCGLs. However, characterization is an ongoing process that will continue as necessary during decommissioning.

2.6 References

2.6.1 Big Rock Point Nuclear Plant, *License Termination Plan,* Section 2.3.3, April 2003

2.6.2 C&M Department Maintenance

2.6.3 Chesapeake Nuclear Services, Inc., *Fermi 1 Radiological Characterization Surveys,* March 2005

2.6.4 Enrico Fermi Atomic Power Plant, Unit 1, *Fermi 1 Safety Analysis Report,* November 2006

2.6.5 Enrico Fermi Atomic Power Plant, Unit 1, *Fermi 1 Manual*

2.6.6 Enrico Fermi Atomic Power Plant, Unit 1, *Historical Site Assessment*

2.6.7 Fermi 1 Decommissioning Evaluation Report, June 1997

2.6.8 Fermi 1 Shift Logs, August 1963 to September 1995

2.6.9 Fermi 1 Operating Reports, August 1963 to December 1975

2.6.10 Golder Associates, Inc., *Report on Groundwater Characterization,* June 2007

2.6.11 Power Reactor Development Company, *Technical Information and Hazards Summary Report*

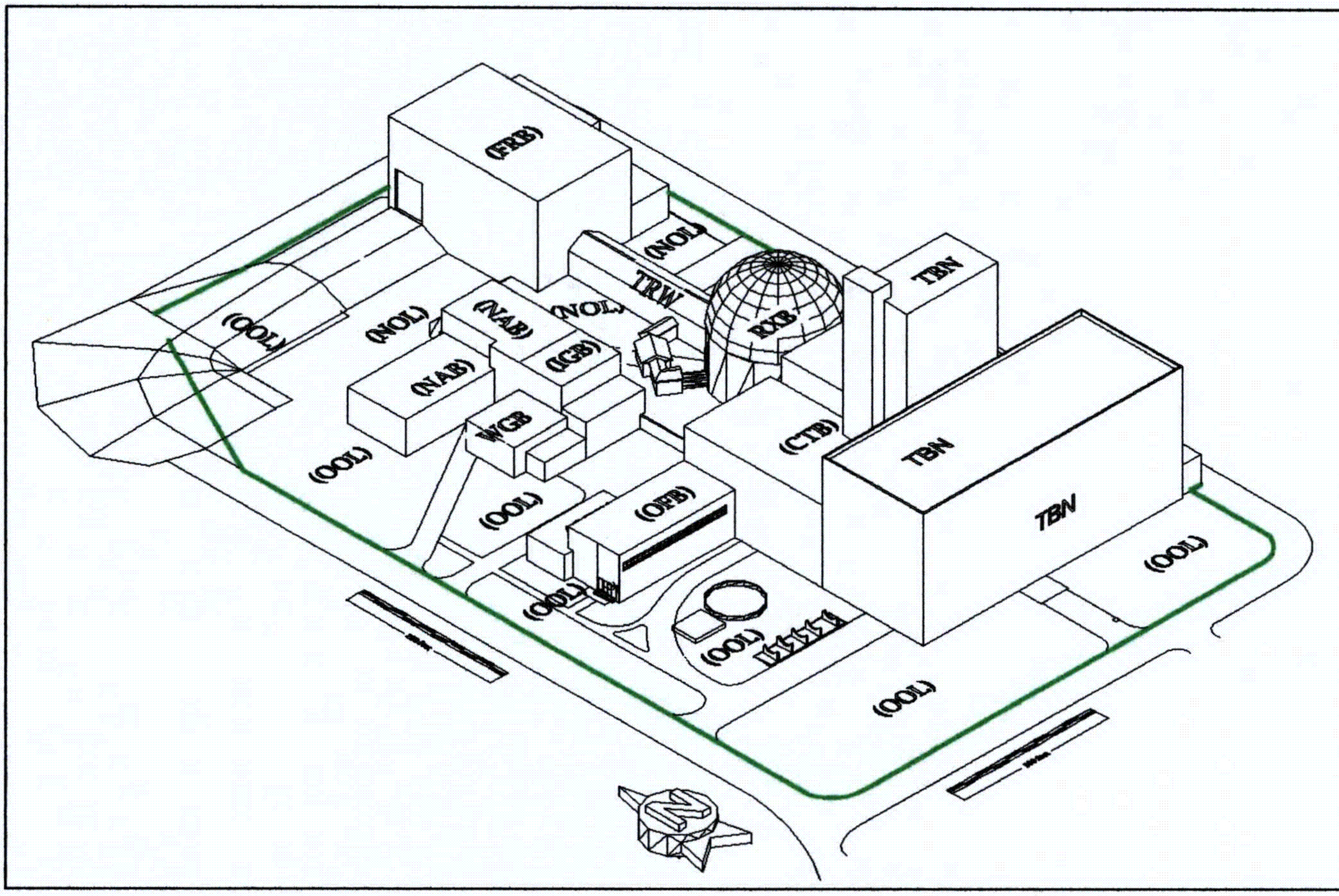
2.6.12 Technical Based Document, (TBD) NESF-08-0018, *Radionuclide Selection for DCGL Development*

2.6.13 U.S. Nuclear Regulatory Commission NUREG-1575, Revision 1, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),* August 2000

2.6.14 U.S. Nuclear Regulatory Commission NUREG/CR-2082 – *Monitoring for Compliance with Decommissioning Termination Survey Criteria*

2.6.15 U.S. Nuclear Regulatory Commission NUREG-0586, *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities (FGEIS),* August 1988

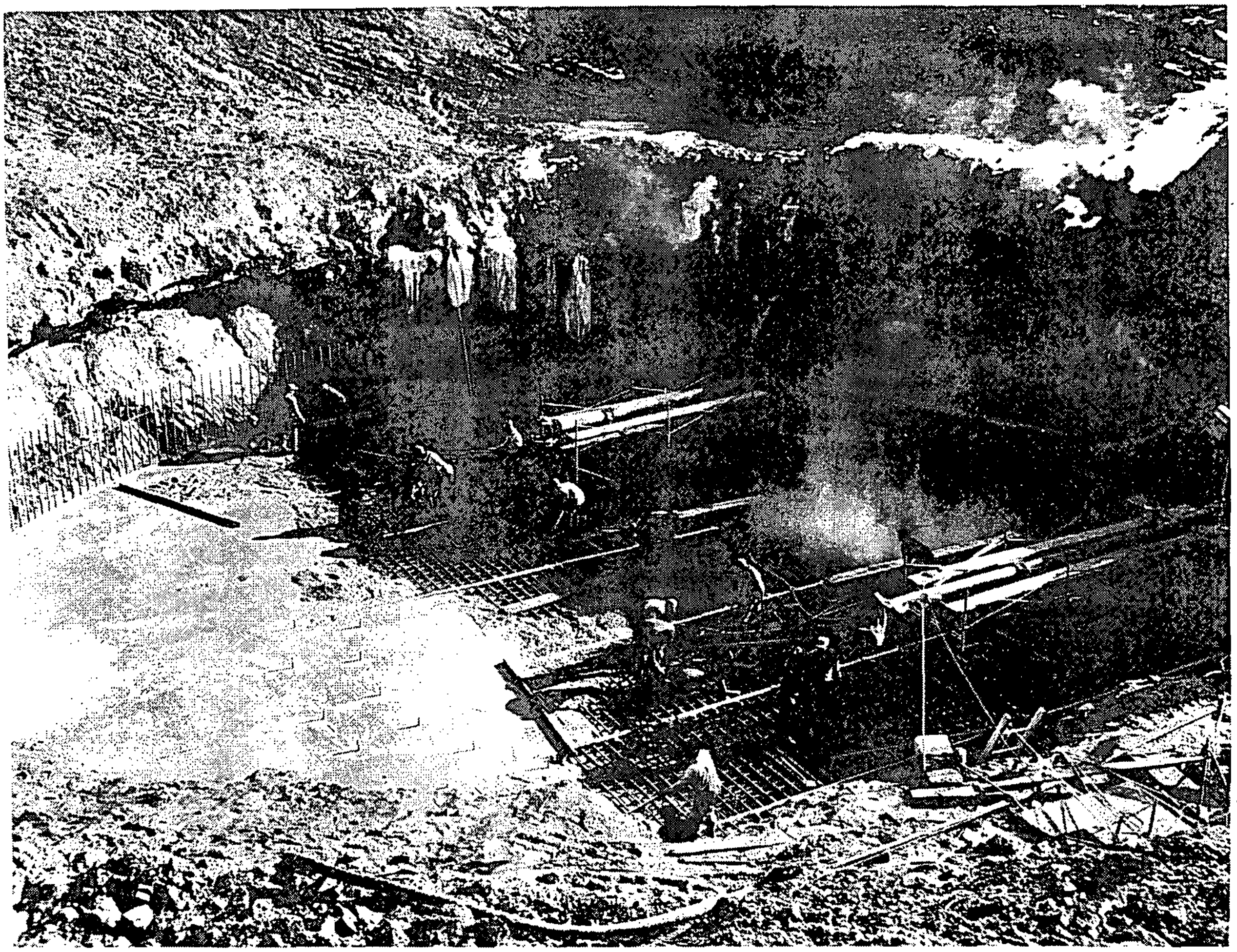
Figure 2-2 EF1 Survey Area Designations



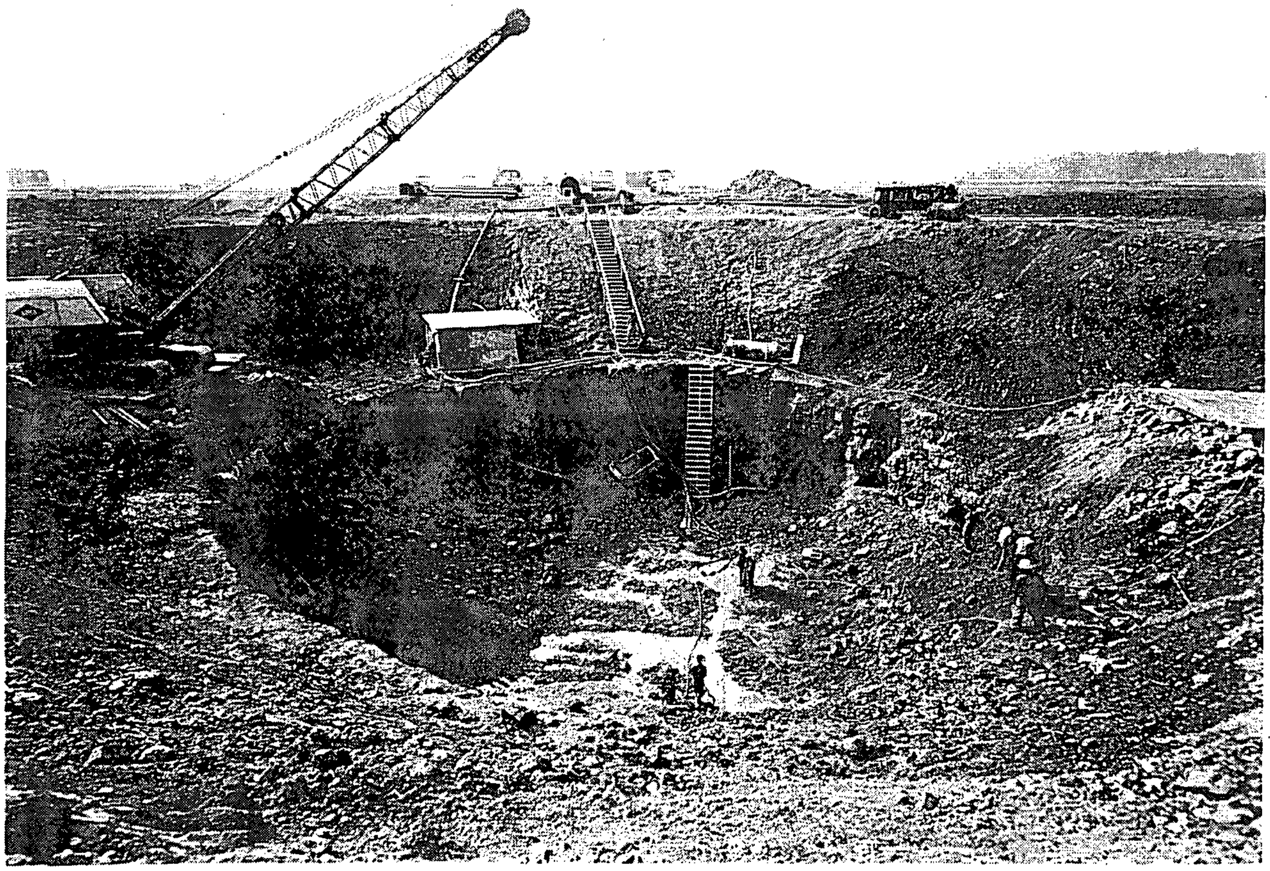
Appendix 2-A

Historical Site Photographs

Pouring Concrete



Reactor Excavation



Enrico Fermi Power Plant
Reactor Excavation - looking West

P R D C

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Reactor Excavation

Enrico Fermi Power Plant
Excavation for Reactor Foundation looking Southeast

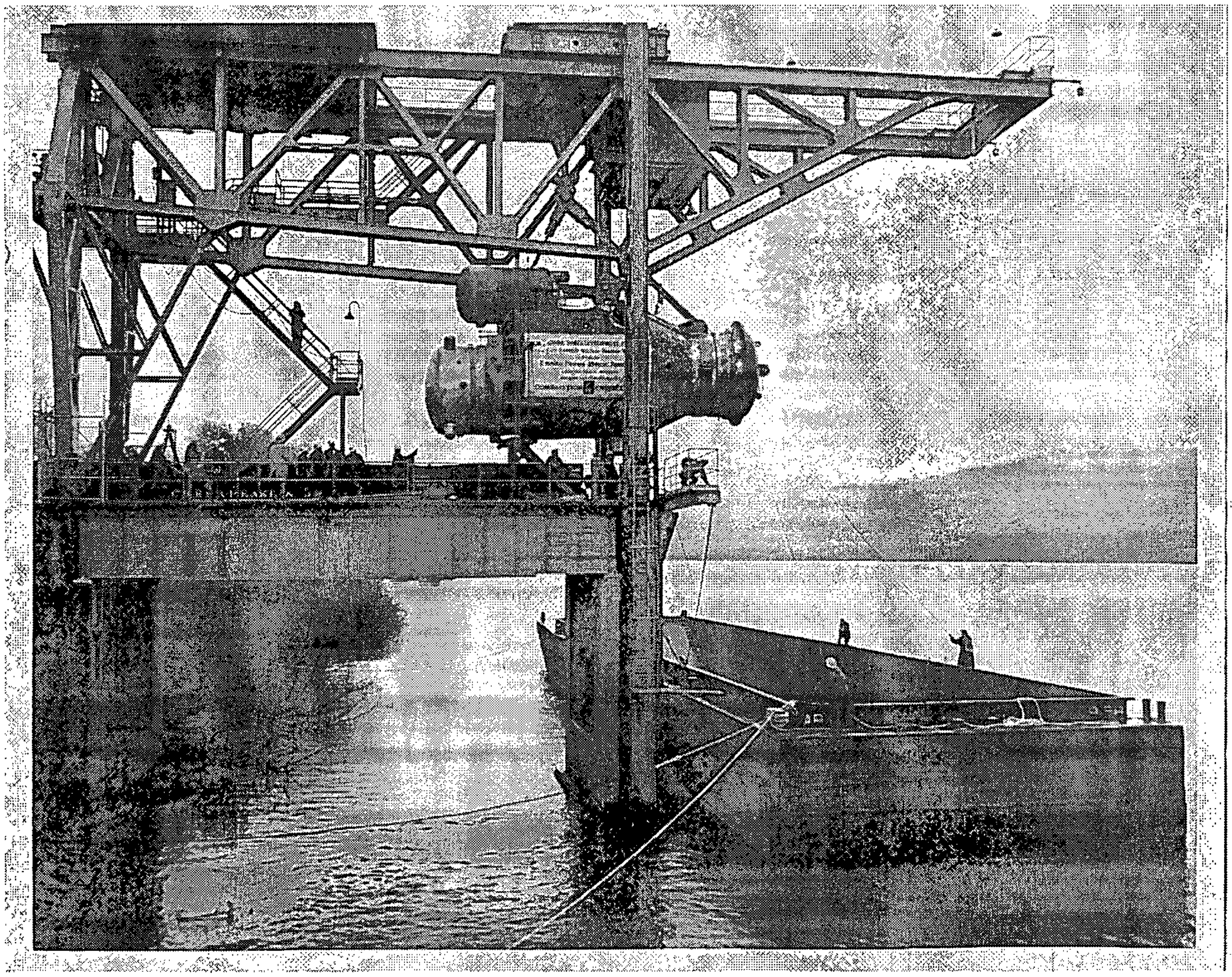
PICTURES FROM THE PAST

—Evening News file pho

In the beginning

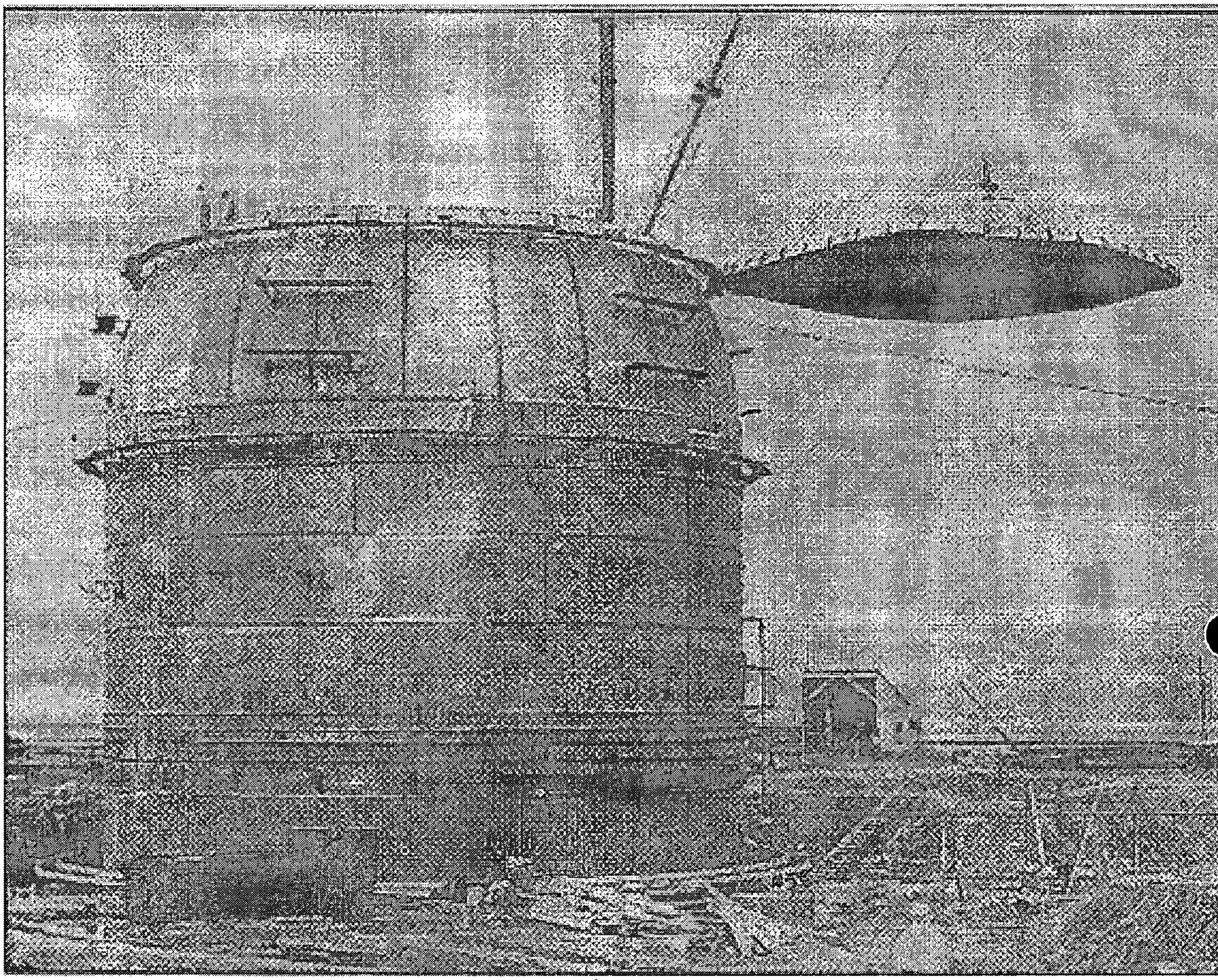
Workers busily lay concrete and install reinforcing rod for the foundations of the Fermi 1 atomic power plant. The scene occurred in January, 1957, as construction began in earnest on the experimental liquid-metal fast-breeder reactor. Crews are shown draping tarps over scaffolding to keep the fresh concrete dry. Work on the Fermi 1 reactor building continued during the winter months. The 56-foot deep excavation was 87-feet across at the bottom and extended 20 feet down into the underlying rock. The projec was built by an international industrial consortiun that included Detroit Edison Co. The 1-megawat plant began operations in August, 1963, and suffered a partial fuel-melting incident on Oct. 5 1966. The plant was repaired and restarted in 1968 but was shut down in 1971 and decommissioned in 1972. Related component and buildings still stand at what is now the site o the Fermi 2 nuclear plant.

Arrival of the Reactor Vessel

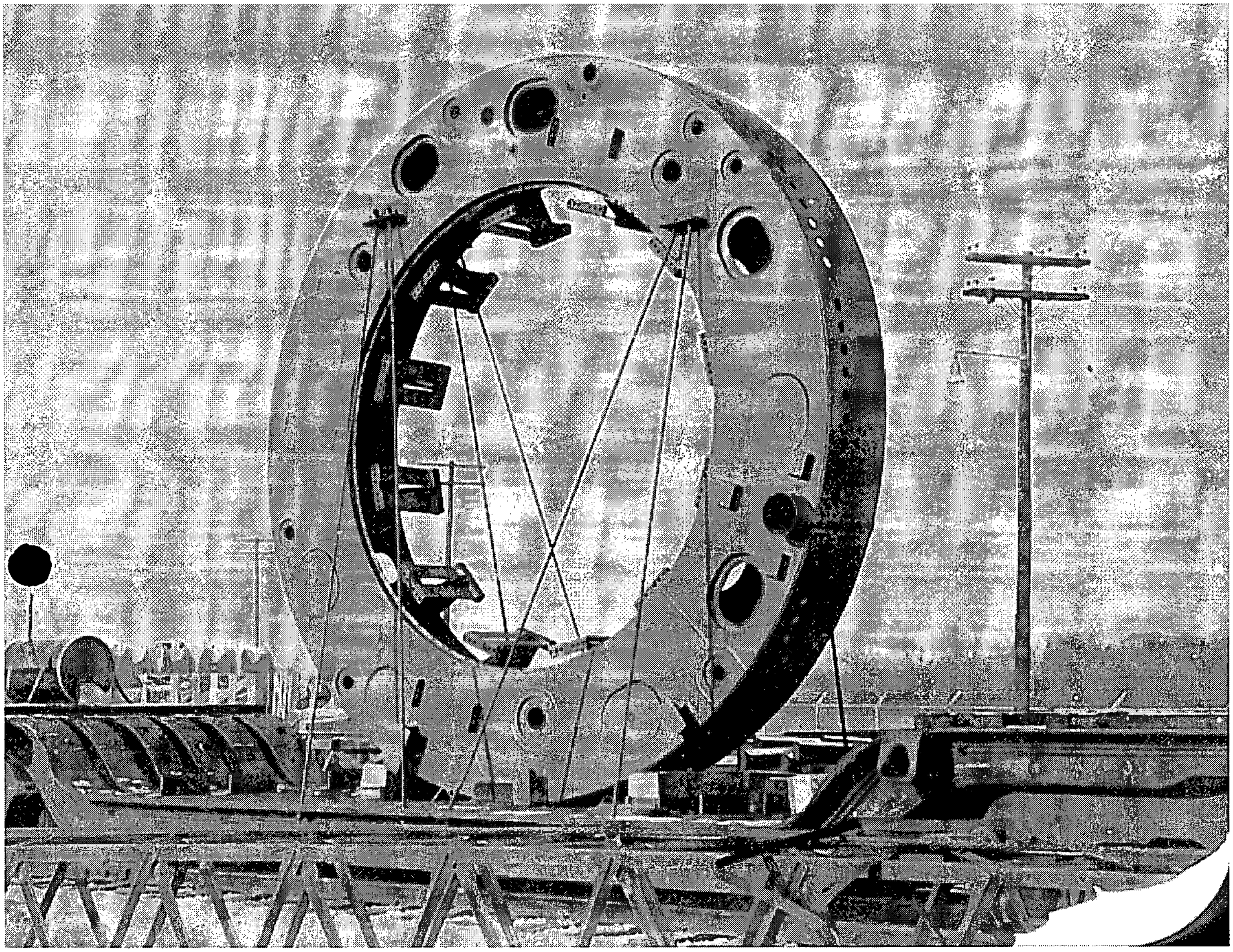


Entering the Reactor

The Top of the Reactor goes on

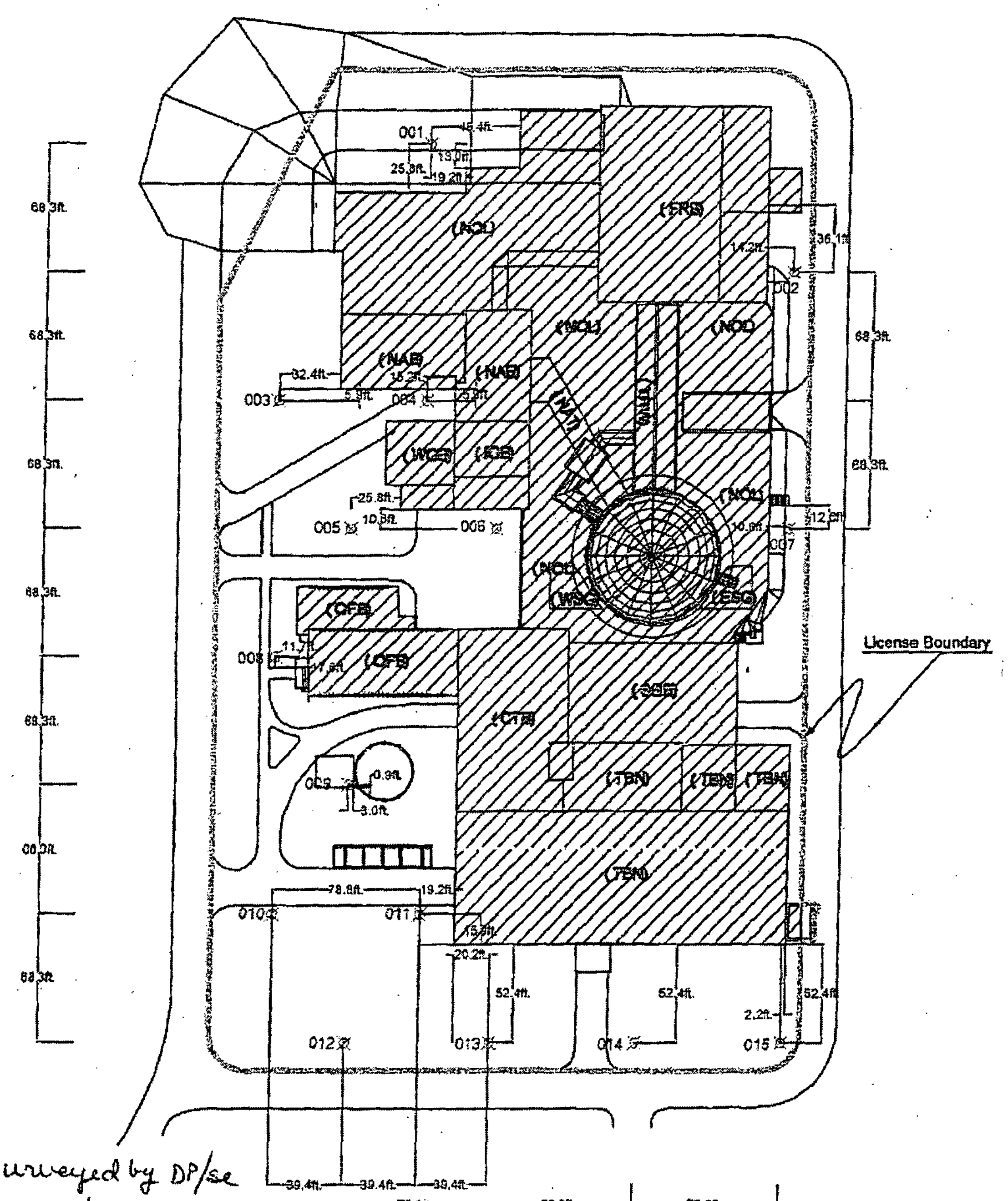


Arrival of the Reactor Transition Deck



Appendix 2-B

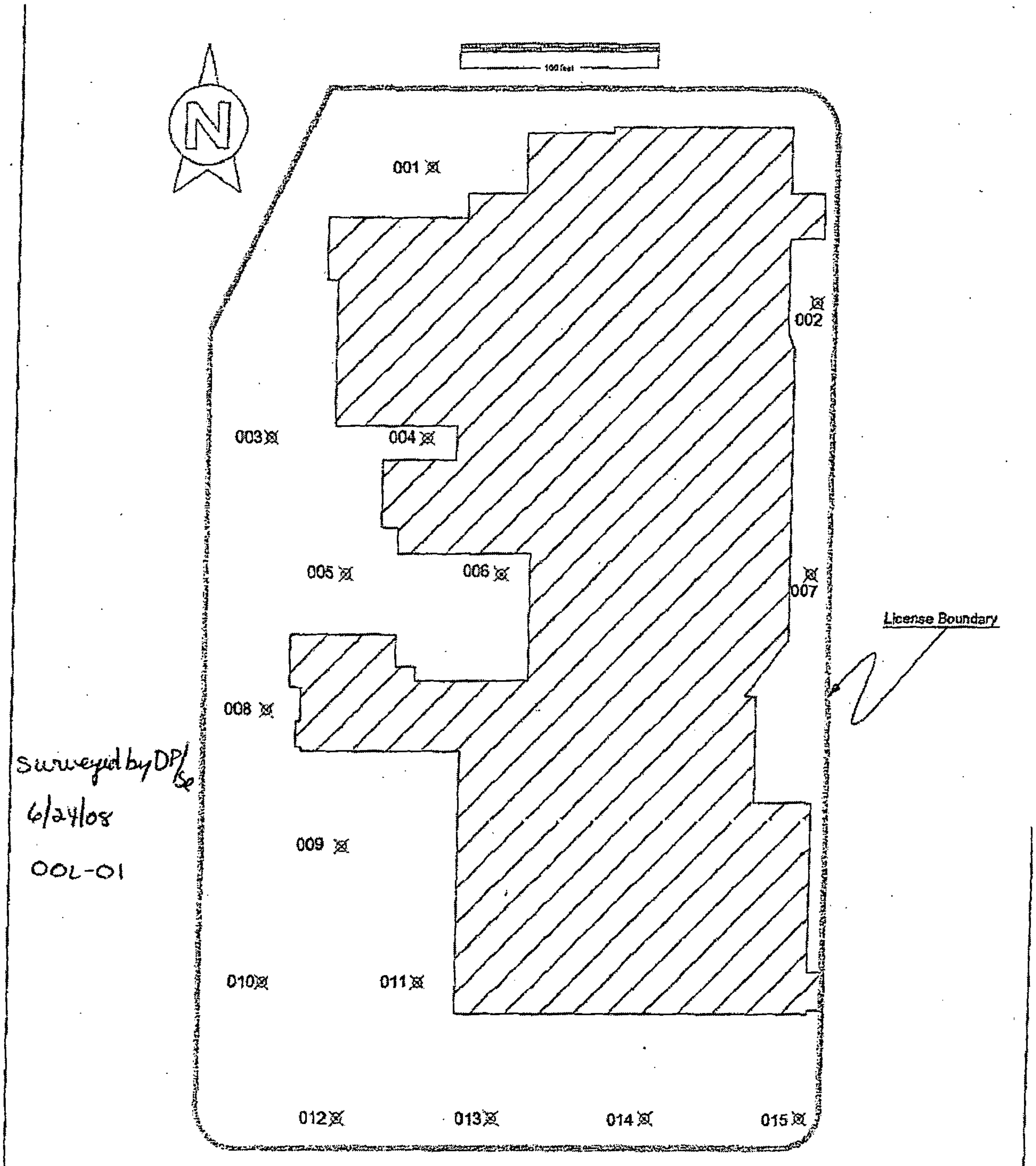
Recent Site Characterization



Surveyed by DP/se
6/24/08
OOL-01

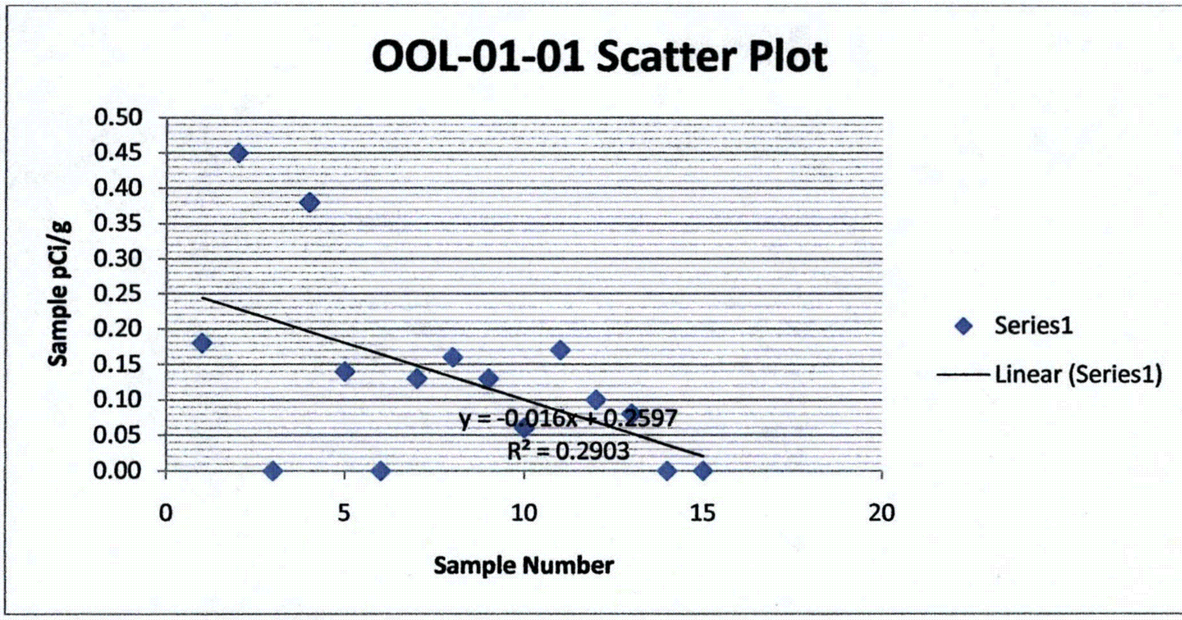
Note: All sample locations (001-015) generated using Visual Sample Plan Software.

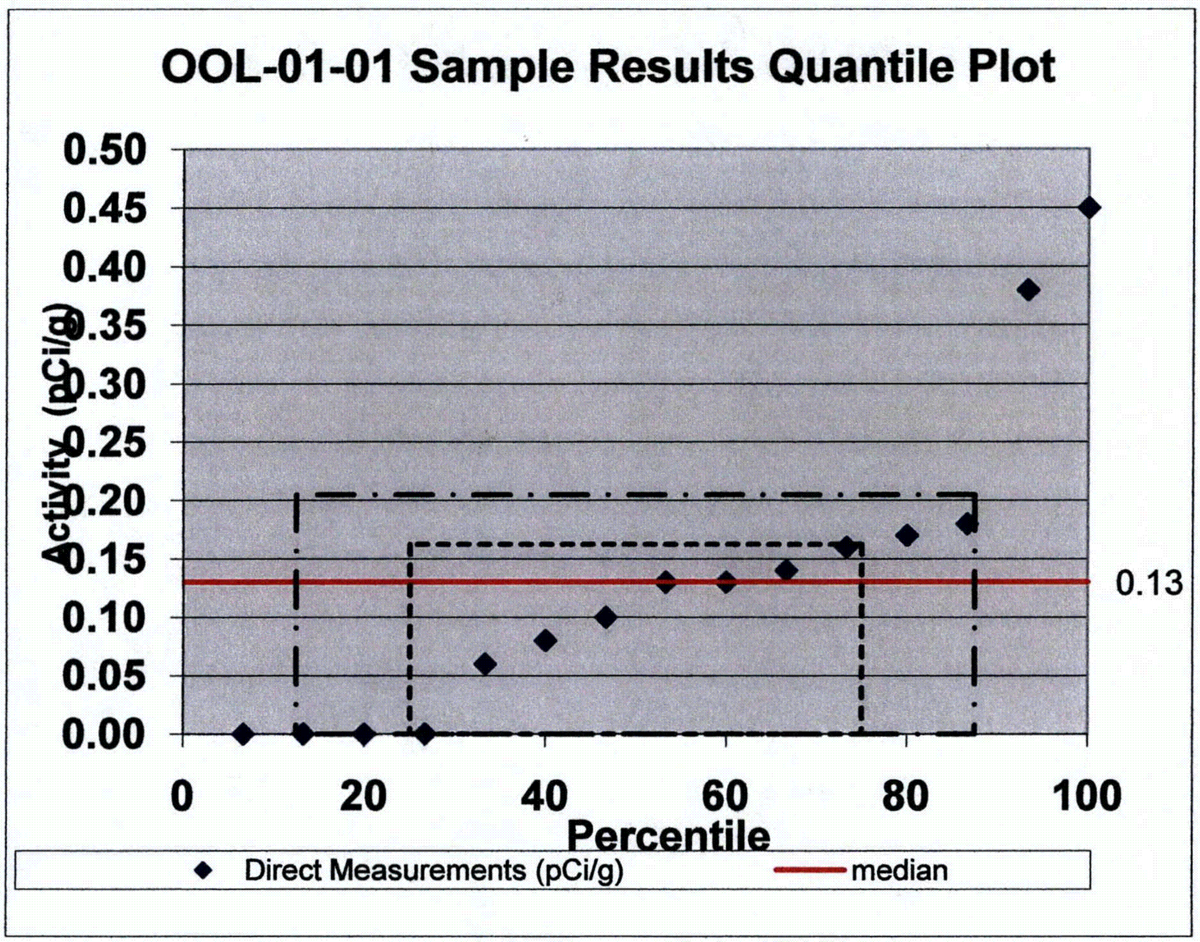
DTE Energy	Detroit Edison Company	ENRICO FERMI ATOMIC POWER PLANT	Unit 1	License Termination
TITLE: Initial Open Land Area Chatacterization Sample Set			AREA: OOL	Prepared By: L. Dockins Issue Date: 04.29.08



Note: All sample locations (001 -015) generated using Visual Sample Plan Software.

DTE Energy	Detroit Edison Company	ENRICO FERMI ATOMIC POWER PLANT	Unit 1	License Termination	
TITLE: Initial Open Land Area Chatacterization Sample Set			AREA: OOL	Prepared By:	L. Dockins
				Issue Date:	04.29.08

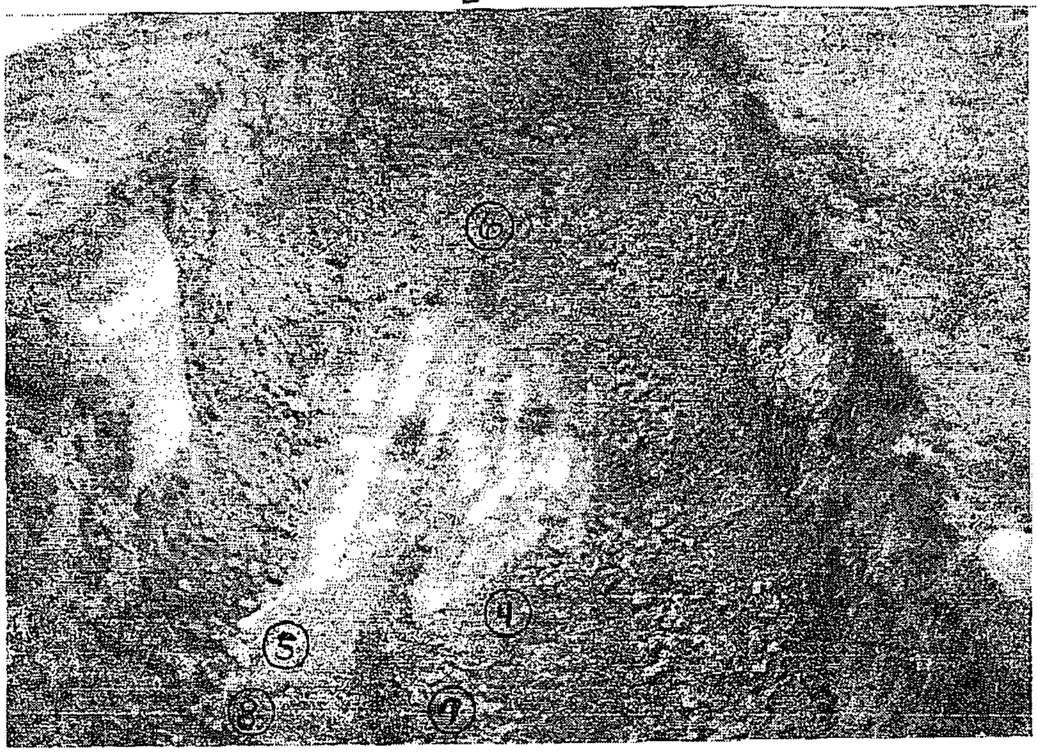

OOL-01-01 Scatter Plot
Sample pCi/g
Sample Number
Series1
Linear (Series1)
y = -0.016x + 0.2597
R² = 0.2903


OOL-01-01 Sample Results Quantile Plot
Activity (pCi/g)
Percentile
0.13
Direct Measurements (pCi/g)
median

Characterization Soil Sample Designation	Tech Initials	Time	Sample Date	Date Sent Offsite for Analysis	Date of Results	H-3	C-14	Na-22	Mn-54	Fe-55	Co-60	Ni-63	Sr-90	Nb-94	Tc-99	Cs-134	Cs-137	Eu-152	Eu-155	Pu-238	Pu-239/240	Pu-241
EF1-CHAR-OOL01-001	DP/SE	9:25	6/23/08	N/A	11/3/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.18	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-002	DP/SE	14:07	6/25/08	N/A	11/3/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.45	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-003	DP/SE	13:45	6/24/08	N/A	11/3/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-004	DP/SE	15:53	6/25/08	N/A	11/3/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.38	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-005	DP/SE	14:00	6/24/08	N/A	11/4/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.09	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-005-S	DP/SE	14:00	6/24/08	10/13/2008	11/10/08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.14	ND	ND	ND	ND	ND
EF1-CHAR-OOL01-006	DP/SE	13:12	6/24/08	N/A	11/4/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-007	DP/SE	15:41	6/24/08	N/A	11/5/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.13	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-008	DP/SE	14:30	6/24/08	N/A	11/5/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.06	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-008-S	DP/SE	14:30	6/24/08	10/13/2008	11/10/08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.16	ND	ND	ND	ND	ND
EF1-CHAR-OOL01-009	DP/SE	14:38	6/24/08	N/A	11/5/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.13	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-010	DP/SE	14:50	6/24/08	N/A	11/6/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-010-RC	DP/SE	14:50	6/24/08	N/A	11/10/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.06	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-011	DP/SE	14:56	6/24/08	N/A	11/11/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.17	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-012	DP/SE	13:02	6/24/08	N/A	11/11/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.10	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-013	DP/SE	14:16	6/25/08	N/A	11/6/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.06	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-013-RC	DP/SE	14:16	6/25/08	N/A	11/10/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.08	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-014	DP/SE	15:20	6/24/08	N/A	11/6/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A
EF1-CHAR-OOL01-015	DP/SE	15:30	6/24/08	N/A	11/11/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A

Note: Results reported in pCi/g.	Mean	0.16
ND = indicates no activity >MDA	Median	0.13
S = Split Sample	Std.Dev.	0.12
RC = Recount		

⇧N



N SLOPE	-	11.1 Kcpm	- 13.3 Kcpm
E WALL	-	8.4 Kcpm	- 12.2 Kcpm
S WALL	-	13.1 Kcpm	- 18.2 Kcpm
W WALL	-	9.2 Kcpm	- 17.3 Kcpm
Bottom	-	8.5 Kcpm	- 18. Kcpm
Concrete Bottom	-	13.5 Kcpm	- 17 Kcpm

BKG - 25.5 Kcpm

OOL01-02 EXCAVATION - NORTHWEST CORNER

Instrument / Serial No.
2350-1 / 189090

Probe No. / Serial No.
D1-SPA3 / 2081

SURVEYED ON: 9/30/08 by: DAN PAYEUR

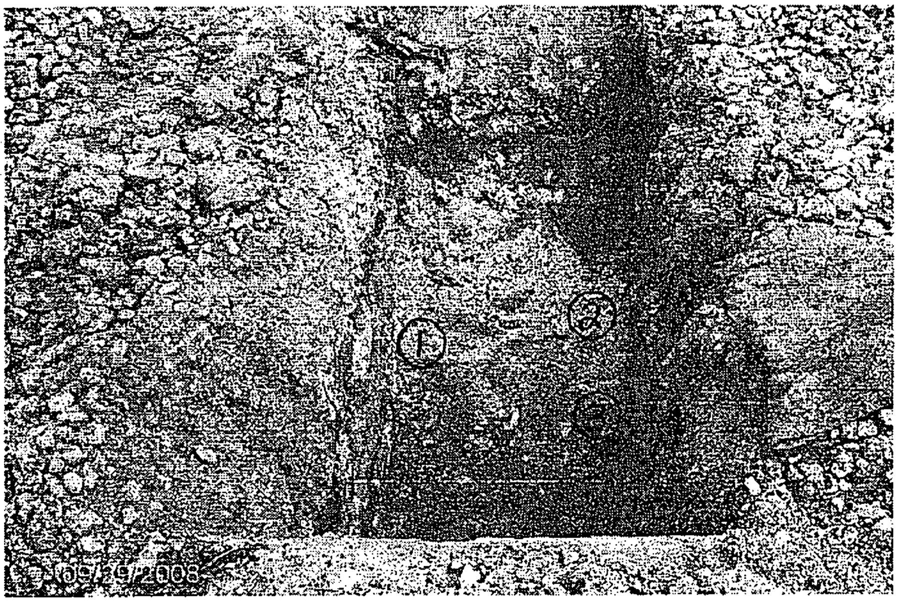
Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 0815
1700

Comments: ALL SURVEY AREAS TAKEN WITH SHIELD
AREA SURVEYED APPROX 22'X6'X3'
OOL01-02 - 004 - 16 Kcpm @ 1455
OOL01-02 - 005 - 18 Kcpm @ 1500
OOL01-02 - 006 - 9 Kcpm @ 1508
OOL01-02 - 007 - 16 Kcpm @ 1505
OOL01-02 - 008 - 18.2 Kcpm @ 1445

PAG 2 of 2

OOL01-02 EXCAVATION - OUTSIDE OFFICE BLDG

N



WITH SHIELD		WITHOUT SHIELD
N WALL	9.3 Kcpm - 11.5 Kcpm	13.1 Kcpm - 17.1 Kcpm
S WALL	9.3 Kcpm - 11.5 Kcpm	13.1 Kcpm - 18.9 Kcpm
E SLOPE	7 Kcpm - 8.5 Kcpm	11.5 Kcpm - 18.5 Kcpm
W WALL	9.5 Kcpm - 12.4 Kcpm	11.9 Kcpm - 13.2 Kcpm
FLOOR	8.5 Kcpm - 12.4 Kcpm	11.9 Kcpm - 18.5 Kcpm
BKG	14 Kcpm	BKG - 22 Kcpm

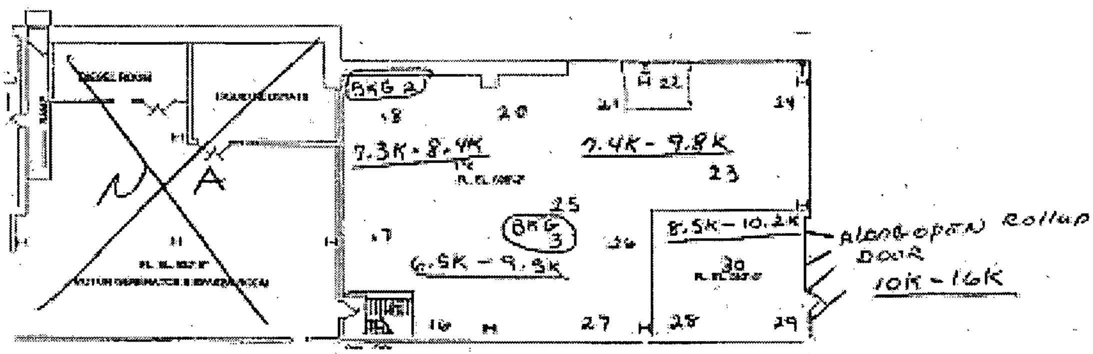
AREA SURVEYED APPROX. 6'x2'x3'

	WITH SHIELD	WITHOUT SHIELD
OOL01-02-001	12.4 Kcpm @ 1033	17.1 Kcpm
OOL01-02-002	12.4 Kcpm @ 1029	11.5 Kcpm
OOL01-02-003	12.9 Kcpm @ 1020	18.9 Kcpm

Characterization Soil Sample Designation	Tech Initials	Time	Sample Date	Date Sent Offsite for Analysis	Date of Results	H-3	C-14	Na-22	Mn-54	Fe-55	Co-60	Ni-63	Sr-90	Nb-94	Tc-99	Cs-134	Cs-137	Eu-152	Eu-155	Pu-238	Pu-239/240
EF1-CHAR-OOL01-02-001	DP/SE	10:33	9/30/08	N/A	11/13/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-OOL01-02-002	DP/SE	10:28	9/30/08	N/A	11/26/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-OOL01-02-003	DP/SE	10:20	9/30/08	N/A	11/20/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-OOL01-02-004	DP/SE	14:55	9/30/08	N/A	11/17/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-OOL01-02-004-RC	DP/SE	14:55	9/30/08	N/A	11/17/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-OOL01-02-005	DP/SE	15:00	9/30/08	N/A	11/17/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-OOL01-02-006	DP/SE	15:08	9/30/08	N/A	12/8/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.006	ND	ND	N/A	N/A
EF1-CHAR-OOL01-02-007	DP/SE	15:05	9/30/08	N/A	11/26/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-OOL01-02-008	DP/SE	14:15	9/30/08	N/A	11/24/08	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-OOL01-02-008-S	DP/SE	14:15	9/30/08	10/13/2008	11/10/08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Note: Results reported in pCi/g.
ND = indicates no activity >MDA
S = Split Sample
RC = Recount

SGB01 1[st] Floor



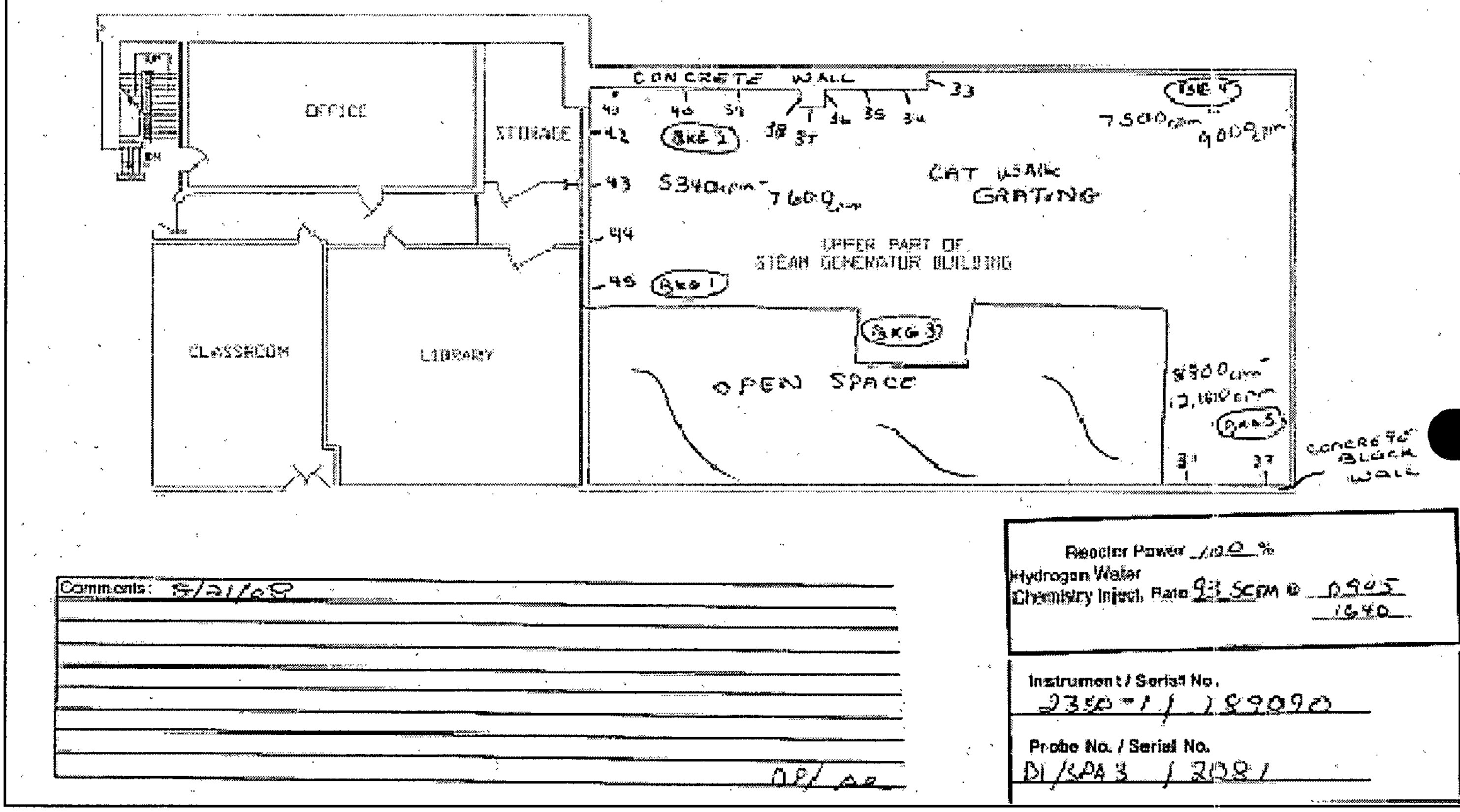
Reactor Power 100 %
Hydrogen Water
Chemistry Inject. Rate 93 SCFM @ 0830
1645

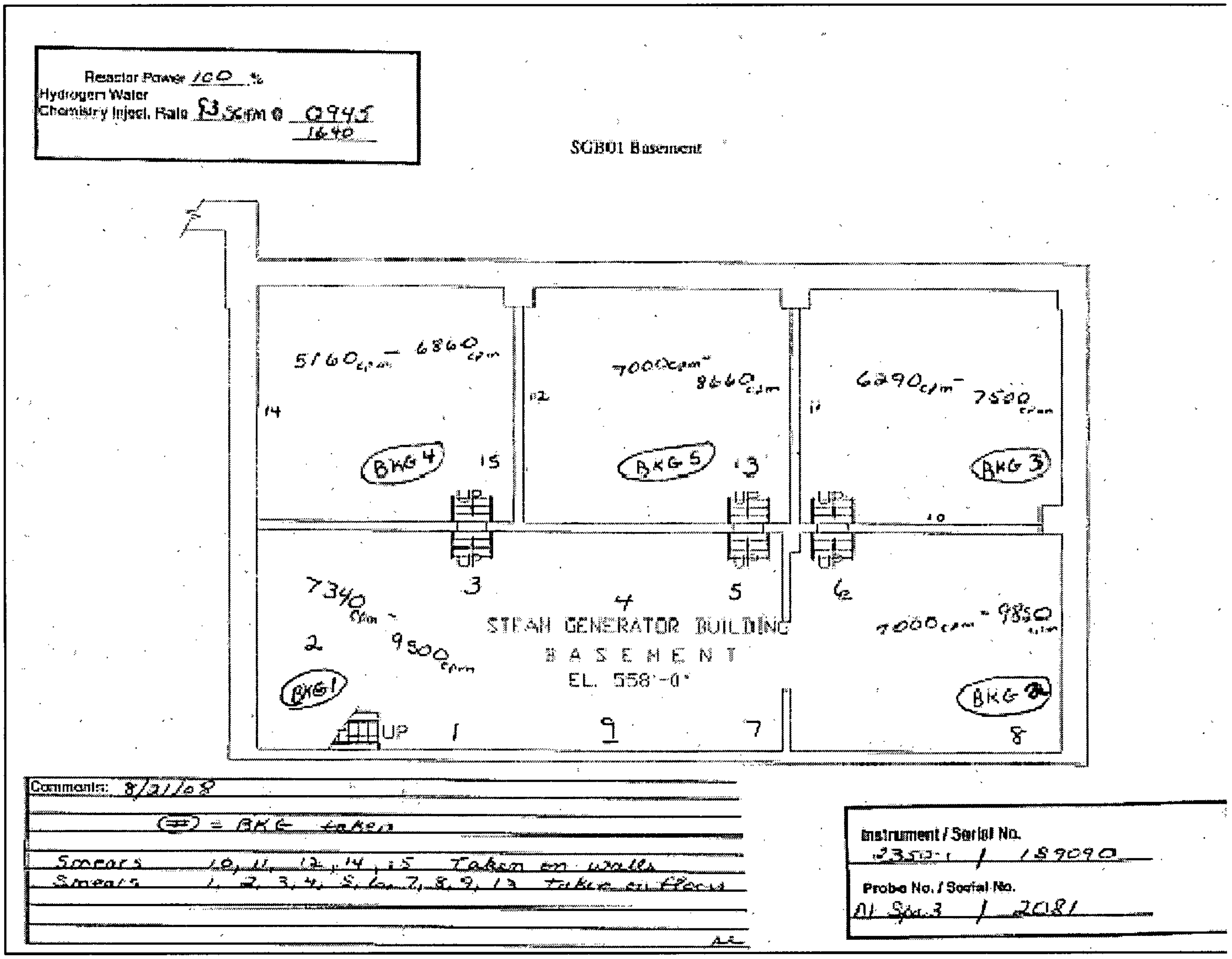
Comments: 9/4/08 ae
16 - 30 Smears Taken
Spa 3 readings are underlined
Spa 3 readings along concrete walls at floor 8.5K - 13K
No elevated readings detected

Instrument / Serial No.
2350-1 / 139090

Probe No. / Serial No.
01/Spa3 / 2081

SGB01 2nd Floor





Reactor Power 100 %
Hydrogen Water
Chemistry Inject. Rate 13 Scfm @ 0945
1640
SGB01 Basement
5160 cpm - 6860 cpm
14
15
BKG 4
7000 cpm - 8660 cpm
12
13
BKG 5
6290 cpm - 7500 cpm
11
10
BKG 3
UP
7340 cpm - 9500 cpm
2
3
4
5
6
BKG 1
STEAM GENERATOR BUILDING
BASEMENT
EL. 558'-0"
7000 cpm - 9850 cpm
BKG 2
1
9
7
8
Comments: 8/21/08
= BKG taken
Smears 10, 11, 12, 14, 15 Taken on walls
Smears 1, 2, 3, 4, 5, 6, 7, 8, 9, 13 taken on floors
Instrument / Serial No.
2350-1 / 189090
Probe No. / Serial No.
DP Spa 3 / 2081

Log #	Location	Results cpm	Time	Surface	Level
0	CHAR-SGB01-001-BKG	312	10:15 AM	BKG	BSM
1	CHAR-SGB01-002-BKG	336	10:17 AM	BKG	BSM
2	CHAR-SGB01-003-BKG	305	10:20 AM	BKG	BSM
3	CHAR-SGB01-004-BKG	270	10:24 AM	BKG	BSM
4	CHAR-SGB01-005-BKG	314	10:27 AM	BKG	BSM
5	CHAR-SGB01-001-F-M	373	10:33 AM	Floor	BSM
6	CHAR-SGB01-002-F-M	395	10:35 AM	Floor	BSM
7	CHAR-SGB01-003-F-M	397	10:37 AM	Floor	BSM
8	CHAR-SGB01-004-F-M	428	10:38 AM	Floor	BSM
9	CHAR-SGB01-005-F-M	391	10:40 AM	Floor	BSM
10	CHAR-SGB01-006-F-M	380	10:41 AM	Floor	BSM
11	CHAR-SGB01-007-F-M	370	10:44 AM	Floor	BSM
12	CHAR-SGB01-008-F-M	359	10:46 AM	Floor	BSM
13	CHAR-SGB01-009-F-M	418	10:48 AM	Floor	BSM
14	CHAR-SGB01-010-F-M	399	10:51 AM	Floor	BSM
15	CHAR-SGB01-011-F-M	404	10:52 AM	Floor	BSM
16	CHAR-SGB01-012-F-M	398	10:56 AM	Floor	BSM
17	CHAR-SGB01-013-F-M	255	10:57 AM	Floor	BSM
18	CHAR-SGB01-014-F-M	411	11:03 AM	Floor	BSM
19	CHAR-SGB01-015-F-M	360	11:05 AM	Floor	BSM

SURVEYED ON: 8/21/08 by: D. Payeur, S. Erickson

Reactor Power - 100%
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 0945
1640

Instrument / Serial No.
2350-1/ 186199

Probe No. / Serial No.
43-68/ PR178065

	dpm/100cm2
Amb. Mean	1135
Count Mean	1412
Count Median	1458
Count Std. Dev.	150

1152
1240
1126
997
1159
1377
1458
1465
1580
1443
1403
1366
1325
1543
1473
1491
1469
941
1517
1329

Comments:
All survey points taken on floor.
BSM = Basement

BKG = Ambient Background
F-M = Fixed measurements

Log #	Location	Results cpm	Time	Surface	Level
0	CHAR-SGB01-001-BKG	118	1108	BKG	FL1
1	CHAR-SGB01-002-BKG	136	1110	BKG	FL1
2	CHAR-SGB01-003-BKG	189	1114	BKG	FL1
3	CHAR-SGB01-004-BKG	213	1116	BKG	FL1
4	CHAR-SGB01-005-BKG	263	1122	BKG	FL1
5	CHAR-SGB01-016-F-M	439	1125	Floor	FL1
6	CHAR-SGB01-017-F-M	397	1127	Floor	FL1
7	CHAR-SGB01-018-F-M	442	1128	Floor	FL1
8	CHAR-SGB01-019-F-M	436	1130	Floor	FL1
9	CHAR-SGB01-020-F-M	454	1132	Floor	FL1
10	CHAR-SGB01-021-F-M	436	1135	Floor	FL1
11	CHAR-SGB01-022-F-M	416	1138	Floor	FL1
12	CHAR-SGB01-023-F-M	494	1146	Floor	FL1
13	CHAR-SGB01-024-F-M	462	1148	Floor	FL1
14	CHAR-SGB01-025-F-M	412	1310	Floor	FL1
15	CHAR-SGB01-026-F-M	444	1311	Floor	FL1
16	CHAR-SGB01-027-F-M	444	1313	Floor	FL1
17	CHAR-SGB01-028-F-M	450	1319	Floor	FL1
18	CHAR-SGB01-029-F-M	389	1320	Floor	FL1
19	CHAR-SGB01-030-F-M	410	1327	Floor	FL1

SURVEYED ON: 9/04/08 by: S. Erickson

Reactor Power - 100%
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 0830
1430

Instrument / Serial No.
2350-1/ 186193

Probe No. / Serial No.
43-68/ PR178065

	cpm	dpm
Amb. Mean	183.8	678
Count Mean	435	1606
Count Median	439	1621
Count Std. Dev.	27	99

436
502
698
786
971
1621
1465
1632
1609
1676
1609
1536
1824
1705
1521
1639
1639
1661
1436
1513

Comments: All points are on concrete floor.
Points 028, 029 and 030 are at ground level elevation - BKG 005 taken at same elevation.
FL1 = 1st floor

416 @ 1345 is a re-do of 027.

BKG = Ambient Background
F-M = Fixed measurements

Log #	Location	Results cpm	Time	Surface	Level
20	CHAR-SGB01-001-BKG	282	1556	BKG	FL2
21	CHAR-SGB01-002-BKG	263	1538	BKG	FL2
22	CHAR-SGB01-003-BKG	303	1540	BKG	FL2
23	CHAR-SGB01-004-BKG	278	1541	BKG	FL2
24	CHAR-SGB01-005-BKG	316	1543	BKG	FL2
25	CHAR-SGB01-031-F-M	564	1546	WCB	FL2
26	CHAR-SGB01-032-F-M	537	1548	WCB	FL2
27	CHAR-SGB01-033-F-M	344	1550	WC	FL2
28	CHAR-SGB01-034-F-M	326	1551	WC	FL2
29	CHAR-SGB01-035-F-M	349	1552	WC	FL2
30	CHAR-SGB01-036-F-M	323	1554	WC	FL2
31	CHAR-SGB01-037-F-M	313	1555	WC	FL2
32	CHAR-SGB01-038-F-M	290	1556	WC	FL2
33	CHAR-SGB01-039-F-M	328	1558	WC	FL2
34	CHAR-SGB01-040-F-M	387	1559	WC	FL2
35	CHAR-SGB01-041-F-M	337	1600	WC	FL2
36	CHAR-SGB01-042-F-M	324	1602	WC	FL2
37	CHAR-SGB01-043-F-M	389	1603	WCB	FL2
38	CHAR-SGB01-044-F-M	470	1605	WCB	FL2
39	CHAR-SGB01-045-F-M	397	1606	WCB	FL2

SURVEYED ON: 8/21/08 by: D. Payeur, S. Erickson

Reactor Power - 100%
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 0945
1640

Instrument / Serial No.
2350-1/ 186199

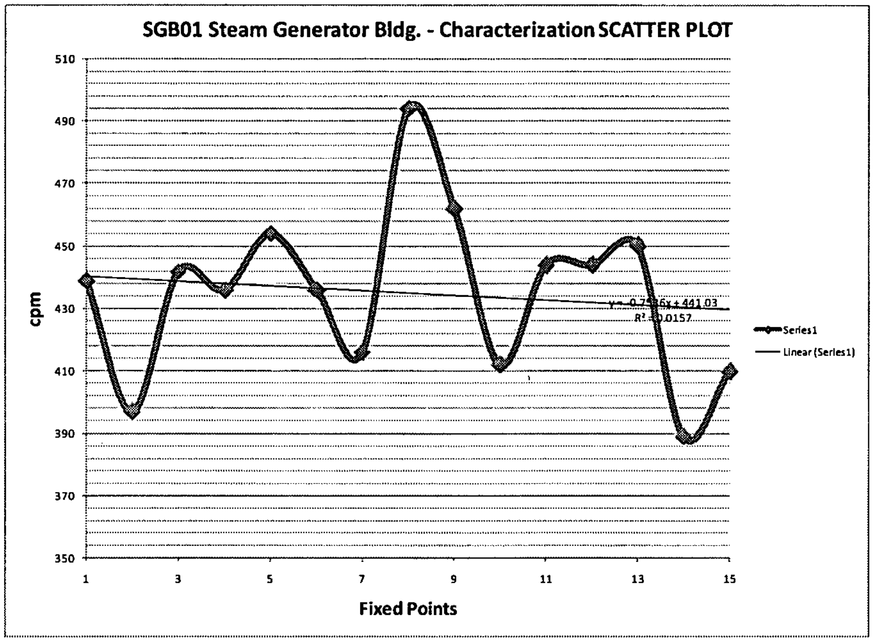
Probe No. / Serial No.
43-68/ PR178065

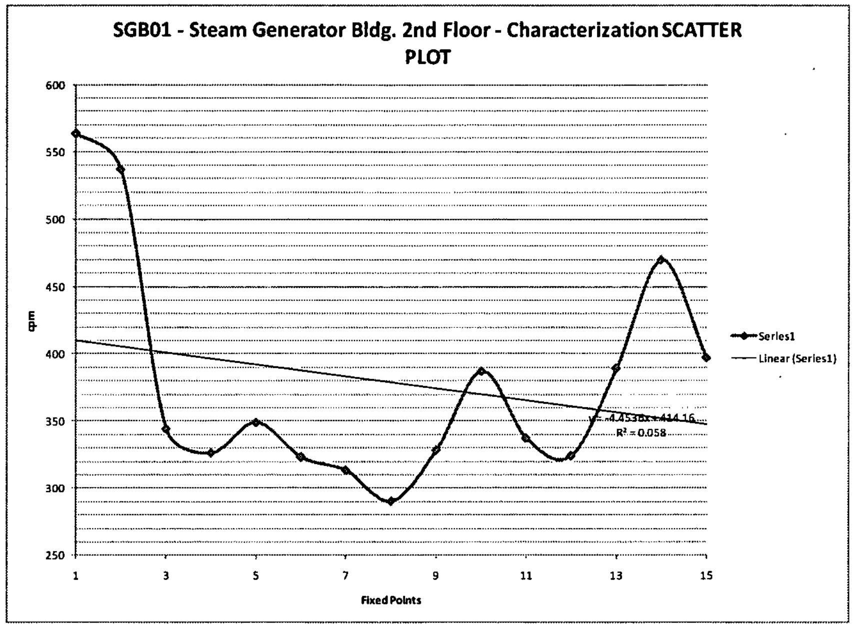
Amb. Mean	1065
Count Mean	1397
Count Median	1270
Count Std. Dev.	305

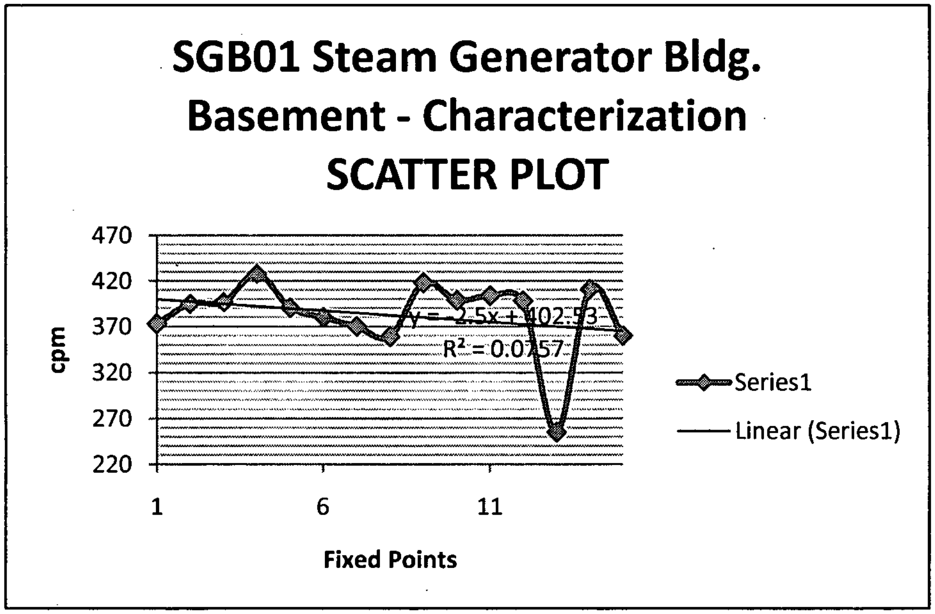
1041
971
1118
1026
1166
2082
1982
1270
1203
1288
1192
1155
1071
1211
1429
1244
1196
1436
1735
1465

Comments:	
	All survey points taken on walls.
	WCB = Wall, Concrete Block
	WC = Wall Concrete
	Floor area is all grating or open space.

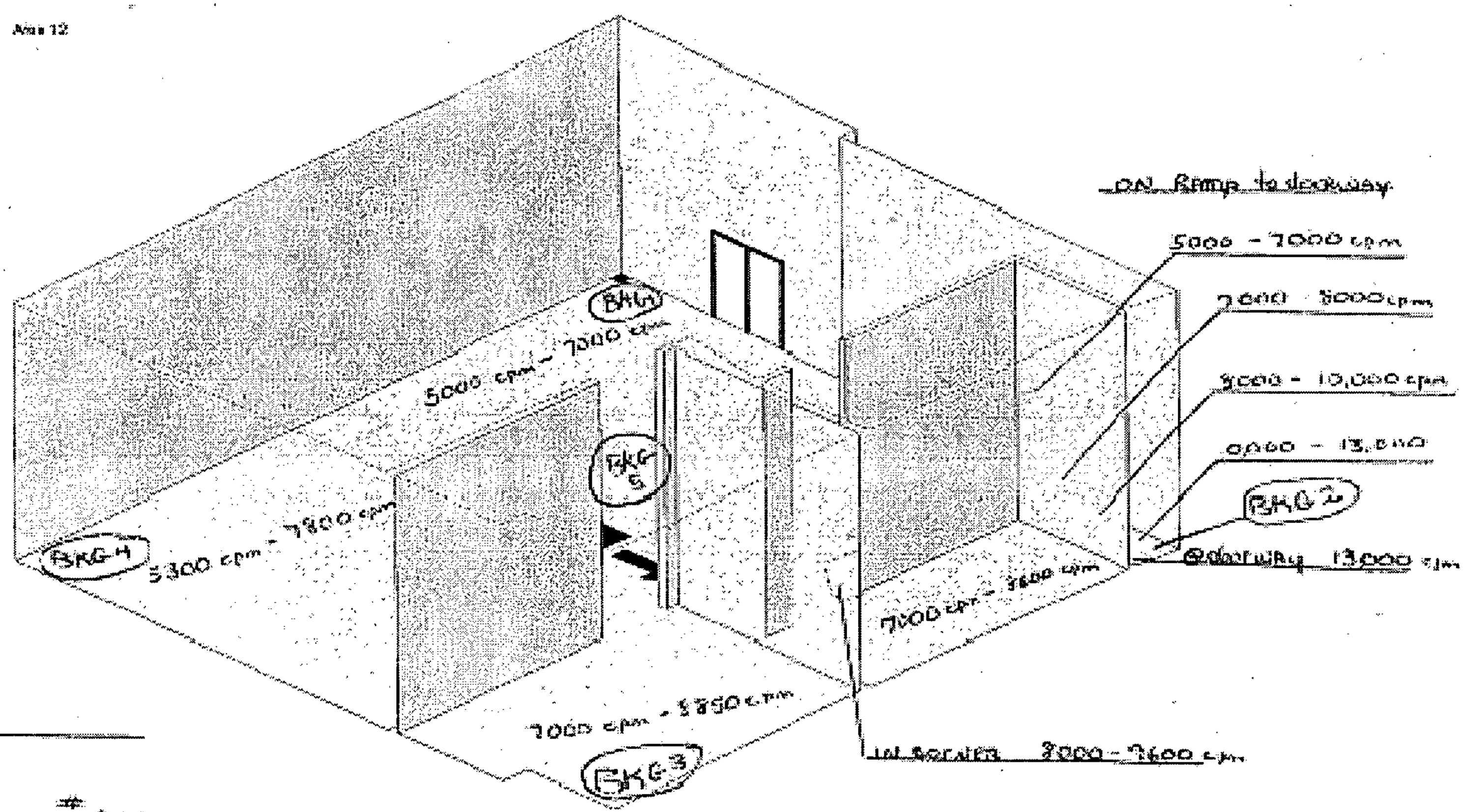
BKG = Ambient Background
F-M = Fixed measurements


SGB01 Steam Generator Bldg. - Characterization SCATTER PLOT
cpm
510
490
470
450
430
410
390
370
350
1
3
5
7
9
11
13
15
Fixed Points
Series1
Linear (Series1)


SGB01 - Steam Generator Bldg. 2nd Floor - Characterization SCATTER PLOT
cpm
600
550
500
450
400
350
300
250
1
3
5
7
9
11
13
15
Fixed Points
R² = 0.058
Series1
Linear (Series1)


SGB01 Steam Generator Bldg. Basement - Characterization SCATTER PLOT
cpm
470
420
370
320
270
220
1
6
11
Fixed Points
Series1
Linear (Series1)

CTB-01 1st Floor South

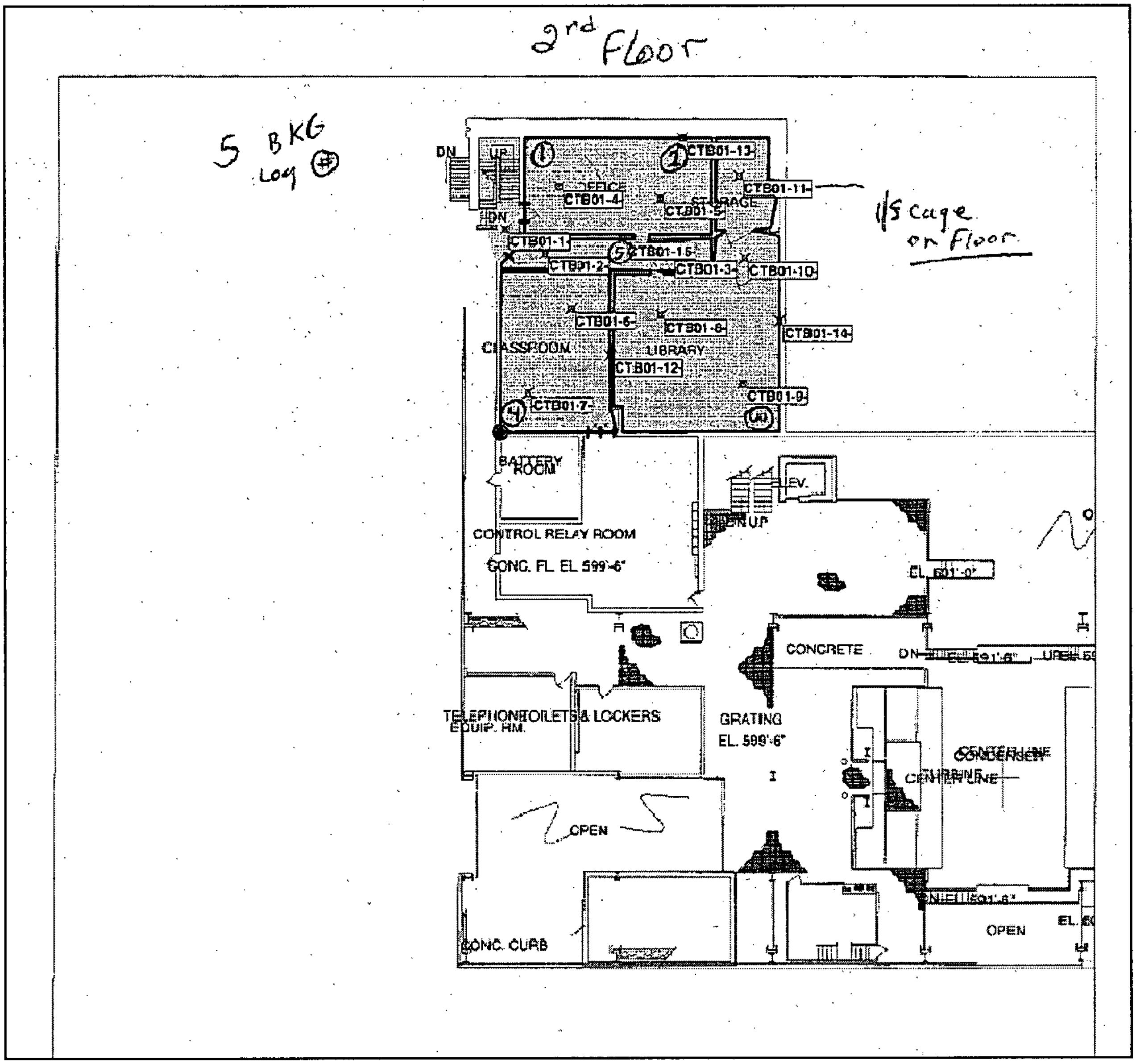


2/18/08

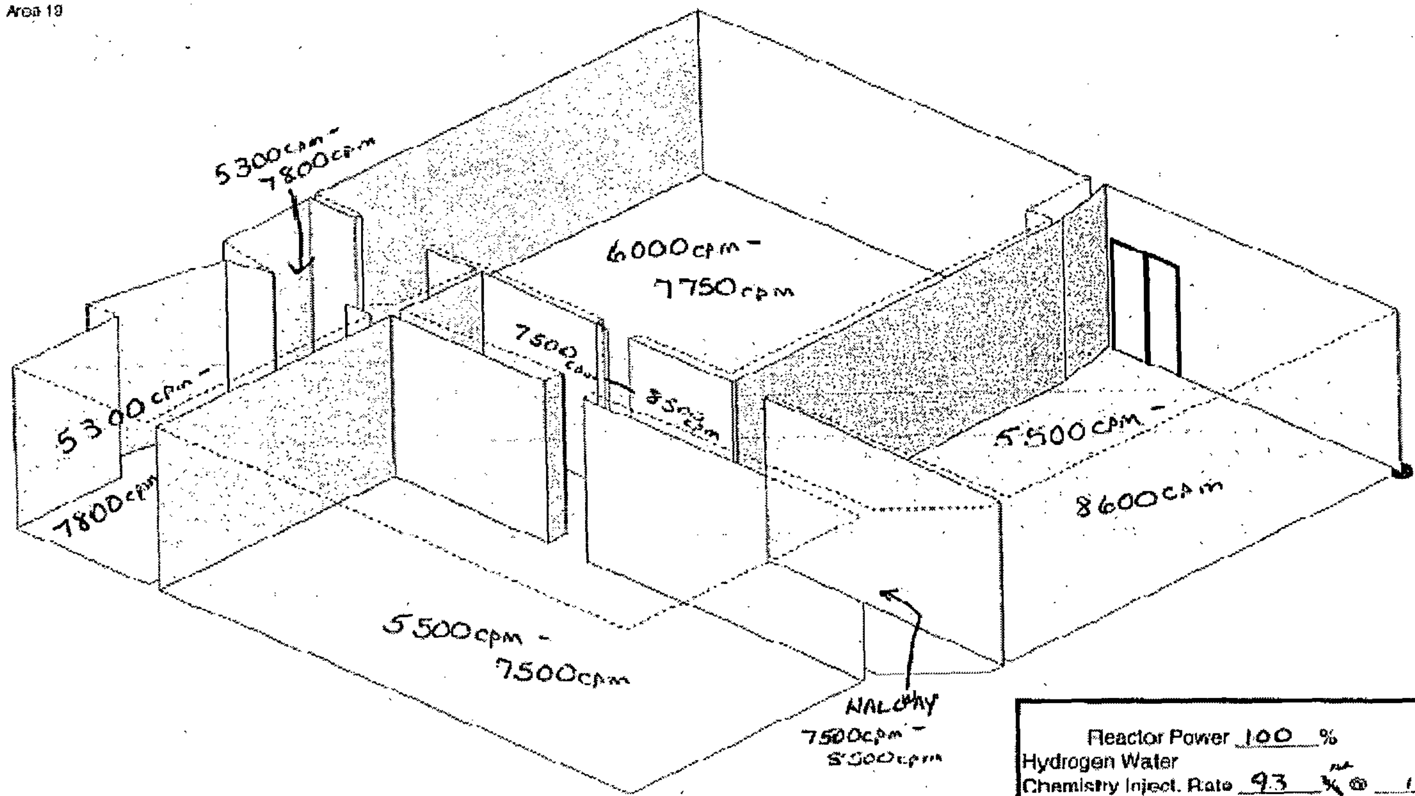
Det 1/SPA 3 # 2081
2350-1 # 189090
Rx Power 100% @ 1000 & 1630
Hydrogen water Chem inj Rate 93 SCFM @ 1000 & 1630

B1 ~ B5 BKGS
Logged as 4 ~ 8

NO ELEVATED READINGS DETECTED
Readings of 5500 cpm ~ 7500 cpm As
no cracks in floor


2nd Floor
5 BKG
Log #
1/5 cage
on Floor
CTB01-13
CTB01-11
CTB01-4
OFFICE
STORAGE
CTB01-5
CTB01-1
CTB01-15
CTB01-2
CTB01-3
CTB01-10
CTB01-6
CTB01-8
CTB01-14
CLASSROOM
LIBRARY
CTB01-12
CTB01-9
CTB01-7
BATTERY ROOM
CONTROL RELAY ROOM
CONC. FL. EL. 599'-6"
CONCRETE
TELEPHONE EQUIP. RM.
TOILETS & LOCKERS
GRATING
EL. 599'-6"
OPEN
CONC. CURB
OPEN

CTB-01 2nd Floor North



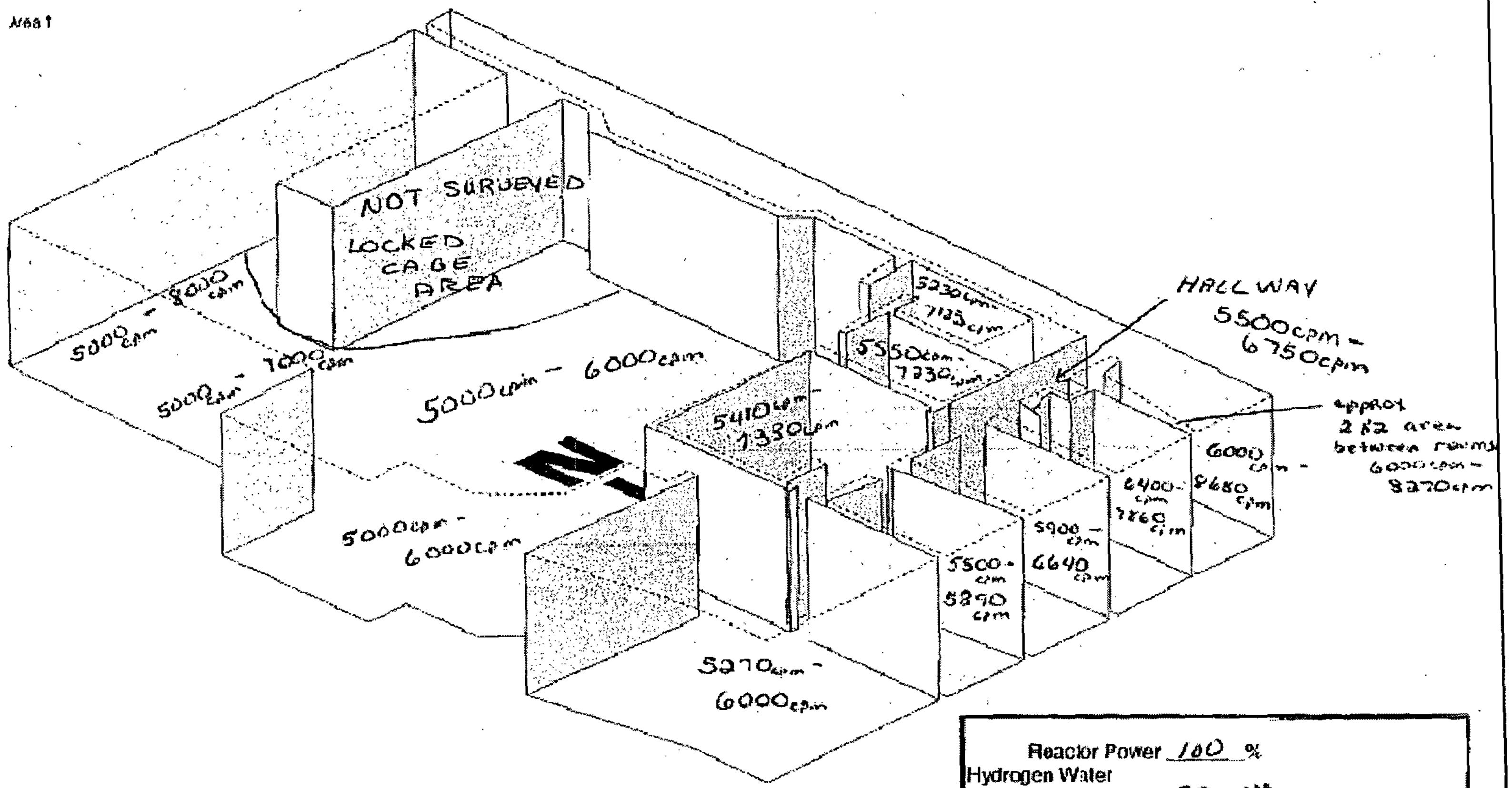
Reactor Power 100 %
Hydrogen Water
Chemistry Inject. Rate 93 % @ 1000
1630

Comments: 8/18/08
NO ELEVATED READINGS DETECTED
READINGS ALONG FLOOR AND CONCRETE WALLS - 6500cpm - 8000cpm

Instrument / Serial No.
2350-1 / 189090

Probe No. / Serial No.
DET 1/SPA 3 / 2081

CTB-01 3rd Floor South



Reactor Power	100 %
Hydrogen Water Chemistry Inject. Rate	93 SCFM @ 1000 1630

Comments: 5/18/08
NO ELEVATED READINGS DETECTED

Instrument / Serial No.	2350-1 / 189090
Probe No. / Serial No.	D1/SPA 3 / 2081

Log #	Location	Results cpm	Date / Time	Surface	Level	Results dpm
3	CHAR-CTB-01-001-BKG	286	8/11/2008 15:42	BKG	1st Floor	1057
4	CHAR-CTB-01-002-BKG	255	8/11/2008 15:44	BKG	1st Floor	943
5	CHAR-CTB-01-003-BKG	272	8/11/2008 15:45	BKG	1st Floor	1006
6	CHAR-CTB-01-004-BKG	281	8/11/2008 15:47	BKG	1st Floor	1039
7	CHAR-CTB-01-005-BKG	277	8/11/2008 15:51	BKG	1st Floor	1024
8	CHAR-CTB-01-001-F-M	371	8/11/2008 15:54	Floor	1st Floor	1372
9	CHAR-CTB-01-002-F-M	373	8/11/2008 15:55	Floor	1st Floor	1379
10	CHAR-CTB-01-003-F-M	356	8/11/2008 15:57	Floor	1st Floor	1316
11	CHAR-CTB-01-004-F-M	264	8/11/2008 15:59	Floor	1st Floor	976
12	CHAR-CTB-01-005-F-M	358	8/11/2008 16:02	Floor	1st Floor	1323
13	CHAR-CTB-01-006-F-M	398	8/11/2008 16:04	Floor	1st Floor	1471
14	CHAR-CTB-01-007-F-M	361	8/11/2008 16:06	Floor	1st Floor	1335
15	CHAR-CTB-01-008-F-M	371	8/11/2008 16:07	Floor	1st Floor	1372
16	CHAR-CTB-01-009-F-M	323	8/11/2008 16:10	Wall 5	1st Floor	1194
17	CHAR-CTB-01-010-F-M	352	8/11/2008 16:12	Wall 4	1st Floor	1301
18	CHAR-CTB-01-011-F-M	368	8/11/2008 16:15	Wall 20	1st Floor	1360
19	CHAR-CTB-01-012-F-M	386	8/11/2008 16:17	Floor	1st Floor	1427
20	CHAR-CTB-01-013-F-M	356	8/11/2008 16:18	Floor	1st Floor	1316
21	CHAR-CTB-01-014-F-M	380	8/11/2008 16:20	Wall 24	1st Floor	1405
23	CHAR-CTB-01-015-F-M	350	8/11/2008 16:23	Wall 4	1st Floor	1294

SURVEYED ON: 8/11/08 by: D. Payeur, S. Erickson

Reactor Power - 100%
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 1300
1730

Instrument / Serial No.
2350-1/ 186193

Probe No. / Serial No.
D3 43-68/ PR178065

Comments:		cpm	dpm
	Bkgd Mean	274	1014
Do not use Log #22 - not at survey point	Area Mean	358	1323
Data Point CTB01-004 is linoleum	Area median	361	1335
	Area Std.dev.	31	116

BKG = Ambient Background
F-M = Fixed measurements

Log #	Location	Results cpm	Date / Time	Surface	Level	dpm/100cm2
0	CHAR-CTB-01-001-BKG	279	8/12/2008 9:34	BKG	2nd Floor	1031
1	CHAR-CTB-01-002-BKG	233	8/12/2008 9:36	BKG	2nd Floor	861
2	CHAR-CTB-01-003-BKG	260	8/12/2008 9:39	BKG	2nd Floor	961
3	CHAR-CTB-01-004-BKG	312	8/12/2008 9:43	BKG	2nd Floor	1153
4	CHAR-CTB-01-005-BKG	277	8/12/2008 9:45	BKG	2nd Floor	1024
5	CHAR-CTB-01-016-F-M	398	8/12/2008 9:54	Floor	2nd Floor	1471
6	CHAR-CTB-01-017-F-M	312	8/12/2008 9:55	Floor	2nd Floor	1153
7	CHAR-CTB-01-018-F-M	285	8/12/2008 9:58	Floor	2nd Floor	1054
8	CHAR-CTB-01-019-F-M	303	8/12/2008 10:00	Floor	2nd Floor	1120
9	CHAR-CTB-01-020-F-M	304	8/12/2008 10:02	Floor	2nd Floor	1124
10	CHAR-CTB-01-021-F-M	280	8/12/2008 10:05	Floor	2nd Floor	1035
11	CHAR-CTB-01-022-F-M	319	8/12/2008 10:07	Floor	2nd Floor	1179
12	CHAR-CTB-01-023-F-M	288	8/12/2008 10:09	Floor	2nd Floor	1065
13	CHAR-CTB-01-024-F-M	296	8/12/2008 10:11	Floor	2nd Floor	1094
14	CHAR-CTB-01-025-F-M	272	8/12/2008 10:14	Floor	2nd Floor	1006
15	CHAR-CTB-01-026-F-M	278	8/12/2008 10:16	Floor	2nd Floor	1028
16	CHAR-CTB-01-027-F-M	199	8/12/2008 10:19	Wall 40	2nd Floor	736
17	CHAR-CTB-01-028-F-M	179	8/12/2008 10:22	Wall 3	2nd Floor	662
18	CHAR-CTB-01-029-F-M	363	8/12/2008 10:25	Wall 31	2nd Floor	1342
19	CHAR-CTB-01-030-F-M	354	8/12/2008 10:27	Wall 49	2nd Floor	1309

SURVEYED ON: 8/12/08 by: D. Payeur, S. Erickson

Reactor Power - 100%
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 0755
1730

Instrument / Serial No.
2350-1/ 186193

Probe No. / Serial No.
D3 43-68/ PR178065

Comments:		cpm	dpm
BKG = Ambient Background	Bkgd Mean	272	1006
F-M = Fixed measurements	Area Mean	295	1092
	Area median	296	1094
	Area Std.dev	56	206

Log #	Location	Results cpm	Date / Time	Surface	Level	dpm/100cm2
20	CHAR-CTB-01-001-BKG	306	8/12/2008 10:39	BKG	3rd Floor	1131
21	CHAR-CTB-01-002-BKG	259	8/12/2008 10:42	BKG	3rd Floor	957
22	CHAR-CTB-01-003-BKG	272	8/12/2008 10:44	BKG	3rd Floor	1006
23	CHAR-CTB-01-004-BKG	239	8/12/2008 10:46	BKG	3rd Floor	884
24	CHAR-CTB-01-005-BKG	258	8/12/2008 10:48	BKG	3rd Floor	954
25	CHAR-CTB-01-031-F-M	325	8/12/2008 10:55	Floor	3rd Floor	1201
26	CHAR-CTB-01-032-F-M	269	8/12/2008 10:56	Floor	3rd Floor	994
27	CHAR-CTB-01-033-F-M	270	8/12/2008 10:58	Floor	3rd Floor	998
28	CHAR-CTB-01-034-F-M	267	8/12/2008 11:00	Floor	3rd Floor	987
29	CHAR-CTB-01-035-F-M	285	8/12/2008 11:02	Floor	3rd Floor	1054
30	CHAR-CTB-01-036-F-M	349	8/12/2008 11:04	Floor	3rd Floor	1290
31	CHAR-CTB-01-037-F-M	301	8/12/2008 11:06	Floor	3rd Floor	1113
32	CHAR-CTB-01-038-F-M	280	8/12/2008 11:08	Floor	3rd Floor	1035
33	CHAR-CTB-01-039-F-M	329	8/12/2008 11:10	Floor	3rd Floor	1216
34	CHAR-CTB-01-040-F-M	293	8/12/2008 11:12	Floor	3rd Floor	1083
35	CHAR-CTB-01-041-F-M	302	8/12/2008 11:14	Floor	3rd Floor	1116
36	CHAR-CTB-01-042-F-M	271	8/12/2008 11:16	Floor	3rd Floor	1002
37	CHAR-CTB-01-043-F-M	281	8/12/2008 11:17	Floor	3rd Floor	1039
38	CHAR-CTB-01-044-F-M	245	8/12/2008 11:19	Floor	3rd Floor	906
39	CHAR-CTB-01-045-F-M	304	8/12/2008 11:22	Floor	3rd Floor	1124

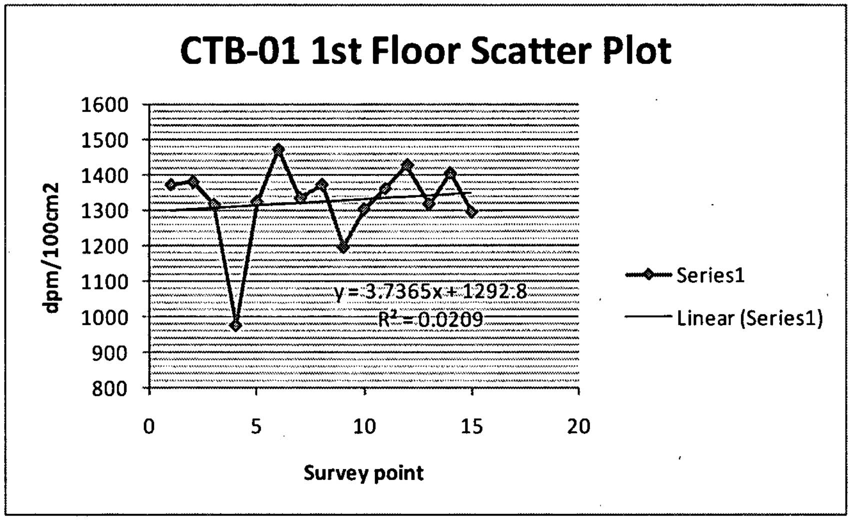
SURVEYED ON: 8/12/08 by: D. Payeur, S. Erickson

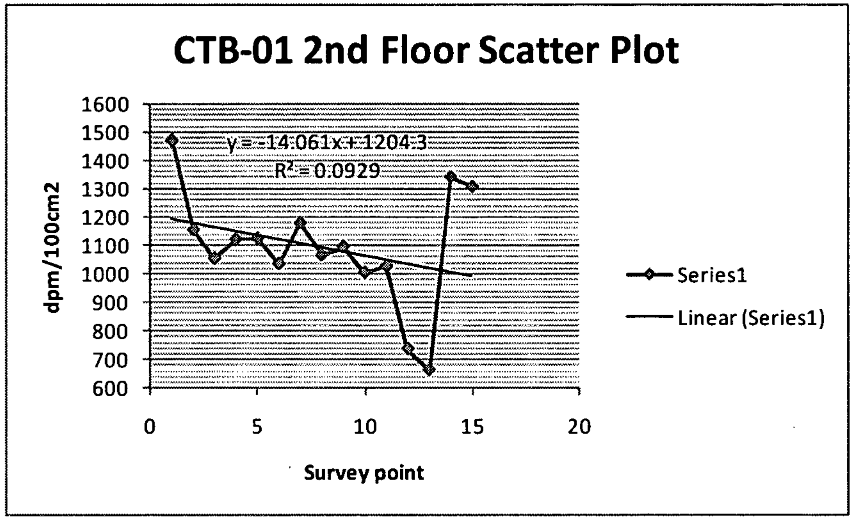
Reactor Power - 100%
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 0755
1730

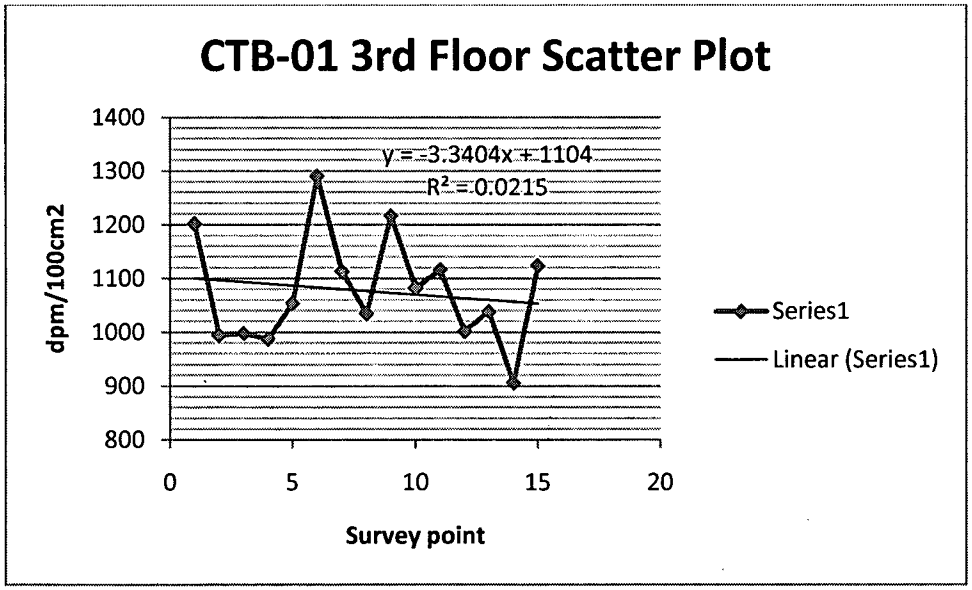
Instrument / Serial No.
2350-1/ 186193

Probe No. / Serial No.
D3 43-68/ PR178065

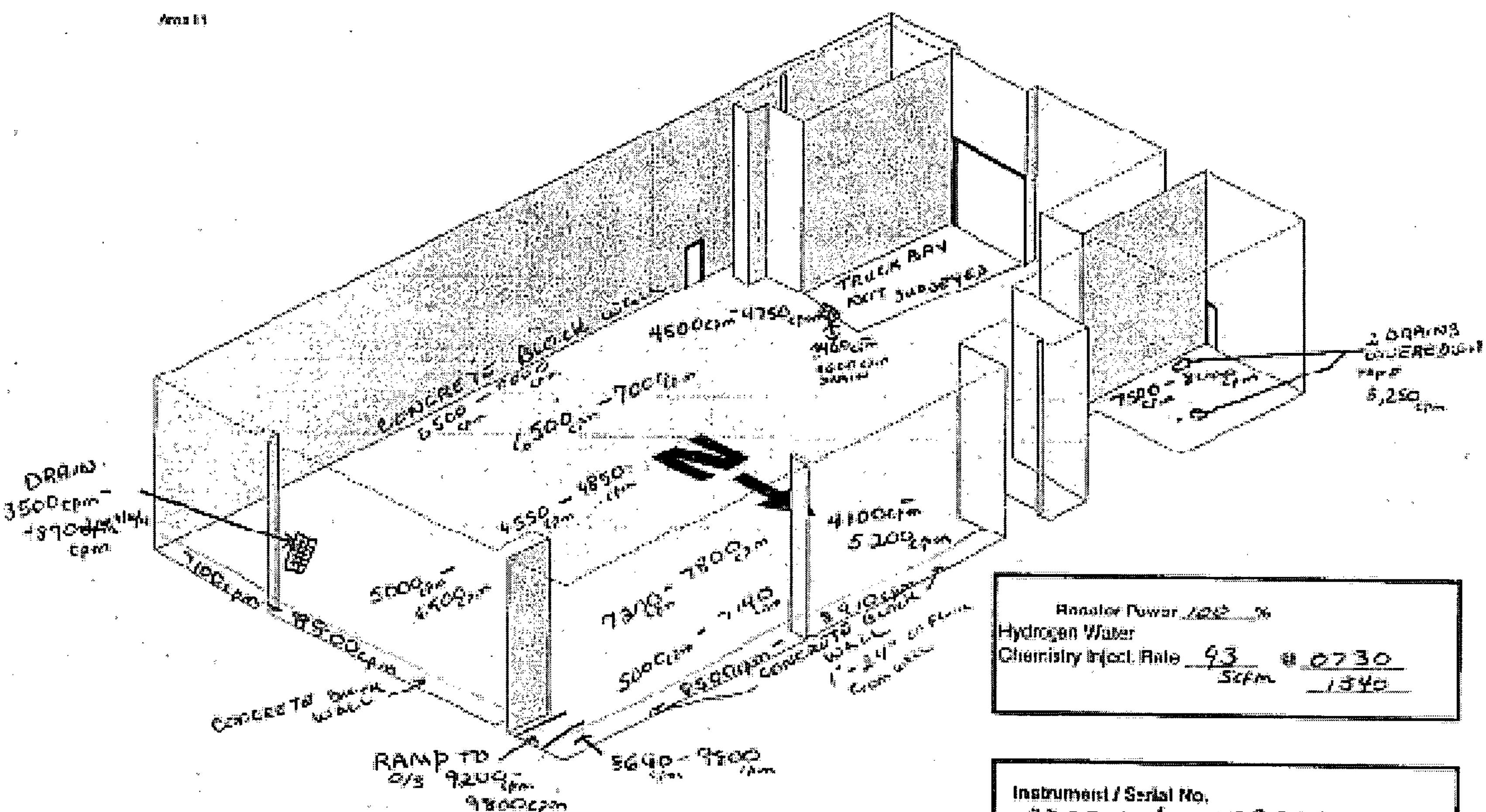
Comments:		cpm	dpm
BKG = Ambient Background	Bkgd Mean	267	986
F-M = Fixed measurements	Area Mean	291	1077
	Area median	285	1054
	Area Std.dev	28	102


CTB-01 1st Floor Scatter Plot
dpm/100cm2
Survey point
y = 3.7365x + 1292.8
R^2 = 0.0209
Series1
Linear (Series1)


CTB-01 2nd Floor Scatter Plot
dpm/100cm2
Survey point
y = -14.061x + 1204.3
R^2 = 0.0929
Series1
Linear (Series1)


CTB-01 3rd Floor Scatter Plot
dpm/100cm2
Survey point
y = -3.3404x + 1104
R^2 = 0.0215
Series1
Linear (Series1)

TBN-01 1st Floor South



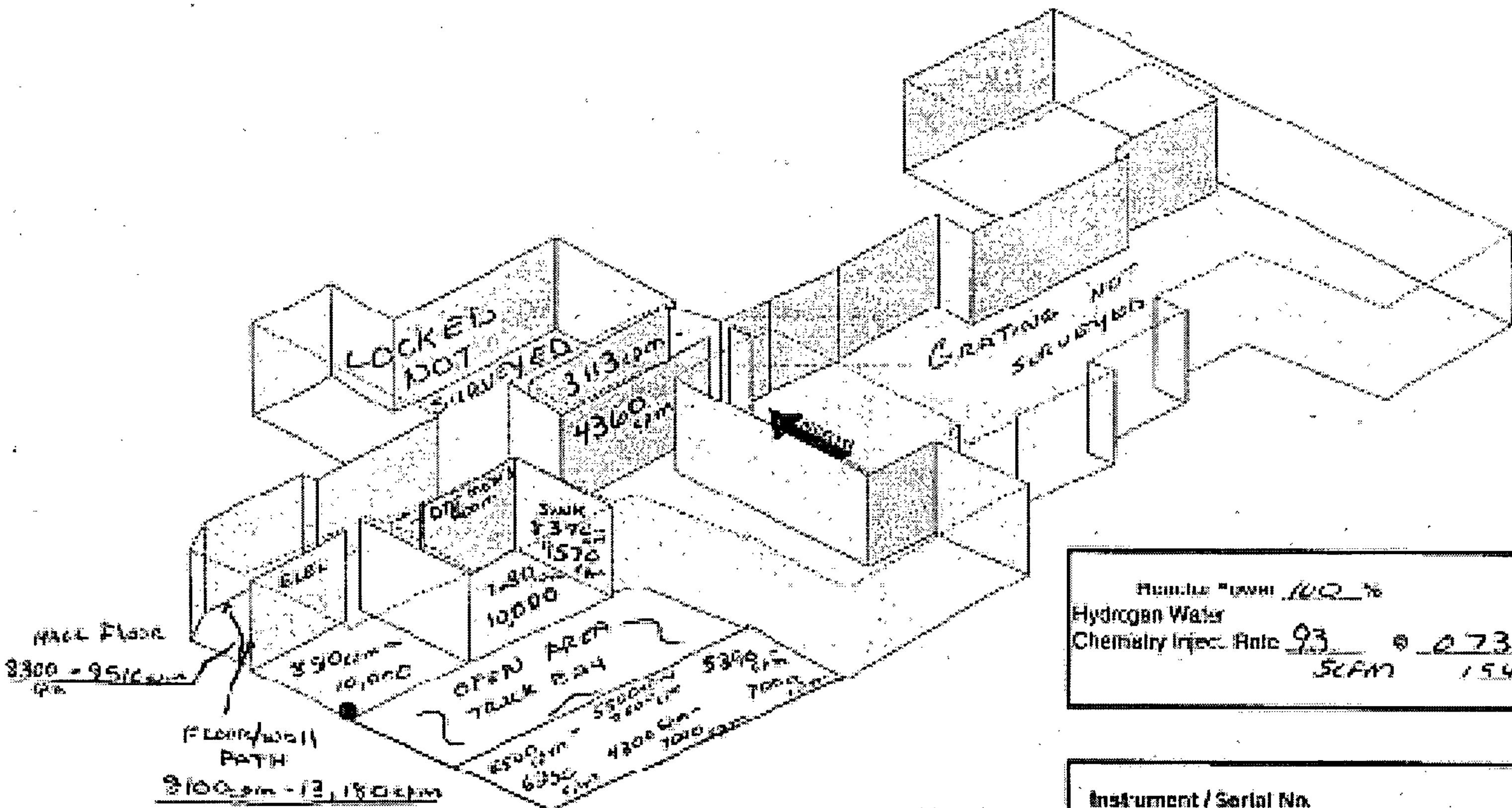
Reactor Power	100 %
Hydrogen Water Chemistry Inject. Rate	43 Scfm @ 0730 1340

Instrument / Serial No.	2350-1 / 189070
Probe No. / Serial No.	01/SPA-3 / 2081

Comments: 8/19/08 DP/se
NO ELEVATED READINGS > BKG DETECTED
BKGs ARE NOTED IN RANGES OF cpm AS FOUND ON MAP ABOVE

TBN-01 2nd Floor North

Area 17



Reactor Power 100 %
Hydrogen Water
Chemistry Inject. Rate 93 @ 0730
SCFM 1540

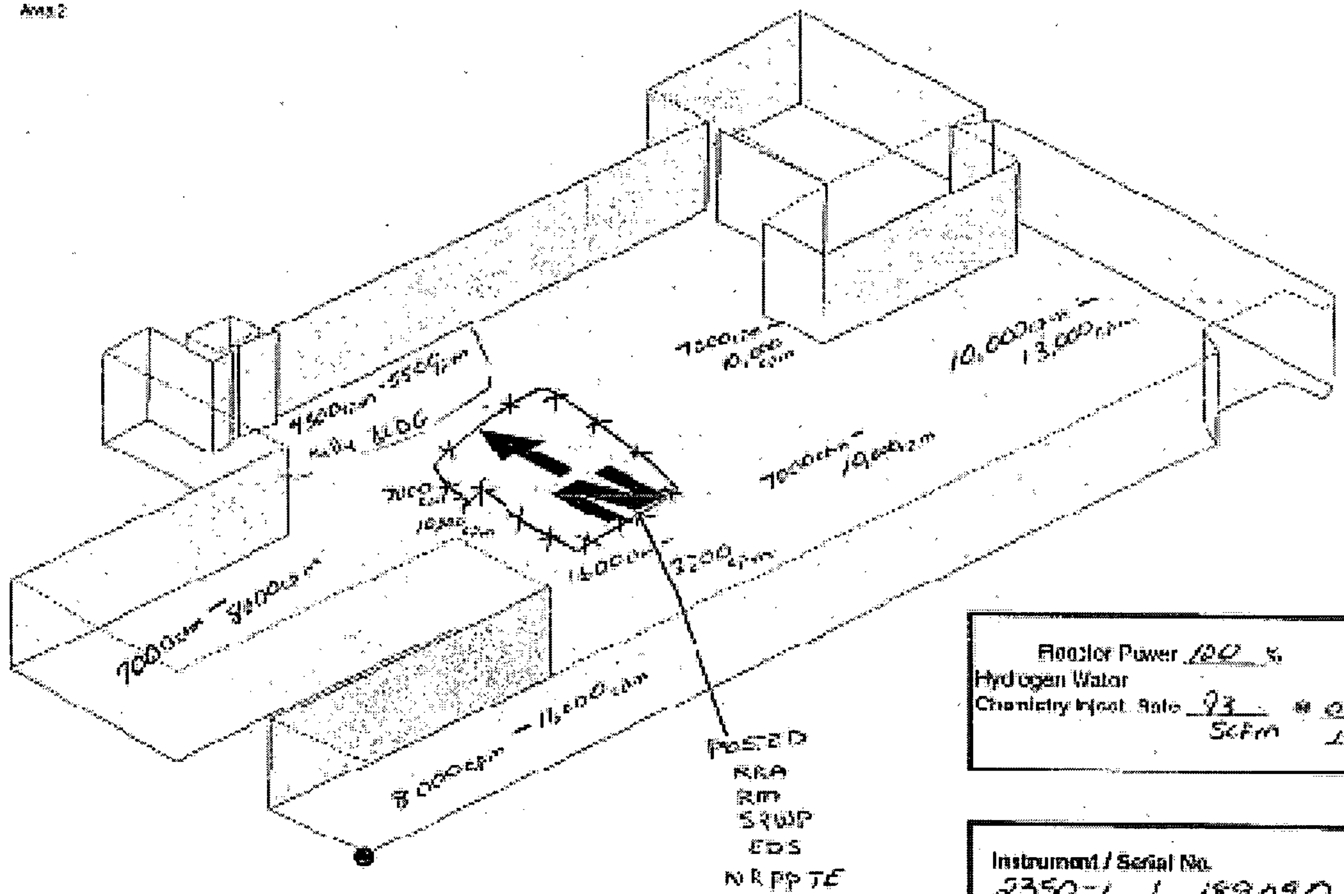
Instrument / Serial No.
2350-1 / 189090

Probe No. / Serial No.
D1 / BM3 / 2081

Comments: 5/19/08 DP/sa
OTC MEN'S ROOM - TILE FLOOR
FLOOR/WALL path in HALL IS CONCRETE BLOCKS WALL
NO ELEVATED READINGS DETECTED > BKG
BKGs are noted in Ranges of cpm as found on map above

TBN-III 3rd Floor North

Area 2



Reactor Power 100 %
Hydrogen Water
Chemistry Inject. Rate 93 SCFM @ 0730 1540

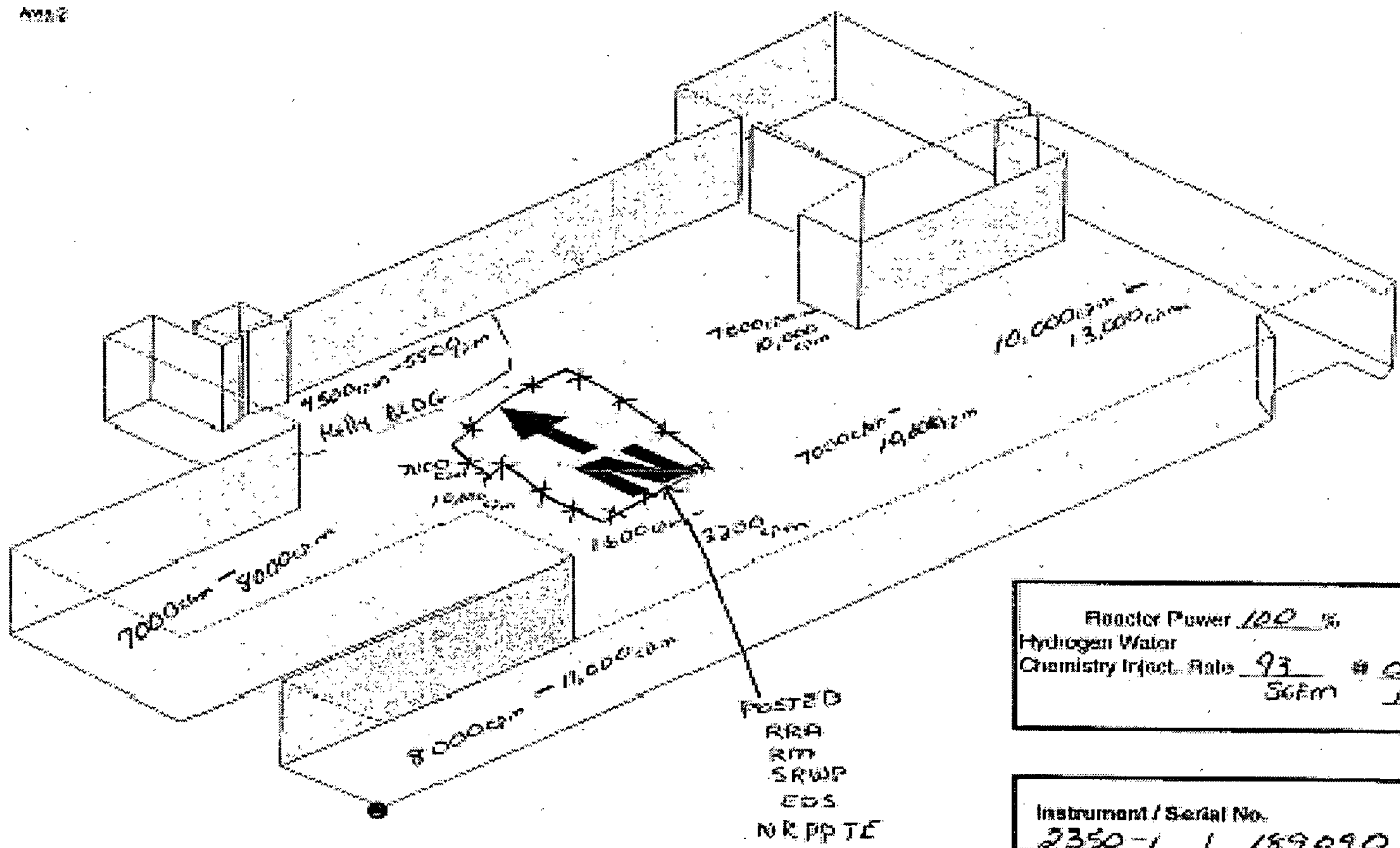
Instrument / Serial No.
2350-1 / 189090

Probe No. / Serial No.
DI/SPA3 / 9081

Comments: 5/19/08 DP/SE
NO ELEVATED READINGS >BKG DETECTED

TBN-01 3rd Floor North

Area 2



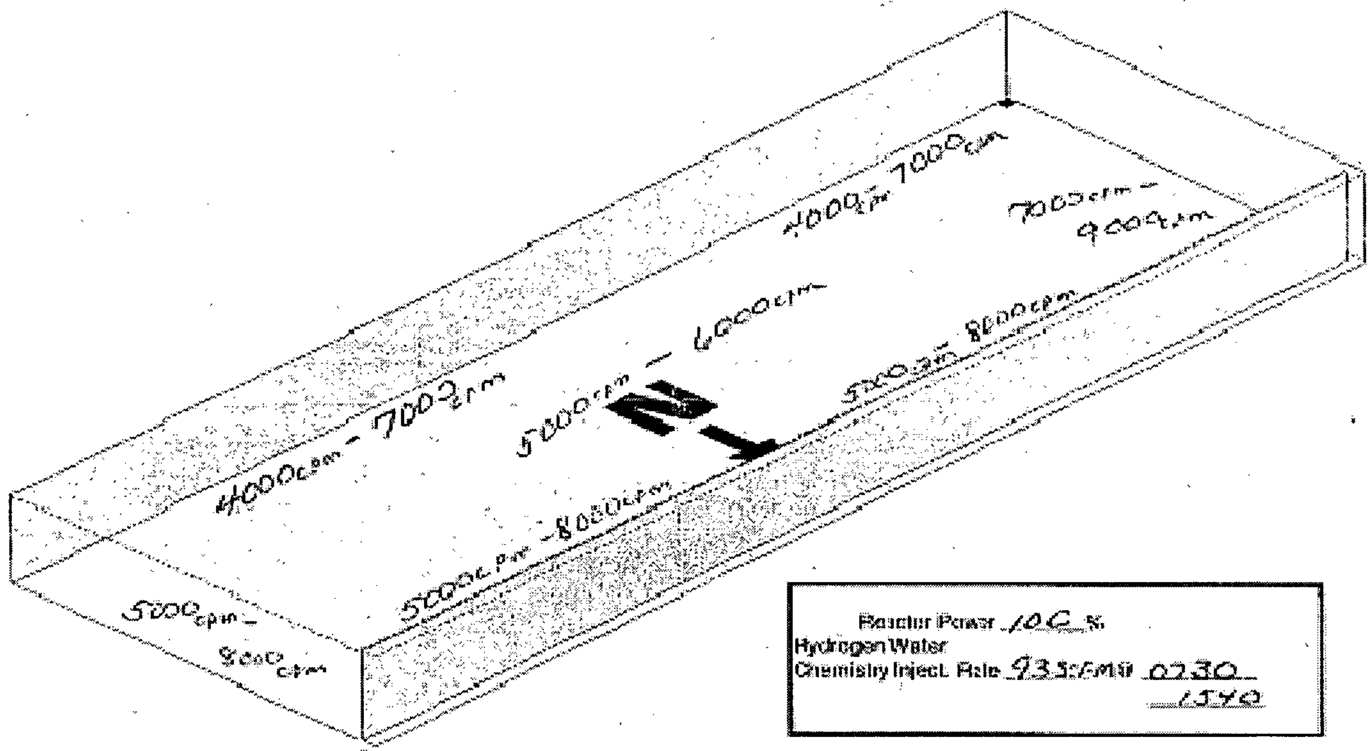
Reactor Power 100 %
Hydrogen Water
Chemistry Inject. Rate 93 @ 0730
SCFM 1540

Instrument / Serial No.
2350-1 / 189090

Probe No. / Serial No.
D1 / SPA 3 / 2081

Comments: 5/19/08 DP/SC
NO ELEVATED READINGS >BKG DETECTED

TBN-01 4th Floor South



Reactor Power 100 %
Hydrogen Water Chemistry Inject. Rate 93 SCFM @ 0230 / 1540

Instrument / Serial No.
2350-1 / 159090

Probe No. / Serial No.
D1/SA93 / 2081

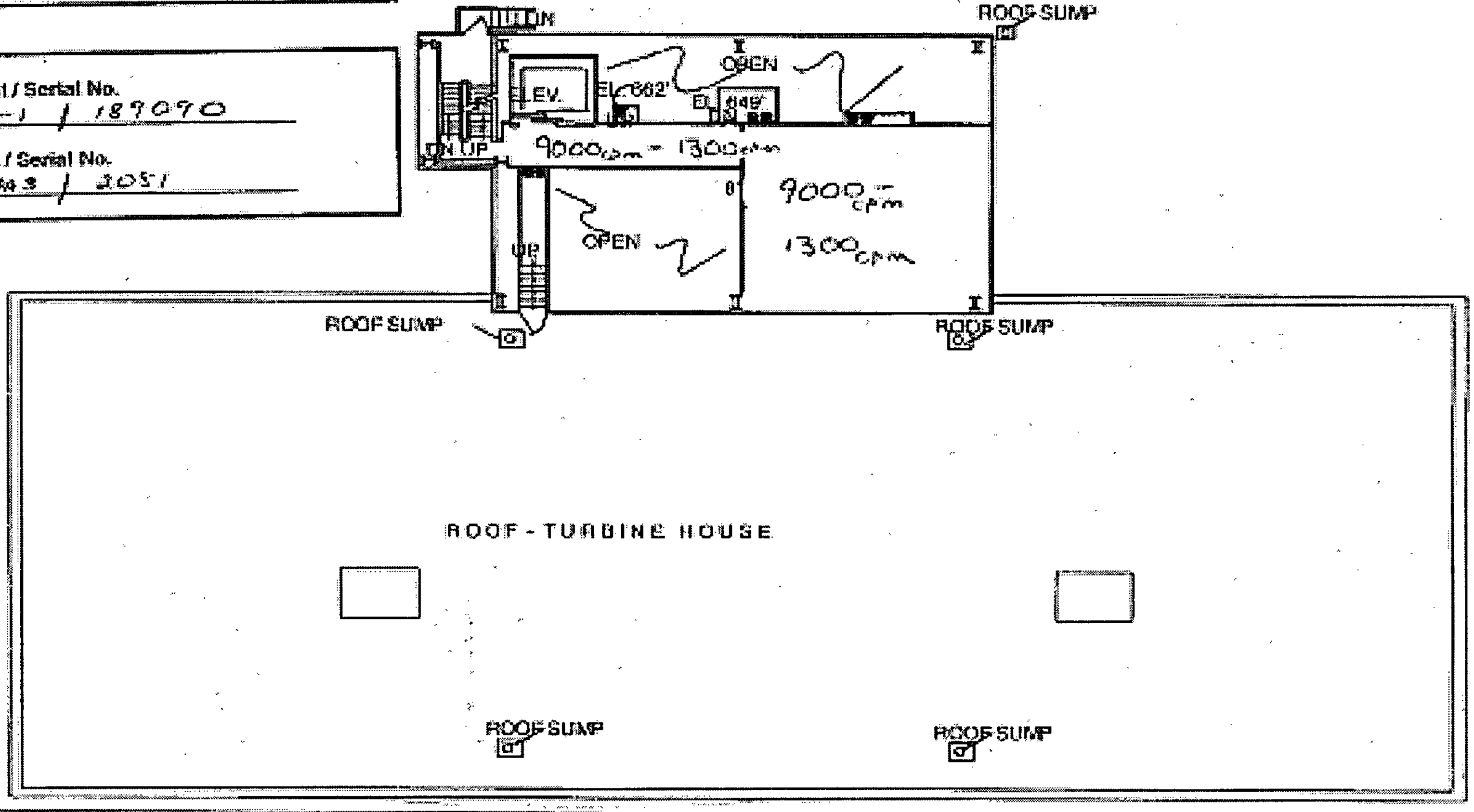
Comments: 5/19/08
NO READINGS > BKG DETECTED
BKGS are noted in Ranges of cpm as found on map above.
Ae

Reactor Power 100 %
Hydrogen Water
Chemistry Inject. Rate 93 SCFM @ 0730
1540

Instrument / Serial No.
2350-1 / 189090

Probe No. / Serial No.
DP 1 / SAAS / 2051

TBN01 5th Floor

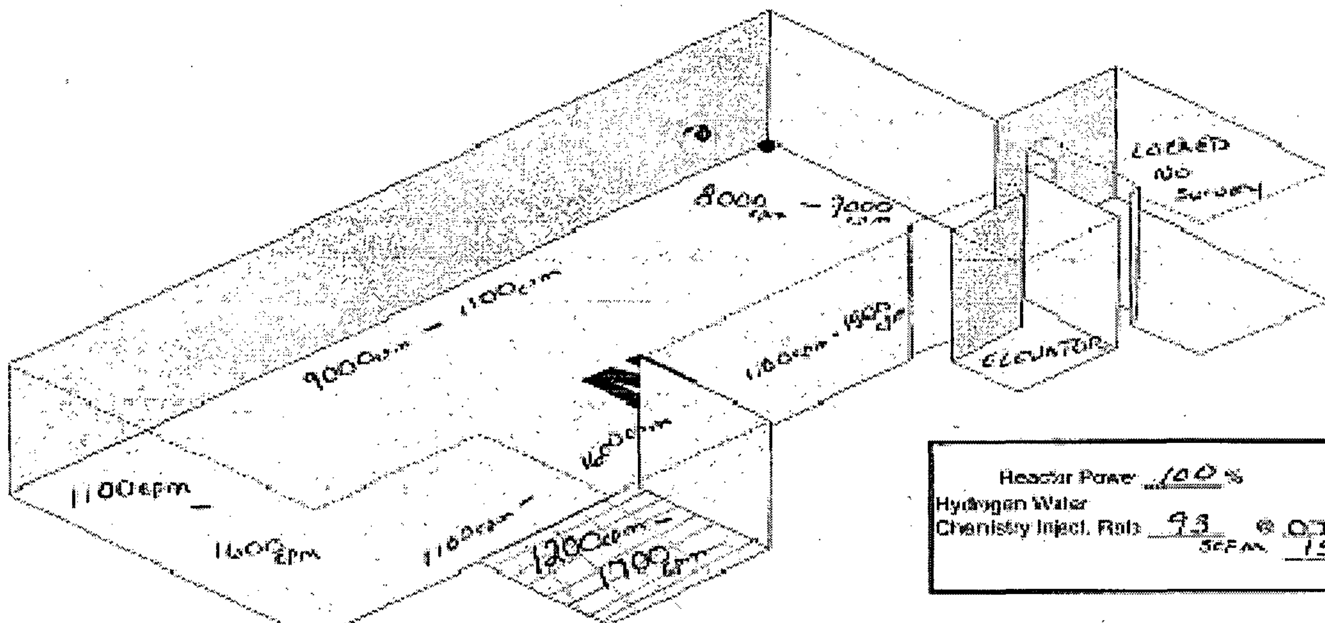


Comments: 5/19/02
NO ELEVATED READINGS >BKG DETECTED
BKGs ARE NOTED IN RANGES of cpm AS FOUND ON MAP
ABOVE

DJP/ae

TBN-01 6th Floor South

Area 1

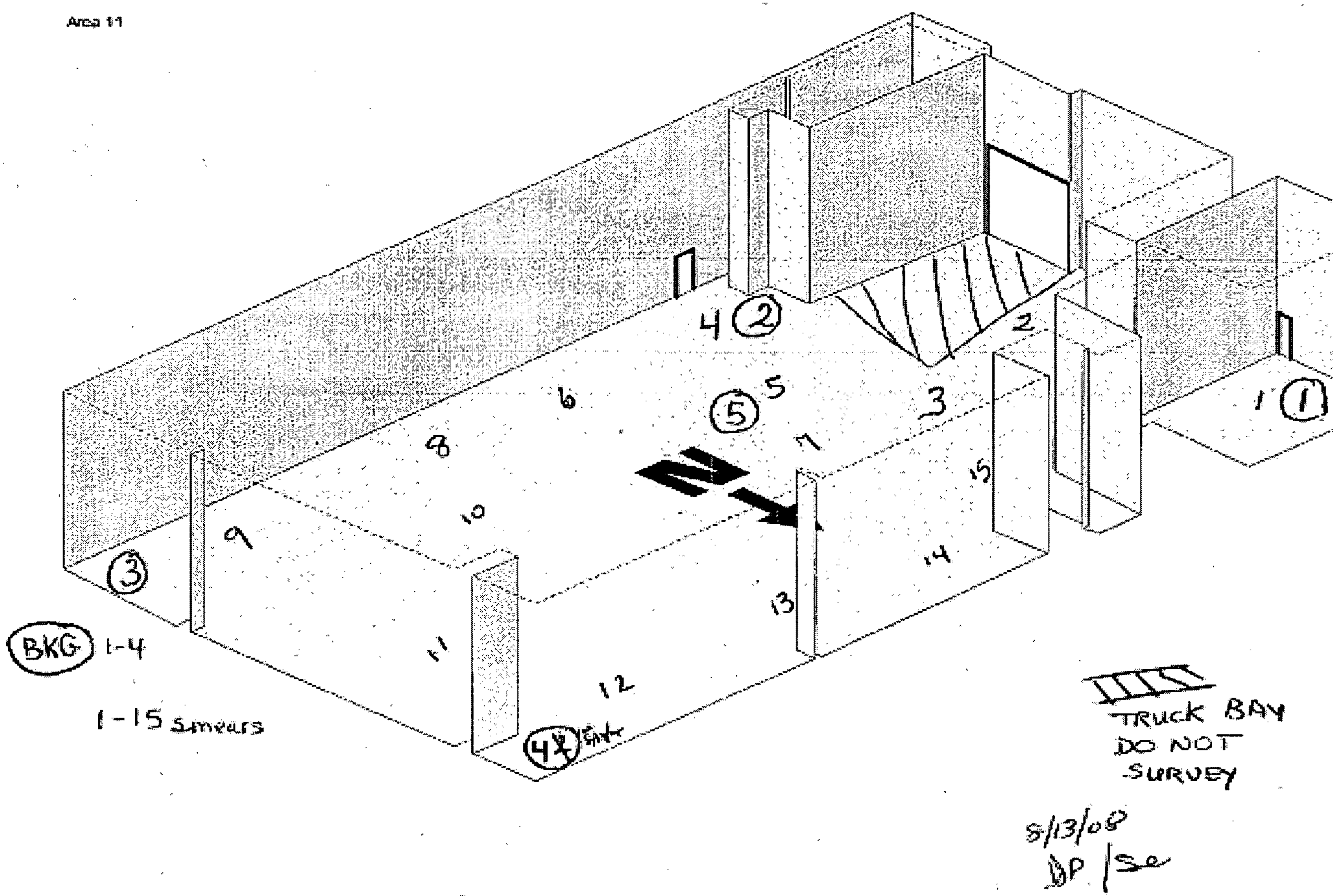


Reactor Power 100 %
Hydrogen Water Chemistry Inject. Rate 93 SCFM @ 0730 1540

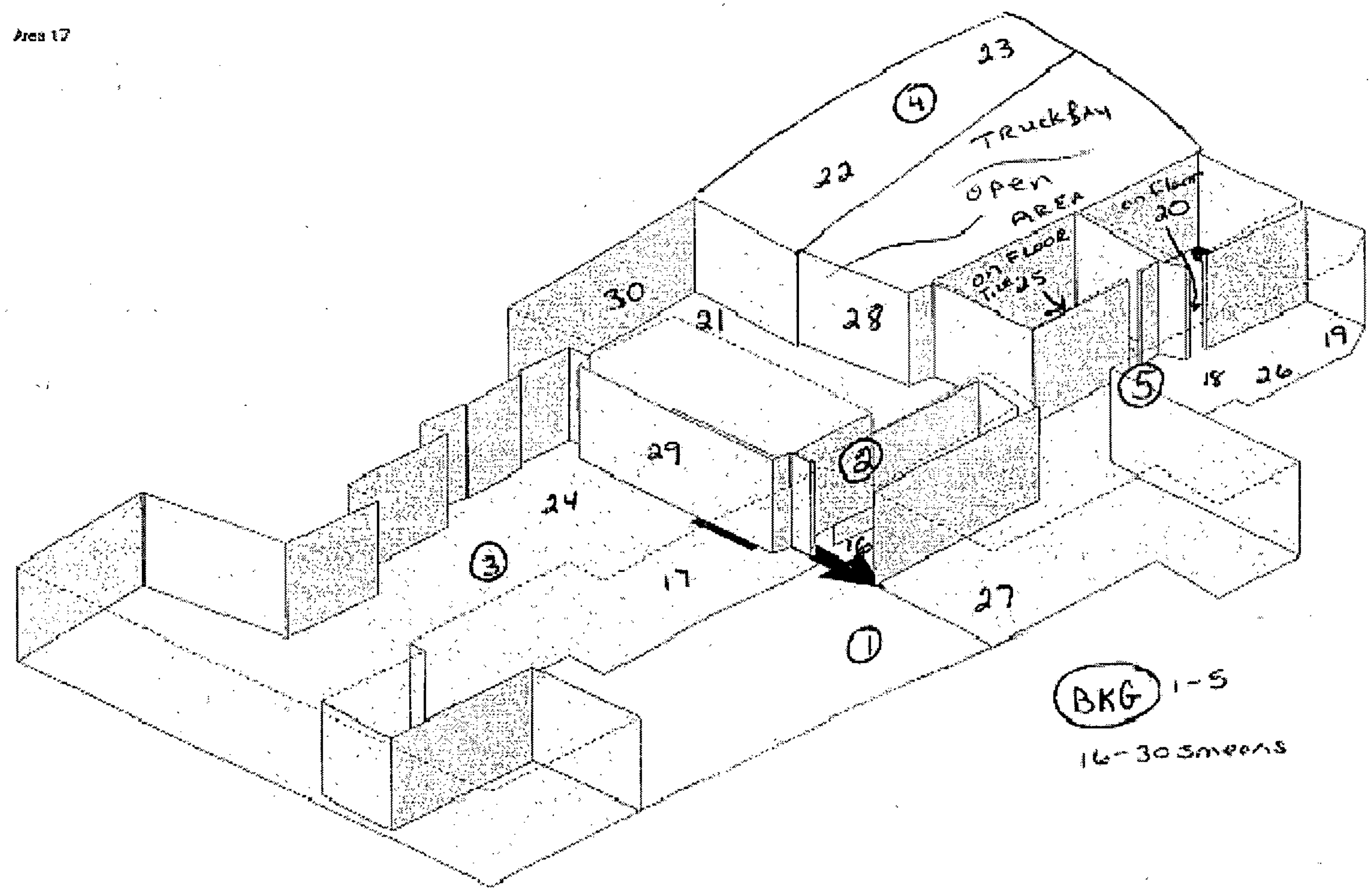
Instrument / Serial No. 2350-1 / 181090
Probe No. / Serial No. D/15PA 3 / 2071

Comments: 8/19/08
TBN = GRATING
NO ELEVATED READINGS > BKG Detected
BKGs are noted in ranges of cpm as found on map above
DP / AA

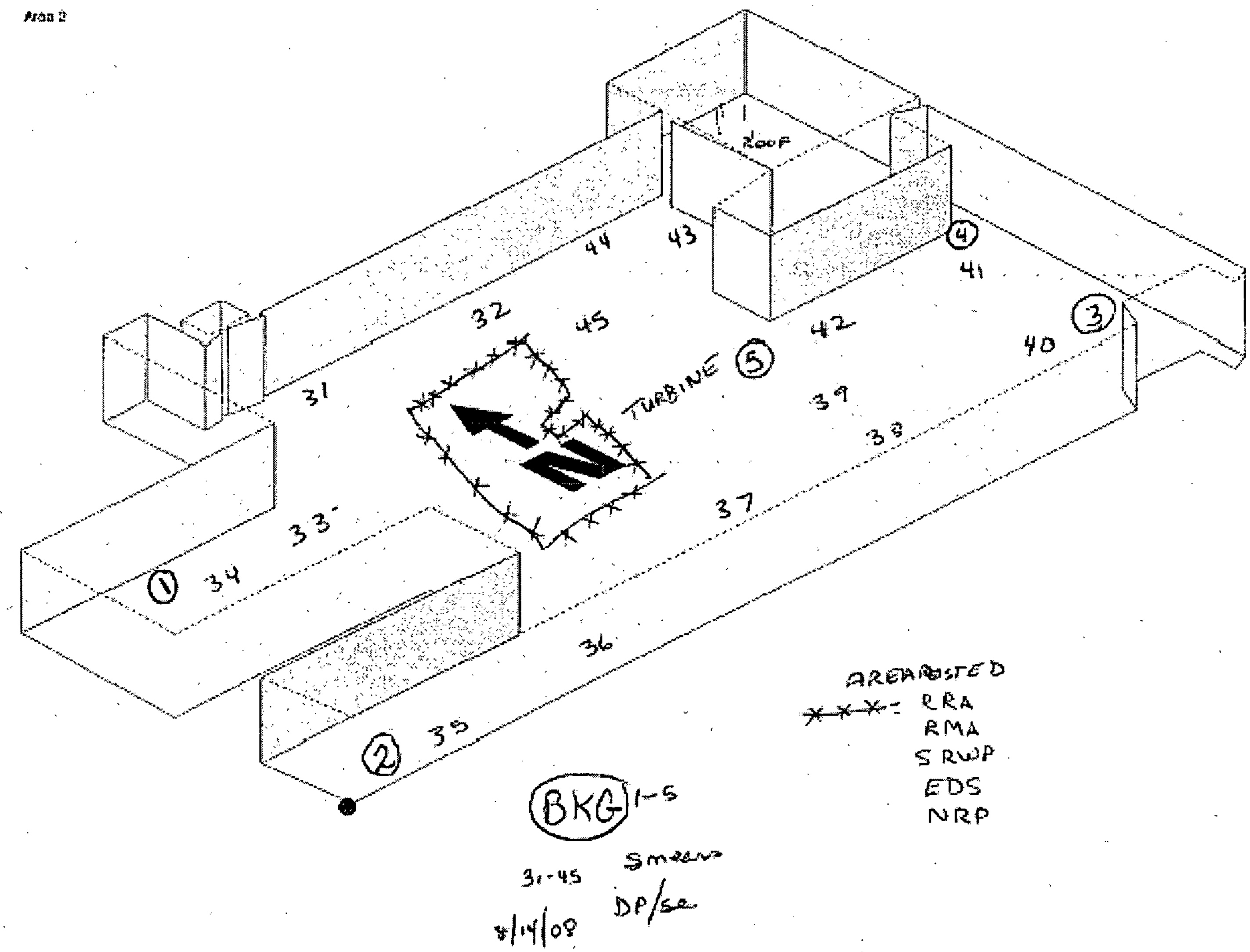
TBN-01 1st Floor South



TBN-01 2nd Floor South



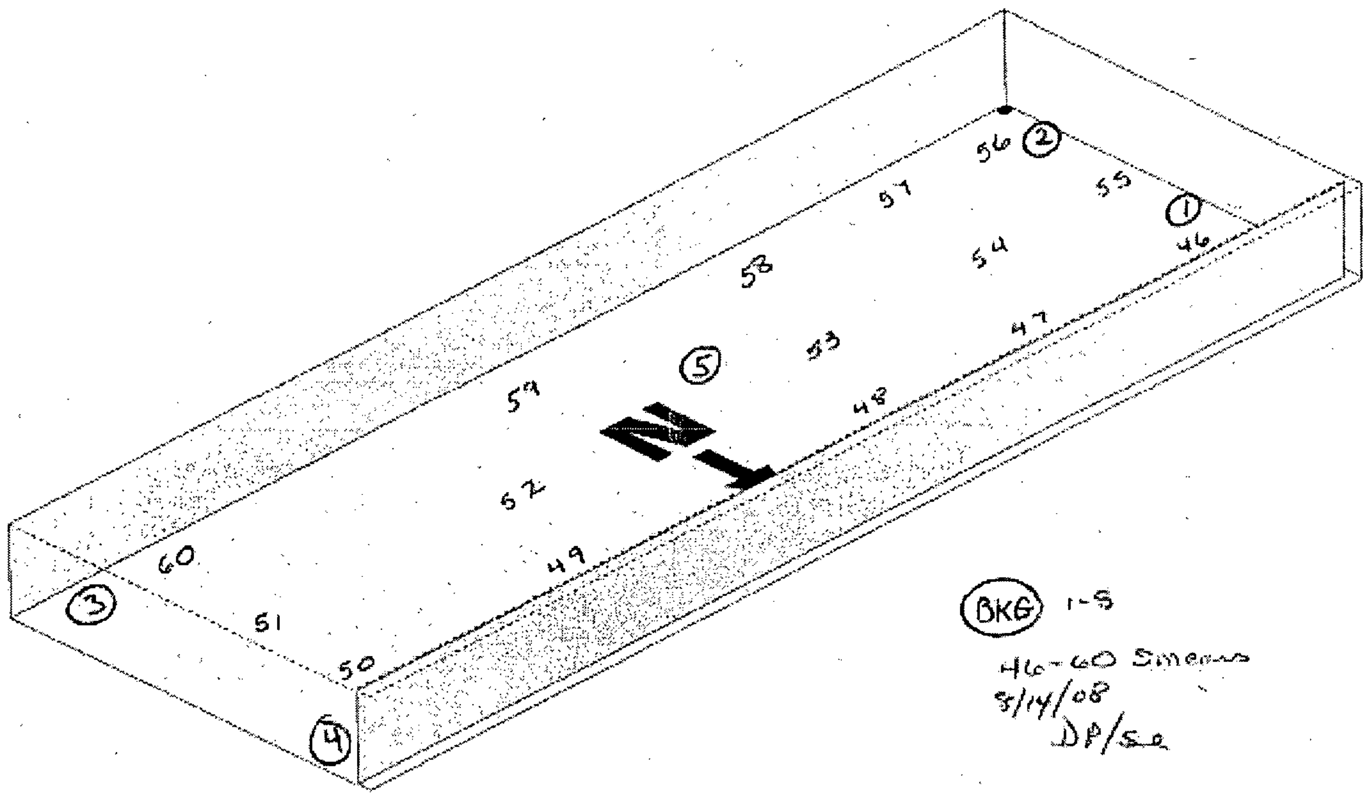
TBN-01 3rd Floor North



TBN-01 4th Floor South

Area 15

46-60

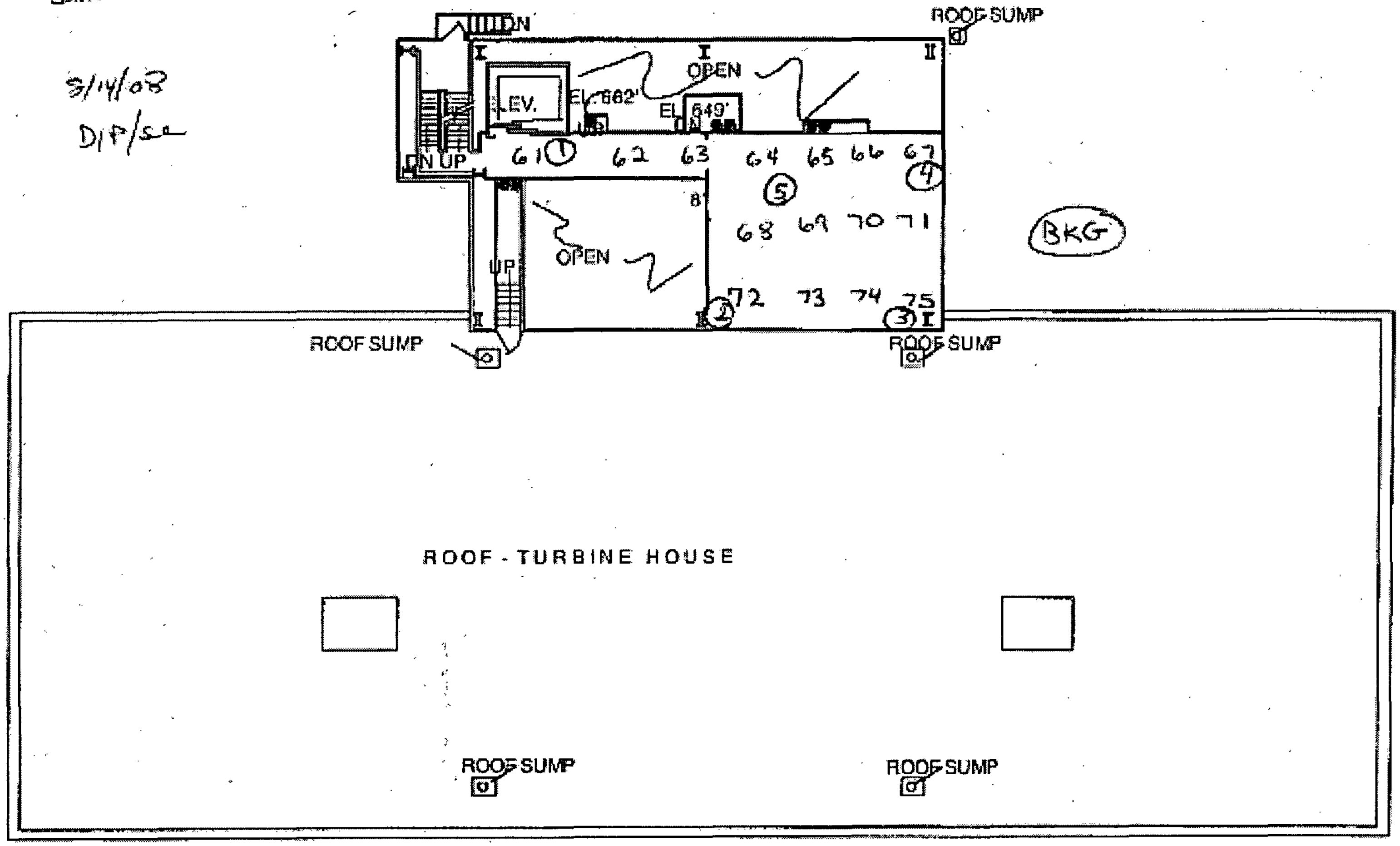


TBN01 5th Floor

BKG 1-5

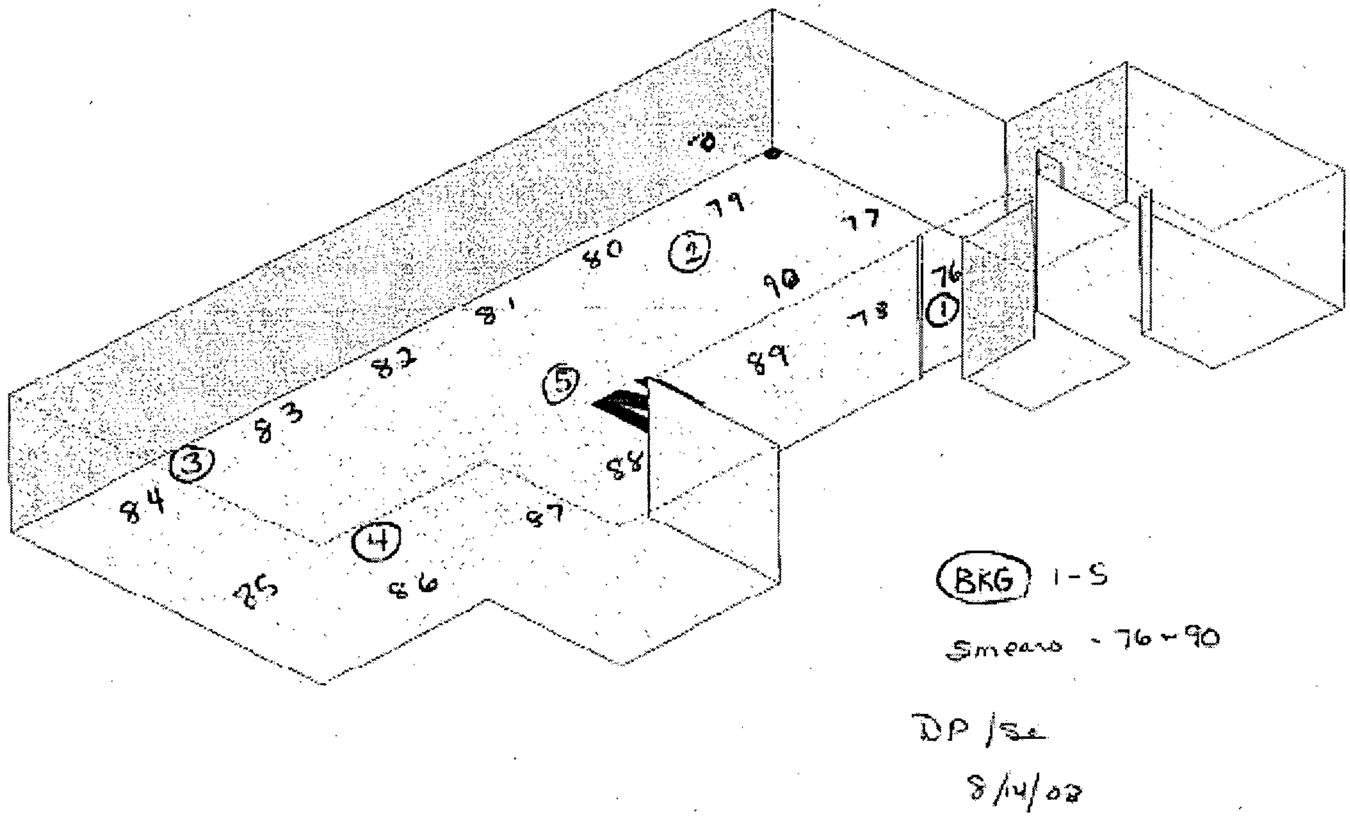
Smears- 61-75

8/14/08
DIP/se



TBN-01 6th Floor South

Area 1



Model No.	Serial No.	Cal Date	Location Code1	Location Code2	Location Code3	Detector Setup	Logged Reading	Units	Count Time	Log Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	CHAR-TBN01-01-001-F-M	FL1	floor	3	427	c	60	log scalar	186199	SE	1579
43-68	PR178065	5/29/2008	CHAR-TBN01-01-002-F-M	FL1	floor	3	379	c	60	log scalar	186199	SE	1401
43-68	PR178065	5/29/2008	CHAR-TBN01-01-003-F-M	FL1	floor	3	338	c	60	log scalar	186199	SE	1250
43-68	PR178065	5/29/2008	CHAR-TBN01-01-004-F-M	FL1	floor	3	356	c	60	log scalar	186199	SE	1316
43-68	PR178065	5/29/2008	CHAR-TBN01-01-005-F-M	FL1	floor	3	324	c	60	log scalar	186199	SE	1198
43-68	PR178065	5/29/2008	CHAR-TBN01-01-006-F-M	FL1	floor	3	370	c	60	log scalar	186199	SE	1368
43-68	PR178065	5/29/2008	CHAR-TBN01-01-007-F-M	FL1	floor	3	336	c	60	log scalar	186199	SE	1242
43-68	PR178065	5/29/2008	CHAR-TBN01-01-008-F-M	FL1	floor	3	349	c	60	log scalar	186199	SE	1290
43-68	PR178065	5/29/2008	CHAR-TBN01-01-009-F-M	FL1	floor	3	354	c	60	log scalar	186199	SE	1309
43-68	PR178065	5/29/2008	CHAR-TBN01-01-010-F-M	FL1	floor	3	346	c	60	log scalar	186199	SE	1279
43-68	PR178065	5/29/2008	CHAR-TBN01-01-011-F-M	FL1	floor	3	294	c	60	log scalar	186199	SE	1087
43-68	PR178065	5/29/2008	CHAR-TBN01-01-012-F-M	FL1	floor	3	365	c	60	log scalar	186199	SE	1349
43-68	PR178065	5/29/2008	CHAR-TBN01-01-013-F-M	FL1	floor	3	376	c	60	log scalar	186199	SE	1390
43-68	PR178065	5/29/2008	CHAR-TBN01-01-014-F-M	FL1	floor	3	367	c	60	log scalar	186199	SE	1357
43-68	PR178065	5/29/2008	CHAR-TBN01-01-015-F-M	FL1	floor	3	345	c	60	log scalar	186199	SE	1275
							cpm						dpm/100cm2
							Average = 355.07						Average = 1313
							Median = 354.00						Median = 1309
							STDEV = 29.55						STDEV = 109
							Minimum = 294.00						Minimum = 1087
							Maximum = 427.00						Maximum = 1579

Model No.	Serial No.	Cal Date	Location Code1	Location Code2	Location Code3	Detector Setup	Logged Reading	Units	Count Time	Log Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	CHAR-TBN01-01-016-F-M	FL2	floor	3	336	c	60	log scalar	186199	SE	1242
43-68	PR178065	5/29/2008	CHAR-TBN01-01-017-F-M	FL2	floor	3	376	c	60	log scalar	186199	SE	1390
43-68	PR178065	5/29/2008	CHAR-TBN01-01-018-F-M	FL2	floor	3	457	c	60	log scalar	186199	SE	1689
43-68	PR178065	5/29/2008	CHAR-TBN01-01-019-F-M	FL2	floor	3	428	c	60	log scalar	186199	SE	1582
43-68	PR178065	5/29/2008	CHAR-TBN01-01-020-F-M	FL2	floor	3	335	c	60	log scalar	186199	SE	1238
43-68	PR178065	5/29/2008	CHAR-TBN01-01-021-F-M	FL2	floor	3	372	c	60	log scalar	186199	SE	1375
43-68	PR178065	5/29/2008	CHAR-TBN01-01-022-F-M	FL2	floor	3	376	c	60	log scalar	186199	SE	1390
43-68	PR178065	5/29/2008	CHAR-TBN01-01-023-F-M	FL2	floor	3	394	c	60	log scalar	186199	SE	1457
43-68	PR178065	5/29/2008	CHAR-TBN01-01-024-F-M	FL2	floor	3	328	c	60	log scalar	186199	SE	1213
43-68	PR178065	5/29/2008	CHAR-TBN01-01-025-F-M	FL2	Tile on floor	3	564	c	60	log scalar	186199	SE	2085
43-68	PR178065	5/29/2008	CHAR-TBN01-01-026-F-M	FL2	wall	3	514	c	60	log scalar	186199	SE	1900
43-68	PR178065	5/29/2008	CHAR-TBN01-01-027-F-M	FL2	wall	3	446	c	60	log scalar	186199	SE	1649
43-68	PR178065	5/29/2008	CHAR-TBN01-01-028-F-M	FL2	wall	3	457	c	60	log scalar	186199	SE	1689
43-68	PR178065	5/29/2008	CHAR-TBN01-01-029-F-M	FL2	wall	3	276	c	60	log scalar	186199	SE	1020
43-68	PR178065	5/29/2008	CHAR-TBN01-01-030-F-M	FL2	wall	3	266	c	60	log scalar	186199	SE	983
							cpm						dpm/100cm2
						Average =	**395.00**					**Average =**	**1460**
						Median =	**376.00**					**Median =**	**1390**
						STDEV =	**83.55**					**STDEV =**	**309**
						Minimum =	**266.00**					**Minimum =**	**983**
						Maximum =	**564.00**					**Maximum =**	**2085**

Model No.	Serial No.	Cal Date	Location Code1	Location Code2	Location Code3	Detector Setup	Logged Reading	Units	Count Time	Log Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	CHAR-TBN01-01-016-F-M	FL2	floor	3	336	c	60	log scalar	186199	SE	1242
43-68	PR178065	5/29/2008	CHAR-TBN01-01-017-F-M	FL2	floor	3	376	c	60	log scalar	186199	SE	1390
43-68	PR178065	5/29/2008	CHAR-TBN01-01-018-F-M	FL2	floor	3	457	c	60	log scalar	186199	SE	1689
43-68	PR178065	5/29/2008	CHAR-TBN01-01-019-F-M	FL2	floor	3	428	c	60	log scalar	186199	SE	1582
43-68	PR178065	5/29/2008	CHAR-TBN01-01-020-F-M	FL2	floor	3	335	c	60	log scalar	186199	SE	1238
43-68	PR178065	5/29/2008	CHAR-TBN01-01-021-F-M	FL2	floor	3	372	c	60	log scalar	186199	SE	1375
43-68	PR178065	5/29/2008	CHAR-TBN01-01-022-F-M	FL2	floor	3	376	c	60	log scalar	186199	SE	1390
43-68	PR178065	5/29/2008	CHAR-TBN01-01-023-F-M	FL2	floor	3	394	c	60	log scalar	186199	SE	1457
43-68	PR178065	5/29/2008	CHAR-TBN01-01-024-F-M	FL2	floor	3	328	c	60	log scalar	186199	SE	1213
43-68	PR178065	5/29/2008	CHAR-TBN01-01-025-F-M	FL2	Tile on floor	3	564	c	60	log scalar	186199	SE	2085
43-68	PR178065	5/29/2008	CHAR-TBN01-01-026-F-M	FL2	wall	3	514	c	60	log scalar	186199	SE	1900
43-68	PR178065	5/29/2008	CHAR-TBN01-01-027-F-M	FL2	wall	3	446	c	60	log scalar	186199	SE	1649
43-68	PR178065	5/29/2008	CHAR-TBN01-01-028-F-M	FL2	wall	3	457	c	60	log scalar	186199	SE	1689
43-68	PR178065	5/29/2008	CHAR-TBN01-01-029-F-M	FL2	wall	3	276	c	60	log scalar	186199	SE	1020
43-68	PR178065	5/29/2008	CHAR-TBN01-01-030-F-M	FL2	wall	3	266	c	60	log scalar	186199	SE	983

Average = 395.00	**Average = 1460**
Median = 376.00	**Median = 1390**
STDEV = 83.55	**STDEV = 309**
Minimum = 266.00	**Minimum = 983**
Maximum = 564.00	**Maximum = 2085**

Model No.	Serial No.	Cal Date	Sample No.	Location Code1	Location Code2	Location Code3	Formatted Date	Detector Setup	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	5	CHAR-TBN01-01-031-F-M	FL3	Floor	8/14/2008 9:47	3	372	c	60	log scalar	186199	SE	1375
43-68	PR178065	5/29/2008	6	CHAR-TBN01-01-032-F-M	FL3	Floor	8/14/2008 9:49	3	334	c	60	log scalar	186199	SE	1235
43-68	PR178065	5/29/2008	7	CHAR-TBN01-01-033-F-M	FL3	Floor	8/14/2008 9:52	3	386	c	60	log scalar	186199	SE	1427
43-68	PR178065	5/29/2008	8	CHAR-TBN01-01-034-F-M	FL3	Floor	8/14/2008 9:53	3	423	c	60	log scalar	186199	SE	1564
43-68	PR178065	5/29/2008	9	CHAR-TBN01-01-035-F-M	FL3	Floor	8/14/2008 9:56	3	428	c	60	log scalar	186199	SE	1582
43-68	PR178065	5/29/2008	10	CHAR-TBN01-01-036-F-M	FL3	Floor	8/14/2008 9:58	3	431	c	60	log scalar	186199	SE	1593
43-68	PR178065	5/29/2008	11	CHAR-TBN01-01-037-F-M	FL3	Floor	8/14/2008 10:02	3	392	c	60	log scalar	186199	SE	1449
43-68	PR178065	5/29/2008	12	CHAR-TBN01-01-038-F-M	FL3	Floor	8/14/2008 10:04	3	433	c	60	log scalar	186199	SE	1601
43-68	PR178065	5/29/2008	13	CHAR-TBN01-01-039-F-M	FL3	Floor	8/14/2008 10:07	3	475	c	60	log scalar	186199	SE	1756
43-68	PR178065	5/29/2008	14	CHAR-TBN01-01-040-F-M	FL3	Floor	8/14/2008 10:09	3	481	c	60	log scalar	186199	SE	1778
43-68	PR178065	5/29/2008	15	CHAR-TBN01-01-041-F-M	FL3	Floor	8/14/2008 10:11	3	430	c	60	log scalar	186199	SE	1590
43-68	PR178065	5/29/2008	16	CHAR-TBN01-01-042-F-M	FL3	Floor	8/14/2008 10:14	3	410	c	60	log scalar	186199	SE	1516
43-68	PR178065	5/29/2008	17	CHAR-TBN01-01-043-F-M	FL3	Floor	8/14/2008 10:16	3	426	c	60	log scalar	186199	SE	1575
43-68	PR178065	5/29/2008	18	CHAR-TBN01-01-044-F-M	FL3	Floor	8/14/2008 10:18	3	389	c	60	log scalar	186199	SE	1438
43-68	PR178065	5/29/2008	19	CHAR-TBN01-01-045-F-M	FL3	Floor	8/14/2008 10:21	3	397	c	60	log scalar	186199	SE	1468
									cpm						dpm/100cm2
	F-M = Fixed measurement								**Average = 413.80**						**Average = 1530**
									Median = 423.00						**Median = 1564**
									STDEV = 37.70						**STDEV = 139**
									Minimum = 334.00						**Minimum = 1235**
									Maximum = 481.00						**Maximum = 1778**

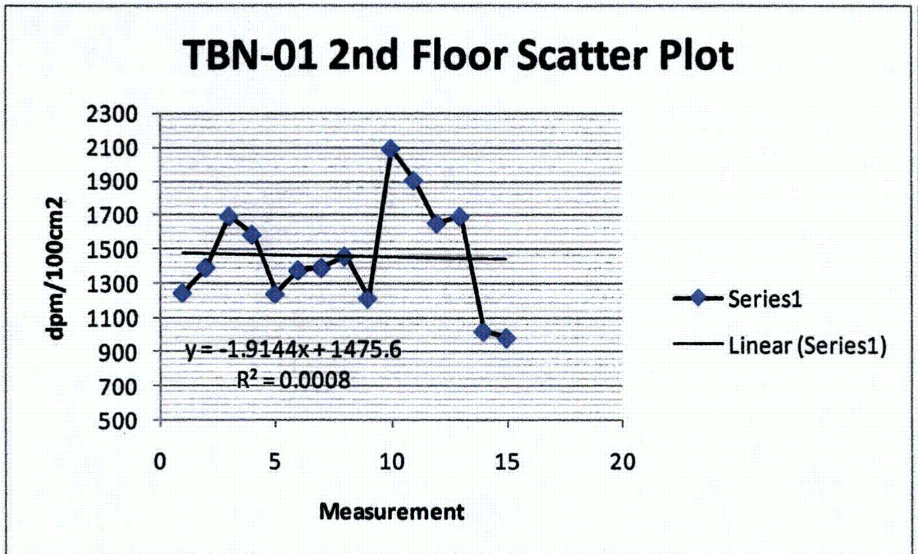
Model No.	Serial No.	Cal Date	Sample No.	Location Code1	Location Code2	Location Code3	Formatted Date	Detector Setup	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	25	CHAR-TBN01-01-046-F-M	FL4	Floor	8/14/2008 10:41	3	404	c	60	log scalar	186199	SE	1494
43-68	PR178065	5/29/2008	26	CHAR-TBN01-01-047-F-M	FL4	Floor	8/14/2008 10:43	3	369	c	60	log scalar	186199	SE	1364
43-68	PR178065	5/29/2008	27	CHAR-TBN01-01-048-F-M	FL4	Floor	8/14/2008 10:45	3	430	c	60	log scalar	186199	SE	1590
43-68	PR178065	5/29/2008	28	CHAR-TBN01-01-049-F-M	FL4	Floor	8/14/2008 10:46	3	387	c	60	log scalar	186199	SE	1431
43-68	PR178065	5/29/2008	29	CHAR-TBN01-01-050-F-M	FL4	Floor	8/14/2008 10:48	3	380	c	60	log scalar	186199	SE	1405
43-68	PR178065	5/29/2008	30	CHAR-TBN01-01-051-F-M	FL4	Floor	8/14/2008 10:55	3	349	c	60	log scalar	186199	SE	1290
43-68	PR178065	5/29/2008	31	CHAR-TBN01-01-052-F-M	FL4	Floor	8/14/2008 10:57	3	369	c	60	log scalar	186199	SE	1364
43-68	PR178065	5/29/2008	32	CHAR-TBN01-01-053-F-M	FL4	Floor	8/14/2008 10:59	3	360	c	60	log scalar	186199	SE	1331
43-68	PR178065	5/29/2008	33	CHAR-TBN01-01-054-F-M	FL4	Floor	8/14/2008 11:00	3	404	c	60	log scalar	186199	SE	1494
43-68	PR178065	5/29/2008	34	CHAR-TBN01-01-055-F-M	FL4	Floor	8/14/2008 11:02	3	391	c	60	log scalar	186199	SE	1445
43-68	PR178065	5/29/2008	35	CHAR-TBN01-01-056-F-M	FL4	Floor	8/14/2008 11:04	3	391	c	60	log scalar	186199	SE	1445
43-68	PR178065	5/29/2008	36	CHAR-TBN01-01-057-F-M	FL4	Floor	8/14/2008 11:07	3	345	c	60	log scalar	186199	SE	1275
43-68	PR178065	5/29/2008	37	CHAR-TBN01-01-058-F-M	FL4	Floor	8/14/2008 11:13	3	360	c	60	log scalar	186199	SE	1331
43-68	PR178065	5/29/2008	38	CHAR-TBN01-01-059-F-M	FL4	Floor	8/14/2008 11:14	3	366	c	60	log scalar	186199	SE	1353
43-68	PR178065	5/29/2008	39	CHAR-TBN01-01-060-F-M	FL4	Floor	8/14/2008 11:17	3	365	c	60	log scalar	186199	SE	1349
									cpm						dpm/100cm2
	F-M = Fixed measurement							Average =	378.00					Average =	1397
								Median =	369.00					Median =	1364
								STDEV =	23.19					STDEV =	86
								Minimum =	345.00					Minimum =	1275
								Maximum =	430.00					Maximum =	1590

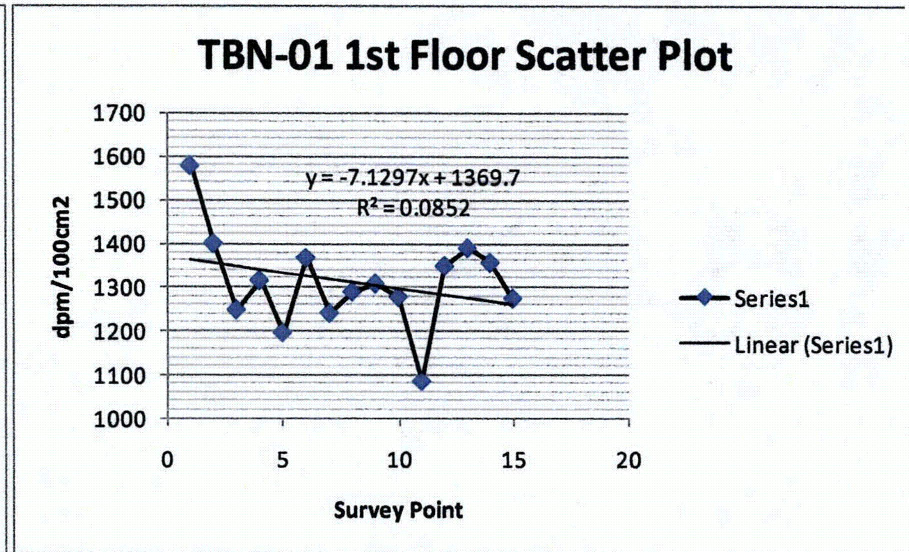
Model No.	Serial No.	Cal Date	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	CHAR-TBN01-01-061-F-M	FL5	Floor	8/14/2008 14:01	470	c	60	log scalar	186199	SE	1738
43-68	PR178065	5/29/2008	CHAR-TBN01-01-062-F-M	FL5	Floor	8/14/2008 14:03	464	c	60	log scalar	186199	SE	1715
43-68	PR178065	5/29/2008	CHAR-TBN01-01-063-F-M	FL5	Floor	8/14/2008 14:05	457	c	60	log scalar	186199	SE	1689
43-68	PR178065	5/29/2008	CHAR-TBN01-01-064-F-M	FL5	Floor	8/14/2008 14:07	437	c	60	log scalar	186199	SE	1616
43-68	PR178065	5/29/2008	CHAR-TBN01-01-065-F-M	FL5	Floor	8/14/2008 14:08	508	c	60	log scalar	186199	SE	1878
43-68	PR178065	5/29/2008	CHAR-TBN01-01-066-F-M	FL5	Floor	8/14/2008 14:10	508	c	60	log scalar	186199	SE	1878
43-68	PR178065	5/29/2008	CHAR-TBN01-01-067-F-M	FL5	Floor	8/14/2008 14:12	487	c	60	log scalar	186199	SE	1800
43-68	PR178065	5/29/2008	CHAR-TBN01-01-068-F-M	FL5	Floor	8/14/2008 14:14	468	c	60	log scalar	186199	SE	1730
43-68	PR178065	5/29/2008	CHAR-TBN01-01-069-F-M	FL5	Floor	8/14/2008 14:16	441	c	60	log scalar	186199	SE	1630
43-68	PR178065	5/29/2008	CHAR-TBN01-01-070-F-M	FL5	Floor	8/14/2008 14:18	500	c	60	log scalar	186199	SE	1848
43-68	PR178065	5/29/2008	CHAR-TBN01-01-071-F-M	FL5	Floor	8/14/2008 14:19	492	c	60	log scalar	186199	SE	1819
43-68	PR178065	5/29/2008	CHAR-TBN01-01-072-F-M	FL5	Floor	8/14/2008 14:21	445	c	60	log scalar	186199	SE	1645
43-68	PR178065	5/29/2008	CHAR-TBN01-01-073-F-M	FL5	Floor	8/14/2008 14:23	470	c	60	log scalar	186199	SE	1738
43-68	PR178065	5/29/2008	CHAR-TBN01-01-074-F-M	FL5	Floor	8/14/2008 14:25	488	c	60	log scalar	186199	SE	1804
43-68	PR178065	5/29/2008	CHAR-TBN01-01-075-F-M	FL5	Floor	8/14/2008 14:26	436	c	60	log scalar	186199	SE	1612
							cpm						dpm/100cm2
	F-M = Fixed measurement					**Average =**	**471.40**					**Average =**	**1743**
						Median =	**470.00**					**Median =**	**1738**
						STDEV =	**25.04**					**STDEV =**	**93**
						Minimum =	**436.00**					**Minimum =**	**1612**
						Maximum =	**508.00**					**Maximum =**	**1878**

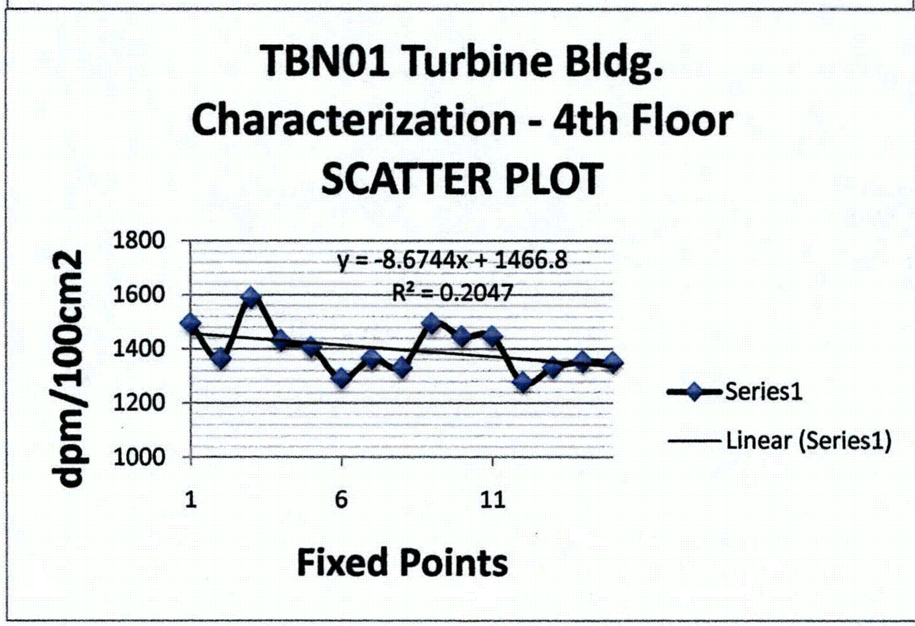
Model No.	Serial No.	Cal Date	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	CHAR-TBN01-01-076-F-M	FL6	Floor	8/14/2008 14:43	465	c	60	log scalar	186199	SE	1719
43-68	PR178065	5/29/2008	CHAR-TBN01-01-077-F-M	FL6	Floor	8/14/2008 14:44	431	c	60	log scalar	186199	SE	1593
43-68	PR178065	5/29/2008	CHAR-TBN01-01-078-F-M	FL6	Floor	8/14/2008 14:46	437	c	60	log scalar	186199	SE	1616
43-68	PR178065	5/29/2008	CHAR-TBN01-01-079-F-M	FL6	Floor	8/14/2008 14:49	490	c	60	log scalar	186199	SE	1811
43-68	PR178065	5/29/2008	CHAR-TBN01-01-080-F-M	FL6	Floor	8/14/2008 14:50	423	c	60	log scalar	186199	SE	1564
43-68	PR178065	5/29/2008	CHAR-TBN01-01-081-F-M	FL6	Floor	8/14/2008 14:52	439	c	60	log scalar	186199	SE	1623
43-68	PR178065	5/29/2008	CHAR-TBN01-01-082-F-M	FL6	Floor	8/14/2008 14:53	434	c	60	log scalar	186199	SE	1604
43-68	PR178065	5/29/2008	CHAR-TBN01-01-083-F-M	FL6	Floor	8/14/2008 14:55	452	c	60	log scalar	186199	SE	1671
43-68	PR178065	5/29/2008	CHAR-TBN01-01-084-F-M	FL6	Floor	8/14/2008 14:57	465	c	60	log scalar	186199	SE	1719
43-68	PR178065	5/29/2008	CHAR-TBN01-01-085-F-M	FL6	Floor	8/14/2008 14:59	447	c	60	log scalar	186199	SE	1652
43-68	PR178065	5/29/2008	CHAR-TBN01-01-086-F-M	FL6	Floor	8/14/2008 15:00	487	c	60	log scalar	186199	SE	1800
43-68	PR178065	5/29/2008	CHAR-TBN01-01-087-F-M	FL6	Floor	8/14/2008 15:02	481	c	60	log scalar	186199	SE	1778
43-68	PR178065	5/29/2008	CHAR-TBN01-01-088-F-M	FL6	Floor	8/14/2008 15:03	513	c	60	log scalar	186199	SE	1896
43-68	PR178065	5/29/2008	CHAR-TBN01-01-089-F-M	FL6	Floor	8/14/2008 15:05	429	c	60	log scalar	186199	SE	1586
43-68	PR178065	5/29/2008	CHAR-TBN01-01-090-F-M	FL6	Floor	8/14/2008 15:07	458	c	60	log scalar	186199	SE	1693
							cpm						dpm/100cm2

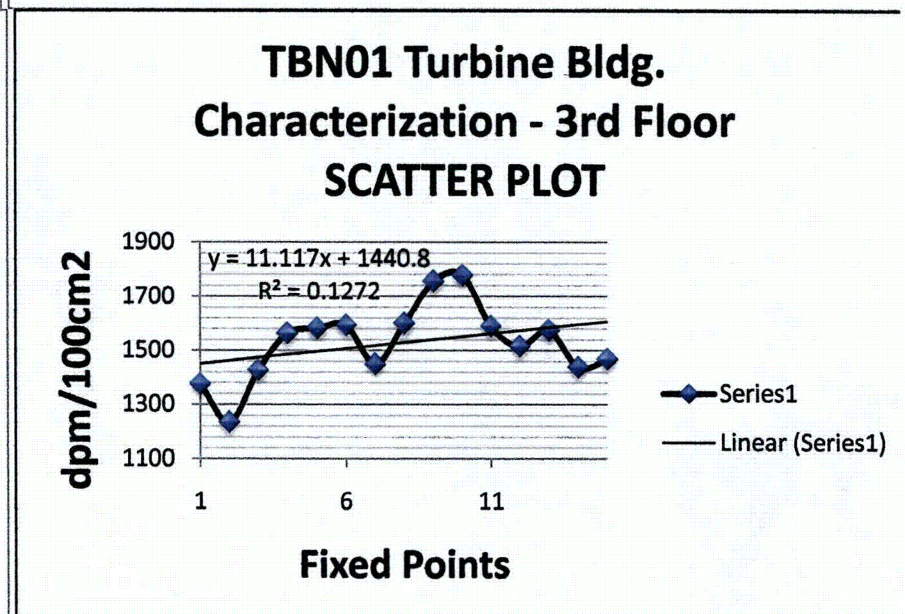
F-M = Fixed measurement

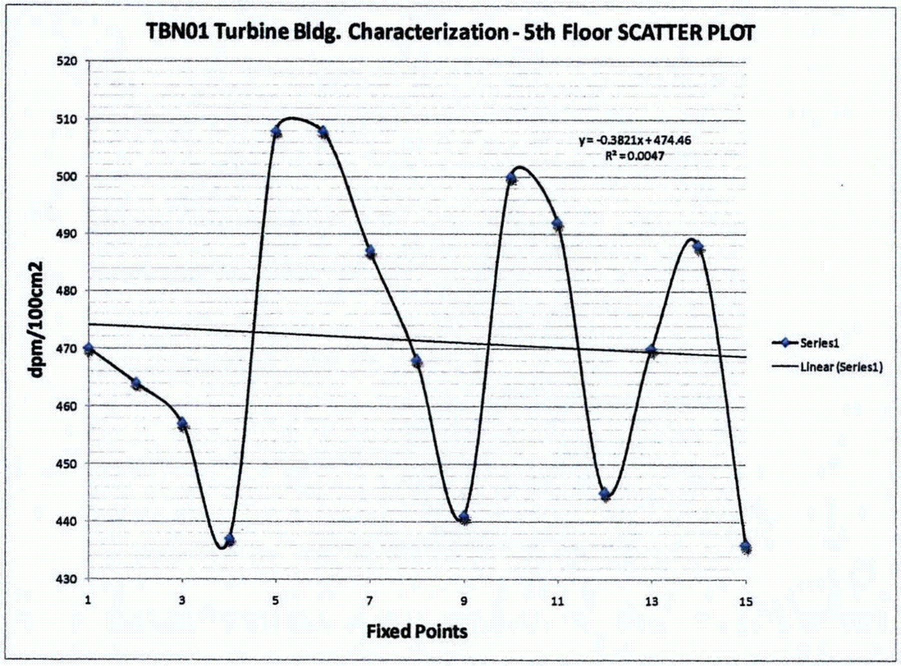
	cpm		dpm/100cm2
Average =	456.73	Average =	1688
Median =	452.00	Median =	1671
STDEV =	26.49	STDEV =	98
Minimum =	423.00	Minimum =	1564
Maximum =	513.00	Maximum =	1896

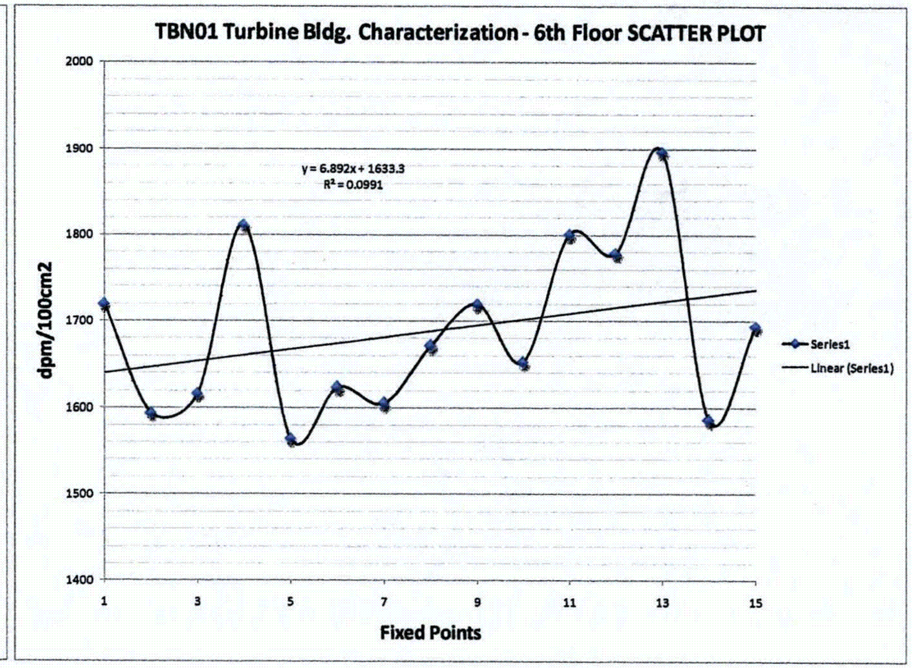

TBN-01 2nd Floor Scatter Plot
dpm/100cm2
Measurement
y = -1.9144x + 1475.6
R^2 = 0.0008
Series1
Linear (Series1)

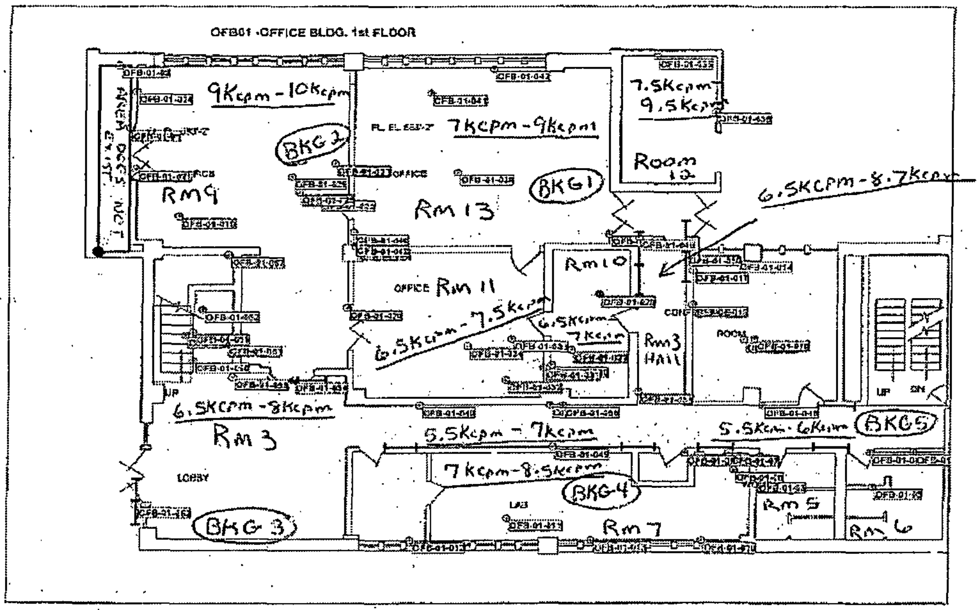

TBN-01 1st Floor Scatter Plot
dpm/100cm2
Survey Point
y = -7.1297x + 1369.7
R^2 = 0.0852
Series1
Linear (Series1)


TBN01 Turbine Bldg. Characterization - 4th Floor SCATTER PLOT
dpm/100cm2
Fixed Points
y = -8.6744x + 1466.8
R^2 = 0.2047
Series1
Linear (Series1)


TBN01 Turbine Bldg. Characterization - 3rd Floor SCATTER PLOT
dpm/100cm2
Fixed Points
y = 11.117x + 1440.8
R^2 = 0.1272
Series1
Linear (Series1)


TBN01 Turbine Bldg. Characterization - 5th Floor SCATTER PLOT
y = -0.3821x + 474.46
R² = 0.0047
dpm/100cm2
Fixed Points
520
510
500
490
480
470
460
450
440
430
1
3
5
7
9
11
13
15
Series1
Linear (Series1)


TBN01 Turbine Bldg. Characterization - 6th Floor SCATTER PLOT
y = 6.892x + 1633.3
R² = 0.0991
dpm/100cm2
Fixed Points
2000
1900
1800
1700
1600
1500
1400
1
3
5
7
9
11
13
15
Series1
Linear (Series1)



		Inst	Time	BKG	Source	Sat/Uns	Initials
10/28/08	Daily	2350-1 186193	1104	205	1262	S	[illegible]
	End of Shift	D3 436x PR178065	1648	278	1321	S	[illegible]
		Instrument	Time	BKG	SOURCE	Sat/Unsat	Initials
10/29/08	Daily	# 1	0857	247	1259	S	[illegible]
	End of Shift	# 1	1628	223	1057	S	[illegible]
	Daily	# 2	0858	7359	44854	S	[illegible]
	End of Shift	# 2	1626	7680	45198	S	[illegible]

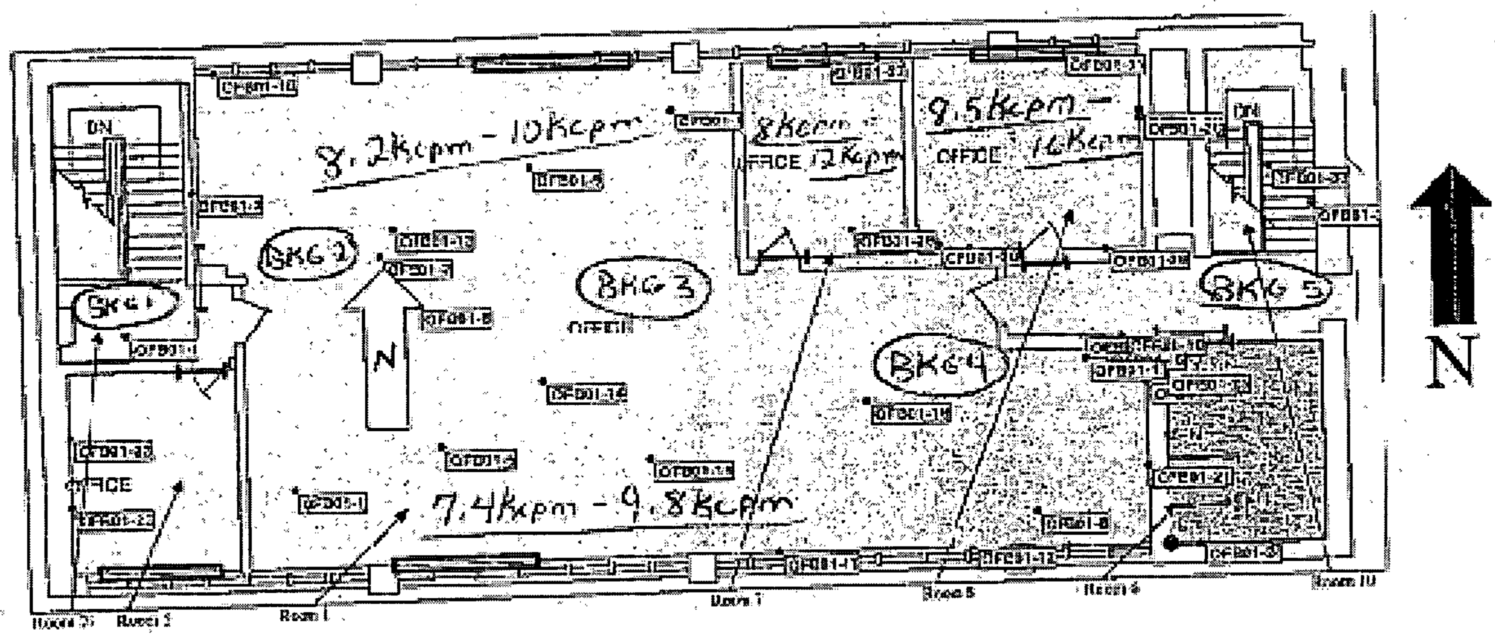
SURVEYED ON: 10/28/08 by: DP/SE 10/29/08

Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 94 scfm @ 1200 0920
1610 1630

Instrument / Serial No.
#1 2350-1/186193
#2 2350-1/186199
Probe No. / Serial No.
#1 D3 43-68/ PR-178065
#2 D1 SPA3/ 2081

Comments: Used same instruments for survey on 10/28/08 and 10/29/08

OFB-01 2nd Floor



	Instrument	Time	BKG	SOURCE	Sat/Unsat	Initials
Daily						
End of Shift			see comments			
Daily						
End of Shift						

SURVEYED ON: 10/29/07 by: PF/SE

Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 94 scfm @ 0920
1630

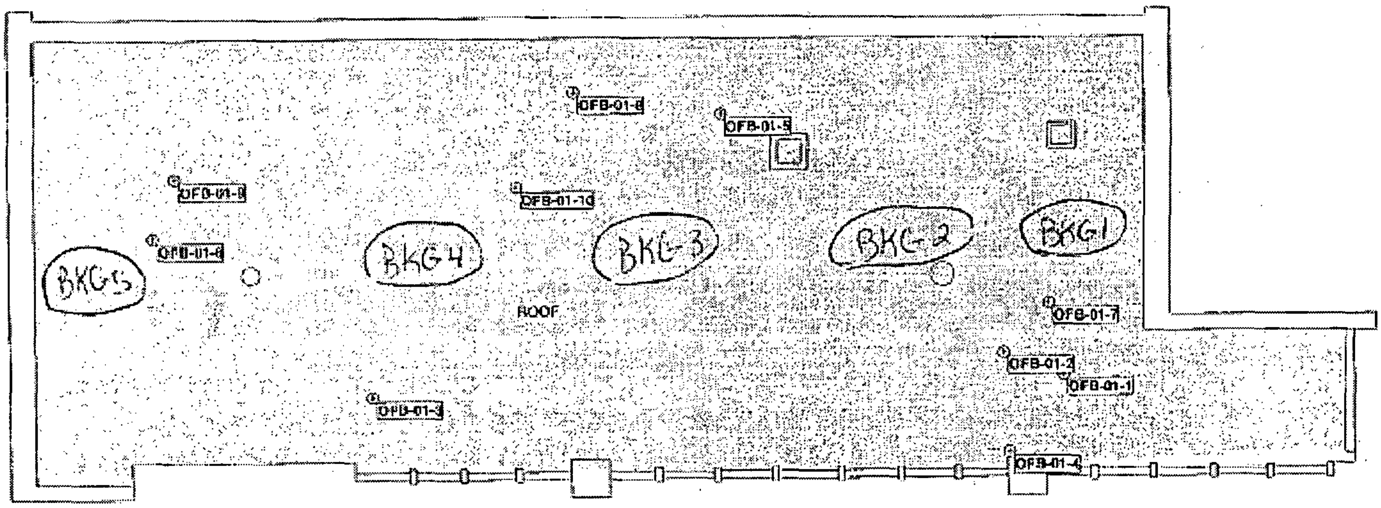
Instrument / Serial No.
2350-1/ 186193

Probe No. / Serial No.
D3 43-68 PR178065
D1 SPA3

Comments: * see data sheet OFB-01 2nd floor BKG for more info

Characterization

OFB-01 ROOF



SURVEYED ON: 10/30/12 by: DF /SC

Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 55 scfm @ 0540
1610

Instrument / Serial No.
2350-1 / 186193

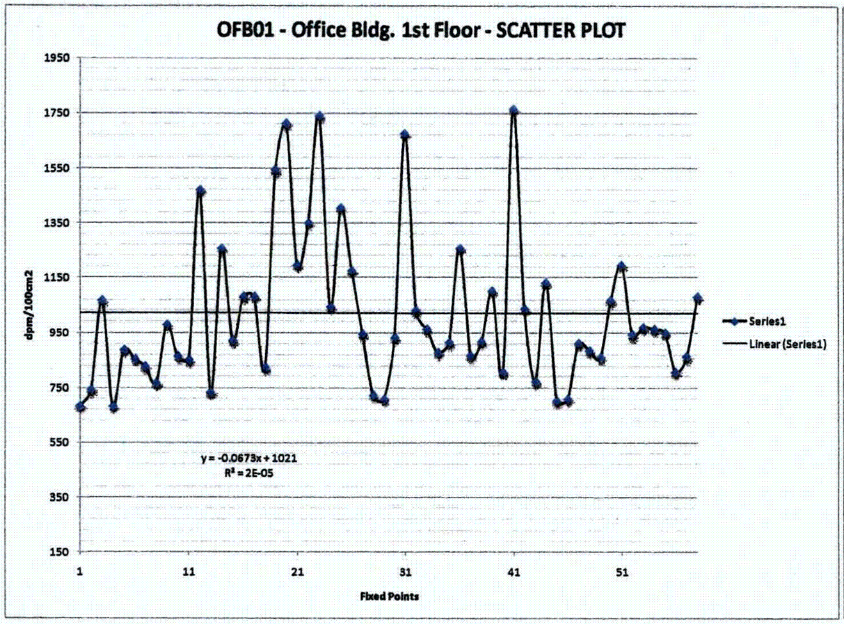
Probe No. / Serial No.
03 4365 / PR 175065

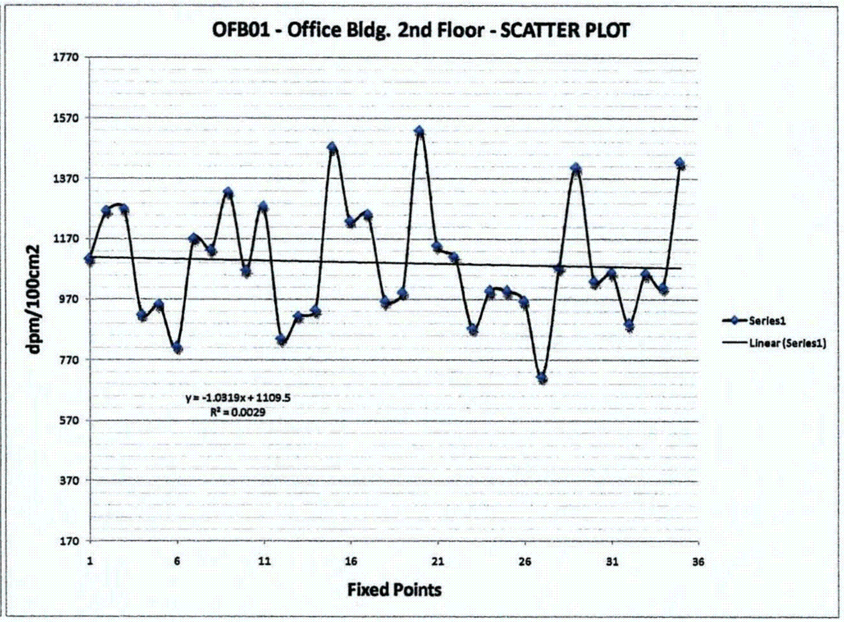
Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-003-F-M	Wall 4	FL1	10/28/2008 16:17	185	60	log scalar	186193	DP/SE	683
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-004-F-M	Wall 1	FL1	10/28/2008 15:56	201	60	log scalar	186193	DP/SE	742
43-68	PR178065	5/29/2008	Linoleum	CHAR-OFB-01-005-F-M	Floor	FL1	10/28/2008 15:54	289	60	log scalar	186193	DP/SE	1067
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-006-F-M	Wall 1	FL1	10/28/2008 15:58	185	60	log scalar	186193	DP/SE	683
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-007-F-M	Wall 3	FL1	10/28/2008 15:38	241	60	log scalar	186193	DP/SE	890
43-68	PR178065	5/29/2008	Tile floor	CHAR-OFB-01-008-F-M	Floor	FL1	10/28/2008 15:35	232	60	log scalar	186193	DP/SE	856
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-009-F-M	Wall 3	FL1	10/28/2008 15:50	224	60	log scalar	186193	DP/SE	827
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-010-F-M	Wall 5	FL1	10/28/2008 15:32	208	60	log scalar	186193	DP/SE	768
43-68	PR178065	5/29/2008	Tile floor	CHAR-OFB-01-011-F-M	Floor	FL1	10/28/2008 15:23	265	60	log scalar	186193	DP/SE	978
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-012-F-M	Wall 5	FL1	10/28/2008 15:17	234	60	log scalar	186193	DP/SE	864
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-013-F-M	Wall 5	FL1	10/28/2008 15:28	231	60	log scalar	186193	DP/SE	853
43-68	PR178065	5/29/2008	concrete floor	CHAR-OFB-01-014-F-M	Floor	FL1	10/29/2008 9:37	398	60	log scalar	186193	DP/SE	1469
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-015-F-M	Wall 4	FL1	10/29/2008 9:30	199	60	log scalar	186193	DP/SE	735
43-68	PR178065	5/29/2008	concrete floor	CHAR-OFB-01-016-F-M	Floor	FL1	10/29/2008 9:42	341	60	log scalar	186193	DP/SE	1259
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-017-F-M	Wall 4	FL1	10/29/2008 9:34	250	60	log scalar	186193	DP/SE	923
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-018-F-M	Ceiling	FL1	10/29/2008 9:49	293	60	log scalar	186193	DP/SE	1082
43-68	PR178065	5/29/2008	carpet	CHAR-OFB-01-019-F-M	Floor	FL1	10/29/2008 13:46	293	60	log scalar	186193	DP/SE	1082
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-020-F-M	Wall 6	FL1	10/29/2008 13:56	223	60	log scalar	186193	DP/SE	823
43-68	PR178065	5/29/2008	concrete block wall	CHAR-OFB-01-021-F-M	Wall 4	FL1	10/29/2008 13:50	418	60	log scalar	186193	DP/SE	1543
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-022-F-M	Ceiling	FL1	10/29/2008 13:37	464	60	log scalar	186193	DP/SE	1713
43-68	PR178065	5/29/2008	carpet	CHAR-OFB-01-023-F-M	Floor	FL1	10/29/2008 13:43	324	60	log scalar	186193	DP/SE	1196
43-68	PR178065	5/29/2008	concrete block wall	CHAR-OFB-01-024-F-M	Wall 4	FL1	10/29/2008 14:01	366	60	log scalar	186193	DP/SE	1351
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-025-F-M	Ceiling	FL1	10/29/2008 13:40	472	60	log scalar	186193	DP/SE	1742
43-68	PR178065	5/29/2008	carpet	CHAR-OFB-01-026-F-M	Floor	FL1	10/29/2008 13:53	283	60	log scalar	186193	DP/SE	1045
43-68	PR178065	5/29/2008	concrete floor	CHAR-OFB-01-027-F-M	Floor	FL1	10/29/2008 11:32	381	60	log scalar	186193	DP/SE	1406
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-028-F-M	Ceiling	FL1	10/29/2008 13:32	319	60	log scalar	186193	DP/SE	1178
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-029-F-M	Ceiling	FL1	10/29/2008 13:29	256	60	log scalar	186193	DP/SE	945
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-030-F-M	Wall 4	FL1	10/29/2008 11:35	196	60	log scalar	186193	DP/SE	724
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-031-F-M	Wall 2	FL1	10/28/2008 15:12	192	60	log scalar	186193	DP/SE	709
43-68	PR178065	5/29/2008	Tile floor	CHAR-OFB-01-032-F-M	Floor	FL1	10/28/2008 15:06	253	60	log scalar	186193	DP/SE	934
43-68	PR178065	5/29/2008	Ceiling tile	CHAR-OFB-01-033-F-M	Ceiling	FL1	10/28/2008 15:04	454	60	log scalar	186193	DP/SE	1676
43-68	PR178065	5/29/2008	Tile floor	CHAR-OFB-01-034-F-M	Floor	FL1	10/28/2008 15:09	279	60	log scalar	186193	DP/SE	1030
43-68	PR178065	5/29/2008	concrete block wall	CHAR-OFB-01-035-F-M	Wall 1	FL1	10/29/2008 13:19	261	60	log scalar	186193	DP/SE	963
43-68	PR178065	5/29/2008	concrete block wall	CHAR-OFB-01-036-F-M	Wall 2	FL1	10/29/2008 13:15	238	60	log scalar	186193	DP/SE	879
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-037-F-M	Wall 2	FL1	10/28/2008 14:41	248	60	log scalar	186193	DP/SE	915
43-68	PR178065	5/29/2008	Tile floor	CHAR-OFB-01-038-F-M	Floor	FL1	10/28/2008 14:44	341	60	log scalar	186193	DP/SE	1259
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-039-F-M	Wall 3	FL1	10/28/2008 14:53	235	60	log scalar	186193	DP/SE	867
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-040-F-M	Wall 4	FL1	10/28/2008 14:47	249	60	log scalar	186193	DP/SE	919

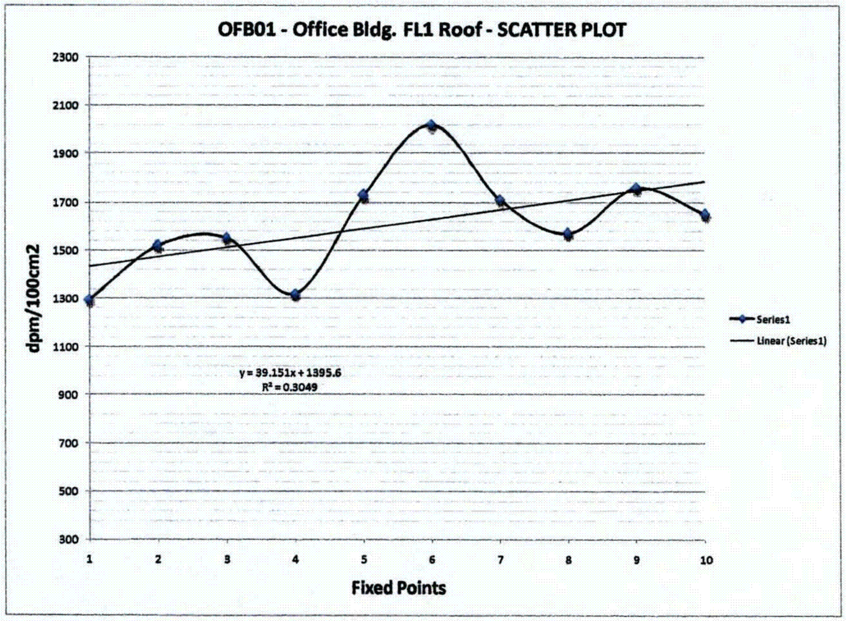
43-68	PR178065	5/29/2008	Tile floor	CHAR-OFB-01-041-F-M	Floor	FL1	10/28/2008 14:57	298	60	log scalar	186193	DP/SE	1100
43-68	PR178065	5/29/2008	Sheetrock	CHAR-OFB-01-042-F-M	Wall 4	FL1	10/28/2008 14:51	219	60	log scalar	186193	DP/SE	808
43-68	PR178065	5/29/2008	Ceiling tile	CHAR-OFB-01-043-F-M	Ceiling	FL1	10/28/2008 15:01	478	60	log scalar	186193	DP/SE	1764
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-044-F-M	Ceiling	FL1	10/29/2008 11:24	281	60	log scalar	186193	DP/SE	1037
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-045-F-M	Wall 13	FL1	10/29/2008 10:37	210	60	log scalar	186193	DP/SE	775
43-68	PR178065	5/29/2008	concrete block wall	CHAR-OFB-01-046-F-M	Wall 8	FL1	10/29/2008 10:30	307	60	log scalar	186193	DP/SE	1133
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-047-F-M	Wall 7	FL1	10/29/2008 10:34	190	60	log scalar	186193	DP/SE	701
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-048-F-M	Wall 11	FL1	10/29/2008 10:18	192	60	log scalar	186193	DP/SE	709
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-049-F-M	Wall 7	FL1	10/29/2008 11:10	247	60	log scalar	186193	DP/SE	912
43-68	PR178065	5/29/2008	steel door	CHAR-OFB-01-050-F-M	Wall 10	FL1	10/29/2008 10:26	240	60	log scalar	186193	DP/SE	886
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-051-F-M	Wall 22	FL1	10/29/2008 10:59	233	60	log scalar	186193	DP/SE	860
43-68	PR178065	5/29/2008	concrete floor	CHAR-OFB-01-052-F-M	Floor	FL1	10/29/2008 10:57	289	60	log scalar	186193	DP/SE	1067
43-68	PR178065	5/29/2008	floor tile	CHAR-OFB-01-053-F-M	Floor	FL1	10/29/2008 10:53	324	60	log scalar	186193	DP/SE	1196
43-68	PR178065	5/29/2008	wood door	CHAR-OFB-01-054-F-M	Wall 5	FL1	10/29/2008 10:49	255	60	log scalar	186193	DP/SE	941
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-055-F-M	Wall 22	FL1	10/29/2008 11:02	263	60	log scalar	186193	DP/SE	971
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-056-F-M	Wall 7	FL1	10/29/2008 11:13	261	60	log scalar	186193	DP/SE	963
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-057-F-M	Wall 1	FL1	10/29/2008 11:19	257	60	log scalar	186193	DP/SE	949
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-058-F-M	Wall 8	FL1	10/29/2008 10:22	219	60	log scalar	186193	DP/SE	808
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-059-F-M	Wall 4	FL1	10/29/2008 11:06	234	60	log scalar	186193	DP/SE	864
43-68	PR178065	5/29/2008	metal panel wall	CHAR-OFB-01-060-F-M	Wall 16	FL1	10/29/2008 10:44	293	60	log scalar	186193	DP/SE	1082
								cpm					dpm/100cm2
							Average =	276.05				Average =	1019
							Median =	255.50				Median =	943
							STDEV =	74.41				STDEV =	275
							Minimum =	185.00				Minimum =	683
							Maximum =	478.00				Maximum =	1764

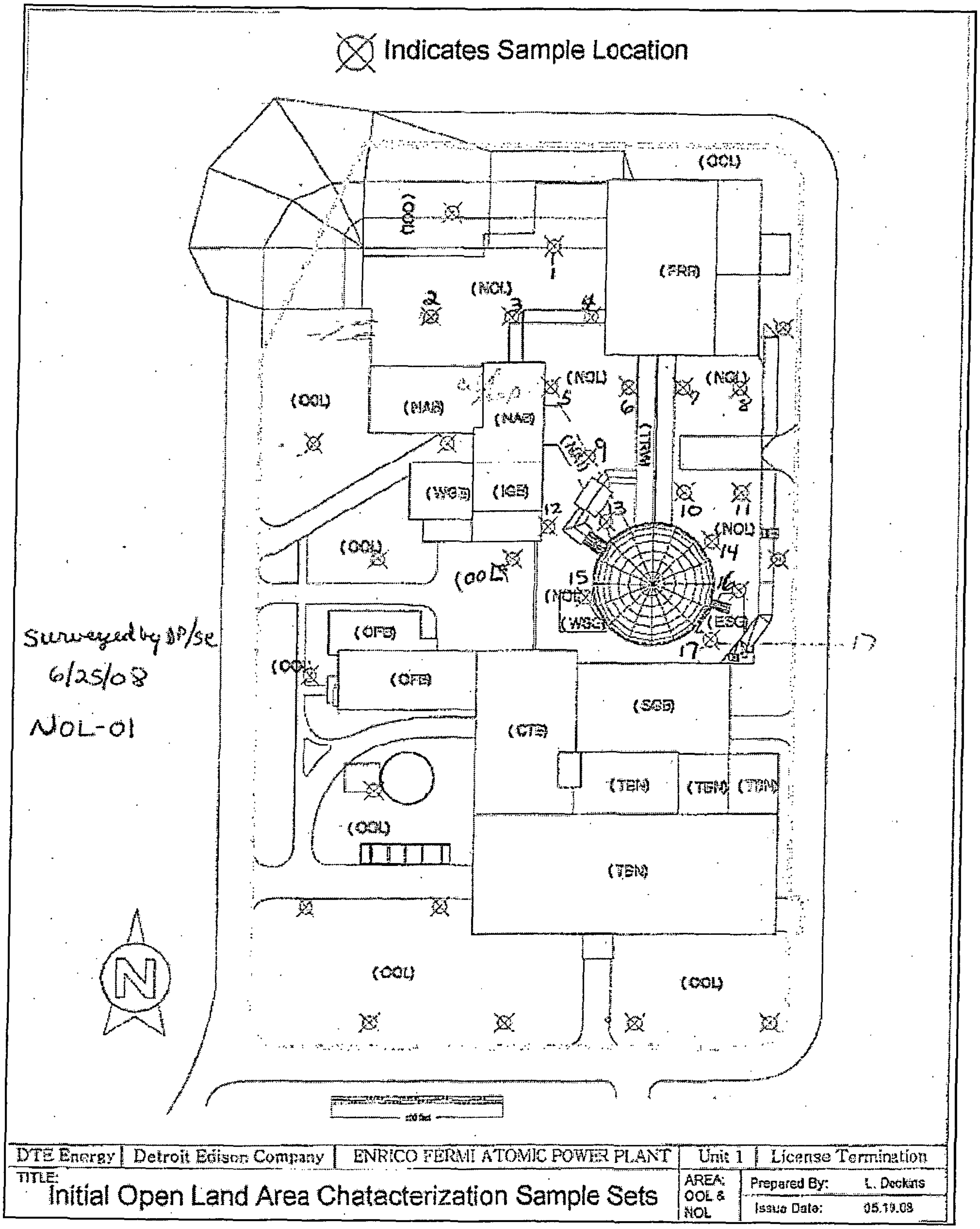
Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-001-F-M	Ceiling	FL2	10/30/2008 10:19	299	60	log scalar	186193	DP/SE	1104
43-68	PR178065	5/29/2008	floor tile	CHAR-OFB-01-001-F-M	Floor	FL2	10/30/2008 9:24	342	60	log scalar	186193	DP/SE	1262
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-002-F-M	Ceiling	FL2	10/30/2008 10:10	344	60	log scalar	186193	DP/SE	1270
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-002-F-M	Wall 2	FL2	10/30/2008 9:27	249	60	log scalar	186193	DP/SE	919
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-003-F-M	Wall 7	FL2	10/29/2008 16:14	258	60	log scalar	186193	DP/SE	952
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-004-F-M	Wall 10	FL2	10/29/2008 15:04	221	60	log scalar	186193	DP/SE	816
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-005-F-M	Ceiling	FL2	10/30/2008 10:13	317	60	log scalar	186193	DP/SE	1170
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-006-F-M	Ceiling	FL2	10/30/2008 10:08	307	60	log scalar	186193	DP/SE	1133
43-68	PR178065	5/29/2008	carpet	CHAR-OFB-01-007-F-M	Floor	FL2	10/29/2008 15:27	359	60	log scalar	186193	DP/SE	1325
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-008-F-M	Ceiling	FL2	10/29/2008 15:16	289	60	log scalar	186193	DP/SE	1067
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-009-F-M	Ceiling	FL2	10/30/2008 10:05	346	60	log scalar	186193	DP/SE	1277
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-010-F-M	Wall 7	FL2	10/29/2008 16:11	228	60	log scalar	186193	DP/SE	842
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-011-F-M	Wall 11	FL2	10/29/2008 15:31	248	60	log scalar	186193	DP/SE	915
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-012-F-M	Wall 11	FL2	10/29/2008 15:11	253	60	log scalar	186193	DP/SE	934
43-68	PR178065	5/29/2008	carpet	CHAR-OFB-01-013-F-M	Floor	FL2	10/29/2008 15:39	399	60	log scalar	186193	DP/SE	1473
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-014-F-M	Ceiling	FL2	10/30/2008 10:03	333	60	log scalar	186193	DP/SE	1229
43-68	PR178065	5/29/2008	floor tile	CHAR-OFB-01-015-F-M	Floor	FL2	10/29/2008 15:35	339	60	log scalar	186193	DP/SE	1251
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-016-F-M	Wall 9	FL2	10/29/2008 15:01	261	60	log scalar	186193	DP/SE	963
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-017-F-M	Ceiling	FL2	10/30/2008 10:23	269	60	log scalar	186193	DP/SE	993
43-68	PR178065	5/29/2008	concrete block wall	CHAR-OFB-01-018-F-M	Wall 1	FL2	10/29/2008 15:23	414	60	log scalar	186193	DP/SE	1528
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-019-F-M	Ceiling	FL2	10/30/2008 10:16	311	60	log scalar	186193	DP/SE	1148
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-020-F-M	Wall 3	FL2	10/29/2008 16:17	301	60	log scalar	186193	DP/SE	1111
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-021-F-M	Wall 10	FL2	10/29/2008 15:07	237	60	log scalar	186193	DP/SE	875
43-68	PR178065	5/29/2008	carpet	CHAR-OFB-01-022-F-M	Floor	FL2	10/30/2008 9:11	270	60	log scalar	186193	DP/SE	997
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-023-F-M	Wall 4	FL2	10/30/2008 9:18	270	60	log scalar	186193	DP/SE	997
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-024-F-M	Wall 3	FL2	10/30/2008 9:50	261	60	log scalar	186193	DP/SE	963
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-025-F-M	Wall 4	FL2	10/30/2008 9:46	194	60	log scalar	186193	DP/SE	716
43-68	PR178065	5/29/2008	ceiling tile	CHAR-OFB-01-026-F-M	Ceiling	FL2	10/30/2008 9:57	291	60	log scalar	186193	DP/SE	1074
43-68	PR178065	5/29/2008	glass	CHAR-OFB-01-027-F-M	Wall 1	FL2	10/30/2008 9:40	381	60	log scalar	186193	DP/SE	1406
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-028-F-M	Wall 2	FL2	10/29/2008 15:50	279	60	log scalar	186193	DP/SE	1030
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-029-F-M	Wall 3	FL2	10/29/2008 16:01	287	60	log scalar	186193	DP/SE	1059
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-030-F-M	Wall 2	FL2	10/29/2008 15:53	241	60	log scalar	186193	DP/SE	890
43-68	PR178065	5/29/2008	steel radiator	CHAR-OFB-01-031-F-M	Wall 1	FL2	10/29/2008 15:45	286	60	log scalar	186193	DP/SE	1056
43-68	PR178065	5/29/2008	sheetrock wall	CHAR-OFB-01-032-F-M	Wall 2	FL2	10/29/2008 16:08	274	60	log scalar	186193	DP/SE	1011
43-68	PR178065	5/29/2008	stairs	CHAR-OFB-01-033-F-M	Floor	FL2	10/29/2008 16:05	386	60	log scalar	186193	DP/SE	1425
								cpm					dpm/100cm2
							Average =	**295.54**				**Average =**	1091
							Median =	**287.00**				**Median =**	1059
							STDEV =	**52.94**				**STDEV =**	195
							Minimum =	**194.00**				**Minimum =**	716
							Maximum =	**414.00**				**Maximum =**	1528

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Roof Membrane	CHAR-OFB-01-001-F-M	Roof	FL1 Roof	10/30/2008 15:00	350	c	60	log scalar	186193	DP/SE	1292
43-68	PR178065	5/29/2008	Roof Membrane	CHAR-OFB-01-002-F-M	Roof	FL1 Roof	10/30/2008 15:05	411	c	60	log scalar	186193	DP/SE	1517
43-68	PR178065	5/29/2008	Roof Membrane	CHAR-OFB-01-003-F-M	Roof	FL1 Roof	10/30/2008 15:27	420	c	60	log scalar	186193	DP/SE	1550
43-68	PR178065	5/29/2008	Roof Membrane	CHAR-OFB-01-004-F-M	Roof	FL1 Roof	10/30/2008 14:56	357	c	60	log scalar	186193	DP/SE	1318
43-68	PR178065	5/29/2008	Roof Membrane	CHAR-OFB-01-005-F-M	Roof	FL1 Roof	10/30/2008 15:14	468	c	60	log scalar	186193	DP/SE	1728
43-68	PR178065	5/29/2008	Roof Membrane	CHAR-OFB-01-006-F-M	Roof	FL1 Roof	10/30/2008 15:36	547	c	60	log scalar	186193	DP/SE	2019
43-68	PR178065	5/29/2008	Roof Membrane	CHAR-OFB-01-007-F-M	Roof	FL1 Roof	10/30/2008 15:09	463	c	60	log scalar	186193	DP/SE	1709
43-68	PR178065	5/29/2008	Roof Membrane	CHAR-OFB-01-008-F-M	Roof	FL1 Roof	10/30/2008 15:18	425	c	60	log scalar	186193	DP/SE	1569
43-68	PR178065	5/29/2008	Roof Membrane	CHAR-OFB-01-009-F-M	Roof	FL1 Roof	10/30/2008 15:31	476	c	60	log scalar	186193	DP/SE	1757
43-68	PR178065	5/29/2008	Roof Membrane	CHAR-OFB-01-010-F-M	Roof	FL1 Roof	10/30/2008 15:23	447	c	60	log scalar	186193	DP/SE	1650
								cpm						dpm/100cm2
								Average = 436.40						**Average = 1611**
								Median = 436.00						**Median = 1609**
								STDEV = 58.15						**STDEV = 215**
								Minimum = 350.00						**Minimum = 1292**
								Maximum = 547.00						**Maximum = 2019**


OFB01 - Office Bldg. 1st Floor - SCATTER PLOT
dpm/100cm2
Fixed Points
Series1
Linear (Series1)
y = -0.0673x + 1021
R² = 2E-05


OFB01 - Office Bldg. 2nd Floor - SCATTER PLOT
dpm/100cm2
Fixed Points
Series1
Linear (Series1)
y = -1.0319x + 1109.5
R² = 0.0029


OFB01 - Office Bldg. FL1 Roof - SCATTER PLOT
dpm/100cm2
Fixed Points
Series1
Linear (Series1)
y = 39.151x + 1395.6
R² = 0.3049


Indicates Sample Location
(OOL)
(FRB)
(NOL)
(NAB)
(WGB)
(IGB)
(TRM)
(OFB)
(SGB)
(CTB)
(TBN)
(ESG)
(WSG)
Surveyed by BP/SE
6/25/08
NOL-01
N
DTE Energy
Detroit Edison Company
ENRICO FERMI ATOMIC POWER PLANT
Unit 1
License Termination
TITLE:
Initial Open Land Area Chataecterization Sample Sets
AREA: OOL & NOL
Prepared By: L. Deckins
Issue Date: 05.19.08

Characterization Soil Sample Designation	Tech Initials	Time	Sample Date	Date Sent Offsite for Analysis	Date of Results	H-3	C-14	Na-22	Mn-54	Fe-55	Co-60	Ni-63	Sr-90	Nb-94	Tc-99	Cs-134	Cs-137	Eu-152	Eu-155	Pu-238	Pu-239/240
EF1-CHAR-NOL01-001	DP/SE	8:55	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.007	ND	ND	N/A	N/A
EF1-CHAR-NOL01-001-CT	DP/SE	8:55	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-002	DP/SE	8:42	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.007	ND	ND	N/A	N/A
EF1-CHAR-NOL01-003	DP/SE	8:48	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.008	ND	ND	N/A	N/A
EF1-CHAR-NOL01-004	DP/SE	9:07	6/25/08	N/A	11/26/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-005	DP/SE	9:15	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-005-S	DP/SE	9:15	6/25/08	10/13/2008	11/10/2008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EF1-CHAR-NOL01-006	DP/SE	16:10	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-007	DP/SE	14:39	6/25/08	N/A	12/8/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.017	ND	ND	N/A	N/A
EF1-CHAR-NOL01-008	DP/SE	14:44	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.019	ND	ND	N/A	N/A
EF1-CHAR-NOL01-008-S	DP/SE	14:44	6/25/08	10/13/2008	11/10/2008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.24	ND	ND	ND	ND
EF1-CHAR-NOL01-009	DP/SE	16:12	6/25/08	N/A	11/20/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-010	DP/SE	13:40	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-010-RC	DP/SE	13:40	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-011	DP/SE	13:26	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.014	ND	ND	N/A	N/A
EF1-CHAR-NOL01-012	DP/SE	16:15	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.05	ND	ND	N/A	N/A
EF1-CHAR-NOL01-013	DP/SE	14:00	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.14	ND	ND	N/A	N/A
EF1-CHAR-NOL01-013-RC	DP/SE	14:00	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.13	ND	ND	N/A	N/A
EF1-CHAR-NOL01-014	DP/SE	13:34	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-015	DP/SE	16:18	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-016	DP/SE	13:43	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.016	ND	ND	N/A	N/A
EF1-CHAR-NOL01-017	DP/SE	13:48	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A

Note: Results reported in pCi/g.
ND = indicates no activity >MDA
S = Split Sample
RC = Recount

Mean	0.06
Median	0.02
Std.Dev.	0.08

Characterization Soil Sample Composition	Tech Initials	Time	Sample Date	Date Sent Offsite For Analysis	Date of Results	H-3	C-14	Na-22	Mn-54	Fe-55	Co-60	Ni-63	Sr-90	Nb-94	Tc-99	Cs-134	Cs-137	Eu-152	Eu-155	Pu-238	Pu-239/240	Pu-241	Am-241	Cm-242	Cm-243
F1-CHAR-NUL01-001	DPGB	8:33	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.048	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-001 [illegible]	DPGB	8:35	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-002	DPGB	8:43	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.029	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-003	DPGB	8:48	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.028	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-004	DPGB	9:09	6/25/08	N/A	11/26/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-005	DPGB	9:15	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-005-S	DPGB	9:15	6/25/08	10/13/2008	11/10/2008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
F1-CHAR-NUL01-006	DPGB	14:30	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-007	DPGB	14:39	6/25/08	N/A	12/4/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.012	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-008	DPGB	14:44	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.019	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-008-S	DPGB	14:44	6/25/08	10/13/2008	11/20/2008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.34	ND	ND	ND	ND	ND	ND	ND	ND
F1-CHAR-NUL01-009	DPGB	16:12	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-010	DPGB	15:40	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-010 RC	DPGB	15:40	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-011	DPGB	15:28	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.014	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-012	DPGB	16:15	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.09	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-013	DPGB	14:00	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.14	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-013 RC	DPGB	14:00	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.13	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-014	DPGB	15:34	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-015	DPGB	16:18	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-016	DPGB	15:45	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.016	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A
F1-CHAR-NUL01-017	DPGB	15:48	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A	N/A	N/A	N/A	N/A

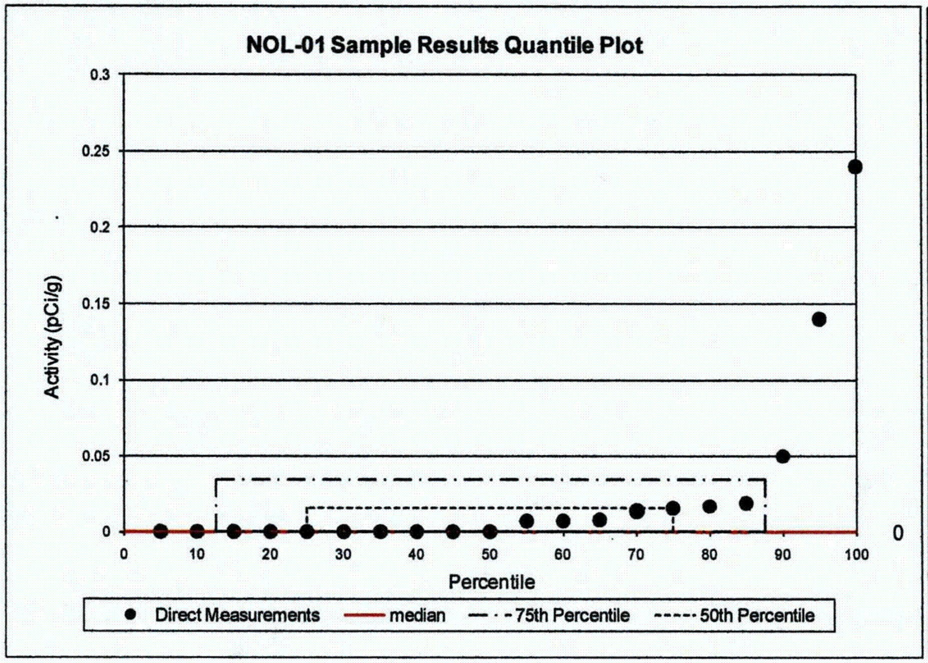
Notes: Results reported in pCi/g
ND - indicates no activity >MDA
S - Split Sample
RC - Recount

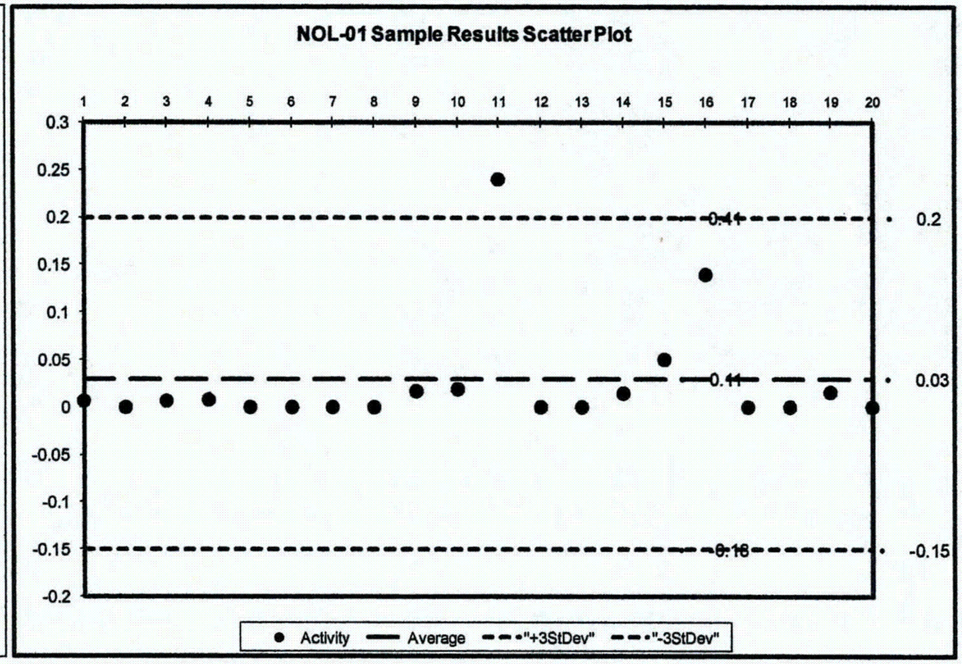
Mean 0.06
Median 0.02
Std Dev 0.08

Characterization Soil Sample Designation	Tech Initials	Time	Sample Date	Date Sent Offsite for Analysis	Date of Results	H-3	C-14	Na-22	Mn-54	Fe-55	Co-60	Ni-63	Sr-90	Nb-94	Tc-99	Cs-134
EF1-CHAR-NOL01-	DP/SE	8:55	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	8:55	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	8:42	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	8:48	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	9:07	6/25/08	N/A	11/26/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	9:15	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	9:15	6/25/08	10/13/2008	11/10/2008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EF1-CHAR-NOL01-	DP/SE	16:10	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	14:39	6/25/08	N/A	12/8/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	14:44	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	14:44	6/25/08	10/13/2008	11/10/2008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EF1-CHAR-NOL01-	DP/SE	16:12	6/25/08	N/A	11/20/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	13:40	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	13:40	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	13:26	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	16:15	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	14:00	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	14:00	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	13:34	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	16:18	6/25/08	N/A	11/25/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	13:43	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND
EF1-CHAR-NOL01-	DP/SE	13:48	6/25/08	N/A	11/24/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND

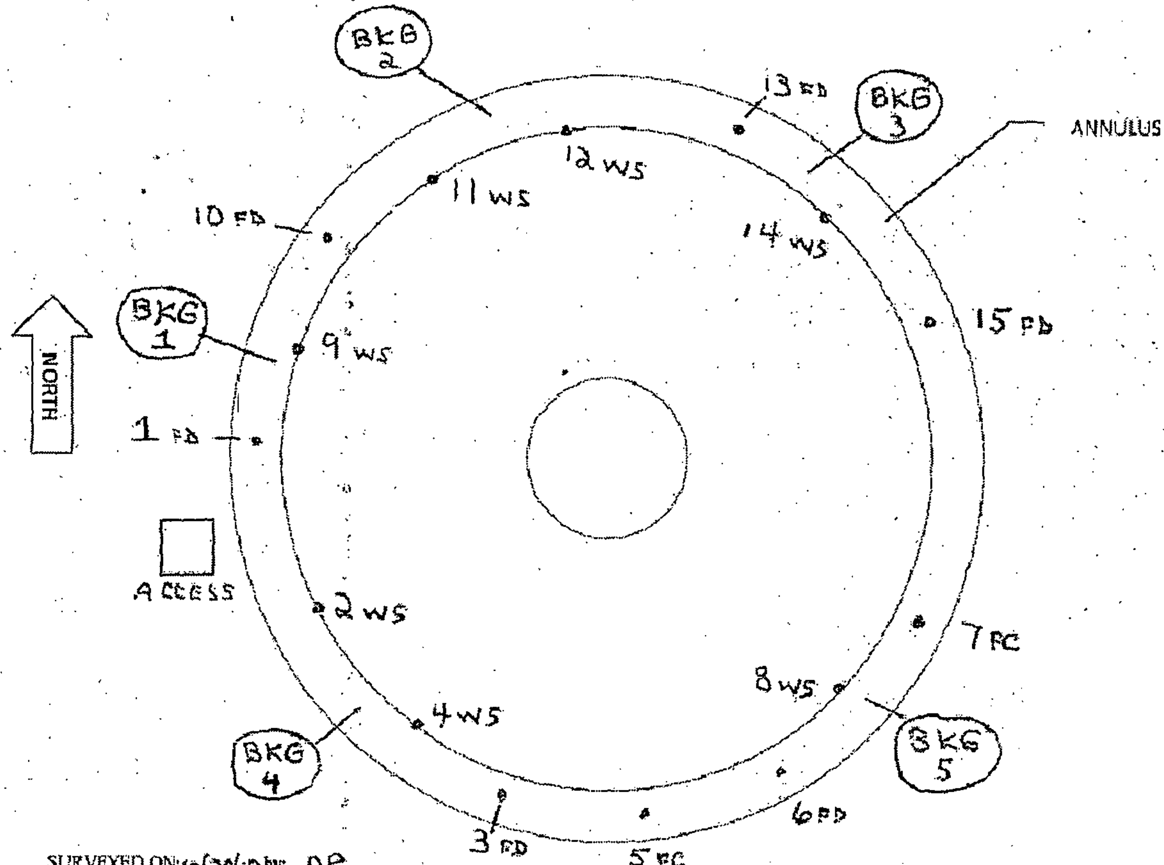
Characterization Soil Sample Designation	Tech Initials	Time	Sample Date	Date Sent Offsite for Analysis	Date of Results	H-3	C-14	Na-22	Mn-54	Fe-55	Co-60	Ni-63	Sr-90	Nb-94	Tc-99	Cs-134	Cs-137	Eu-152	Eu-155	Pu-238	Pu-239/240
EF1-CHAR-NOL01-001	DP/SE	8:55	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.007	ND	ND	N/A	N/A
EF1-CHAR-NOL01-001-CT	DP/SE	8:55	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-002	DP/SE	8:42	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.007	ND	ND	N/A	N/A
EF1-CHAR-NOL01-003	DP/SE	8:48	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.008	ND	ND	N/A	N/A
EF1-CHAR-NOL01-004	DP/SE	9:07	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-005	DP/SE	9:15	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-005-S	DP/SE	9:15	6/25/08	10/13/2008	#########	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EF1-CHAR-NOL01-006	DP/SE	16:10	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-007	DP/SE	14:39	6/25/08	N/A	12/8/2008	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.017	ND	ND	N/A	N/A
EF1-CHAR-NOL01-008	DP/SE	14:44	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.019	ND	ND	N/A	N/A
EF1-CHAR-NOL01-008-S	DP/SE	14:44	6/25/08	10/13/2008	#########	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.24	ND	ND	ND	ND
EF1-CHAR-NOL01-009	DP/SE	16:12	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-010	DP/SE	13:40	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-010-RC	DP/SE	13:40	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-011	DP/SE	13:26	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.014	ND	ND	N/A	N/A
EF1-CHAR-NOL01-012	DP/SE	16:15	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.05	ND	ND	N/A	N/A
EF1-CHAR-NOL01-013	DP/SE	14:00	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.14	ND	ND	N/A	N/A
EF1-CHAR-NOL01-013-RC	DP/SE	14:00	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.13	ND	ND	N/A	N/A
EF1-CHAR-NOL01-014	DP/SE	13:34	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-015	DP/SE	16:18	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
EF1-CHAR-NOL01-016	DP/SE	13:43	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	0.016	ND	ND	N/A	N/A
EF1-CHAR-NOL01-017	DP/SE	13:48	6/25/08	N/A	#########	N/A	N/A	ND	ND	N/A	ND	N/A	N/A	ND	N/A	ND	ND	ND	ND	N/A	N/A
					Mean												0.06				
					Median												0.02				
					Std.Dev.												0.08				

Note: Results reported in pCi/g.
ND = indicates no activity >MDA
S = Split Sample
RC = Recount


NOL-01 Sample Results Quantile Plot
Activity (pCi/g)
Percentile
Direct Measurements
median
75th Percentile
50th Percentile


NOL-01 Sample Results Scatter Plot
Activity
Average
"+3StDev"
"-3StDev"

RXB01-02 552' Elev. Reactor Building Annulus



SURVEYED ON: 10/20/08 by: DP

Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 94 scfm @ 1230
1630

Instrument / Serial No.
2350-1/ 186193

Probe No. / Serial No.
D3 43-68/ PR-178065

	Instrument	Time	BKG	SOURCE	Sat/Unsat	Initials
Daily		0735	244	1263	SAT	DP
End of Shift		1647	242	1281	SAT	DP
Daily						
End of Shift						

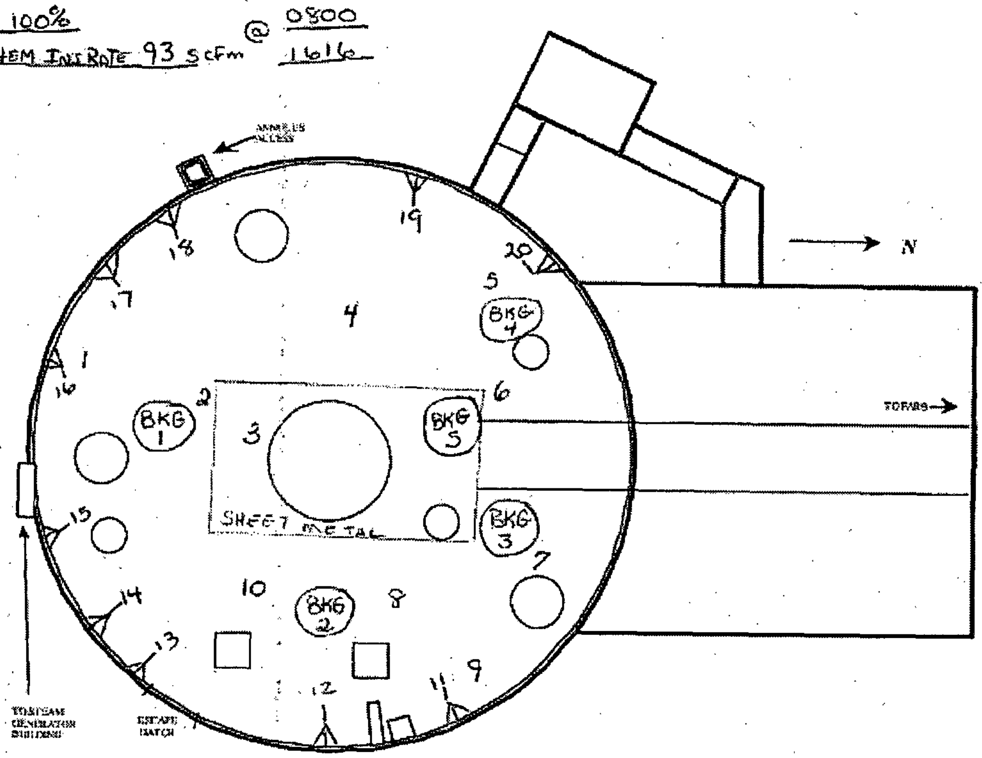
Comments:
FC - Floor Concrete
WS - Wall Steel
FD - Floor Drain

BKG = Ambient Background

RXB-01

590' ELEV

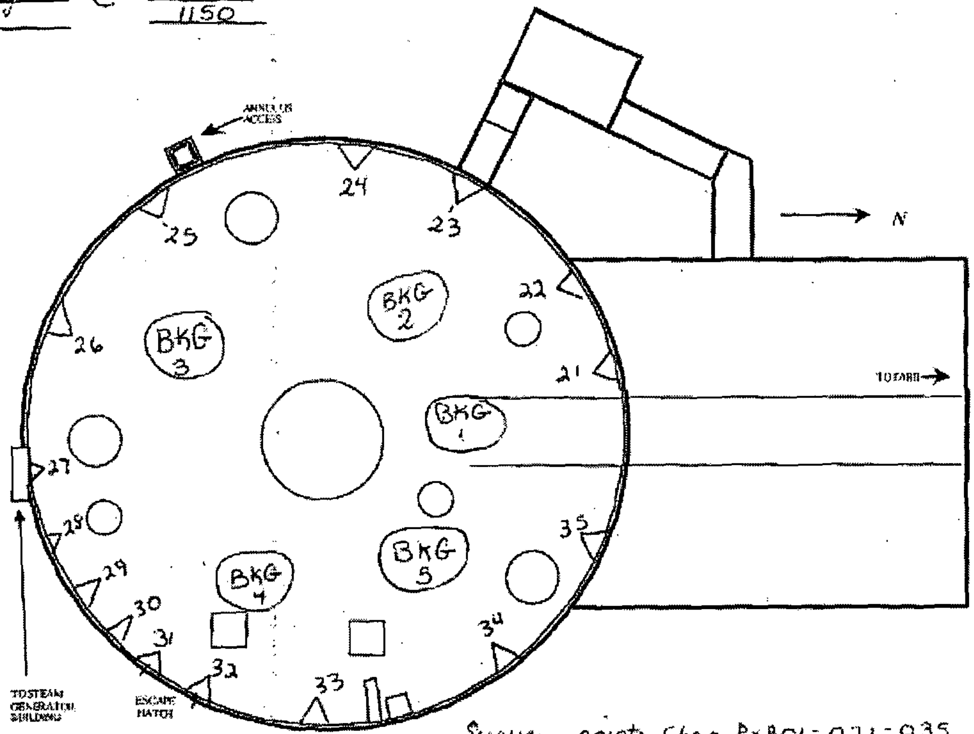
REActor Power 100% @ 0800
HydrogenWATER CHEM InJ RATE 93 scfm 1616



9/10/08 DP/se SMEARS AND SURVEY Points 1-10 Floor
(BKG #) = BKG TAKEN 11-20 WALL
NO SPA-3 SURVEY REQUIRED
Instruments used - 2350-1 Serial # 189090
D-3/4368 Serial #PR178065

CHARACTERIZATION
RXB-01
ELEV 590'

Reactor Power 100%
Hydrogen Water Chem. Ly acte @ 0900
1150



Instrument / Serial #
3350-1 / 186199
D 3 4368 / PR 178065

Survey points Char RxB01-021-035 fixed points on wall >6' - <12' no smears taken 9/11/08 DP/se not required 021-035

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID
43-68	PR178065	5/29/2008	Drain	CHAR-RXB01-02-001-F-M	Floor	552EL	10/20/2008 15:58	320	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Steel	CHAR-RXB01-02-002-F-M	Wall	552EL	10/20/2008 15:55	129	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Drain	CHAR-RXB01-02-003-F-M	Floor	552EL	10/20/2008 15:50	330	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Steel	CHAR-RXB01-02-004-F-M	Wall	552EL	10/20/2008 15:52	150	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-02-005-F-M	Floor	552EL	10/20/2008 15:46	416	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Drain	CHAR-RXB01-02-006-F-M	Floor	552EL	10/20/2008 15:43	400	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-02-007-F-M	Floor	552EL	10/20/2008 15:37	371	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Steel	CHAR-RXB01-02-008-F-M	Wall	552EL	10/20/2008 15:40	359	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Steel	CHAR-RXB01-02-009-F-M	Wall	552EL	10/20/2008 16:01	171	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Drain	CHAR-RXB01-02-010-F-M	Floor	552EL	10/20/2008 16:04	281	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Steel	CHAR-RXB01-02-011-F-M	Wall	552EL	10/20/2008 16:06	200	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Steel	CHAR-RXB01-02-012-F-M	Wall	552EL	10/20/2008 16:09	168	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Drain	CHAR-RXB01-02-013-F-M	Floor	552EL	10/20/2008 16:12	263	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Steel	CHAR-RXB01-02-014-F-M	Wall	552EL	10/20/2008 16:15	154	c	60	log scalar	186193	DP/SE
43-68	PR178065	5/29/2008	Drain	CHAR-RXB01-02-015-F-M	Floor	552EL	10/20/2008 16:17	264	c	60	log scalar	186193	DP/SE

Average = 265.07
Median = 264.00
STDEV = 98.24
Minimum = 129.00
Maximum = 416.00

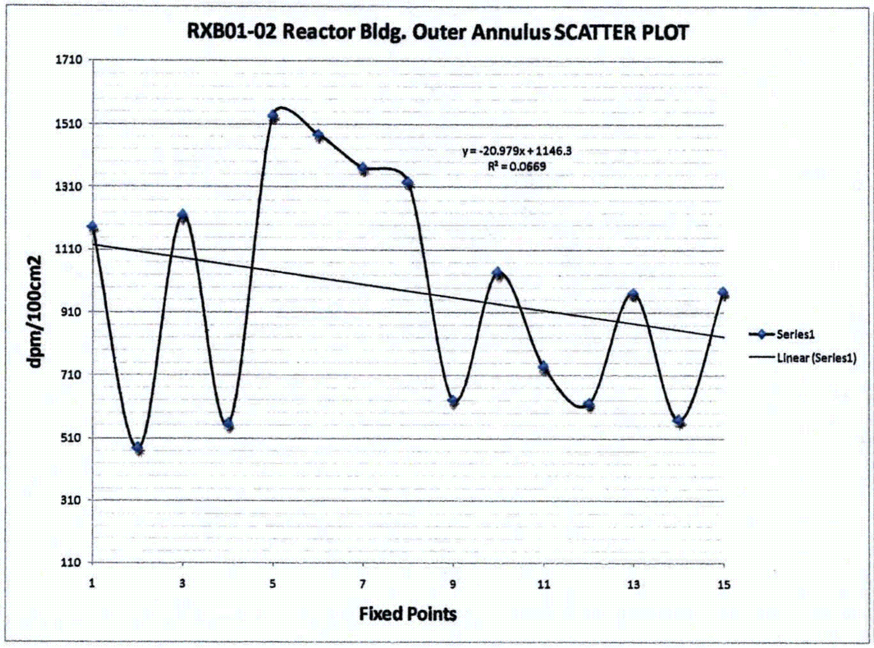
Location	dpm/100cm^2
CHAR-RXB01-02-001-F-M	1181
CHAR-RXB01-02-002-F-M	476
CHAR-RXB01-02-003-F-M	1218
CHAR-RXB01-02-004-F-M	554
CHAR-RXB01-02-005-F-M	1536
CHAR-RXB01-02-006-F-M	1477
CHAR-RXB01-02-007-F-M	1370
CHAR-RXB01-02-008-F-M	1325
CHAR-RXB01-02-009-F-M	631
CHAR-RXB01-02-010-F-M	1037
CHAR-RXB01-02-011-F-M	738
CHAR-RXB01-02-012-F-M	620
CHAR-RXB01-02-013-F-M	971
CHAR-RXB01-02-014-F-M	568
CHAR-RXB01-02-015-F-M	975

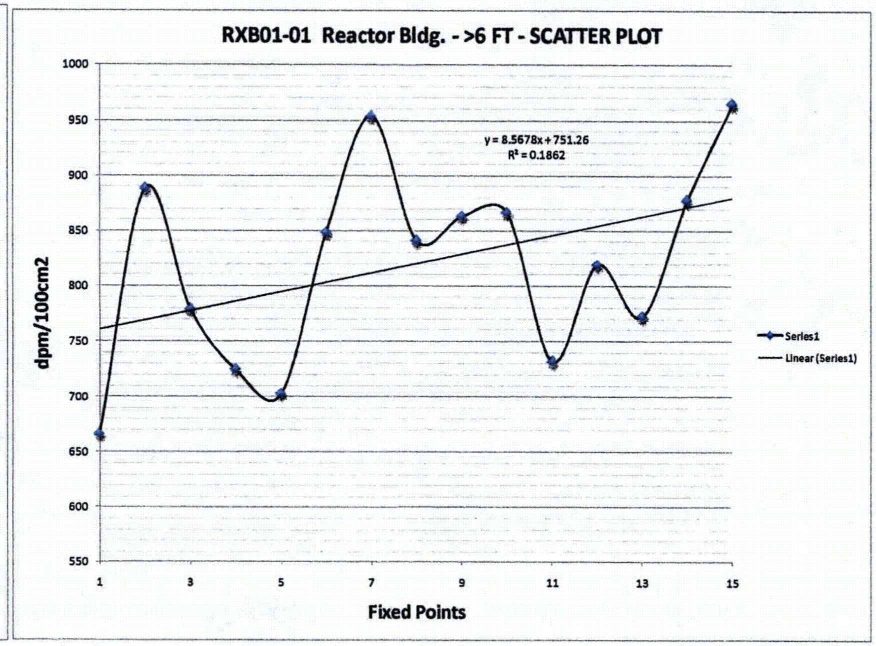
RXB-01 Annulus

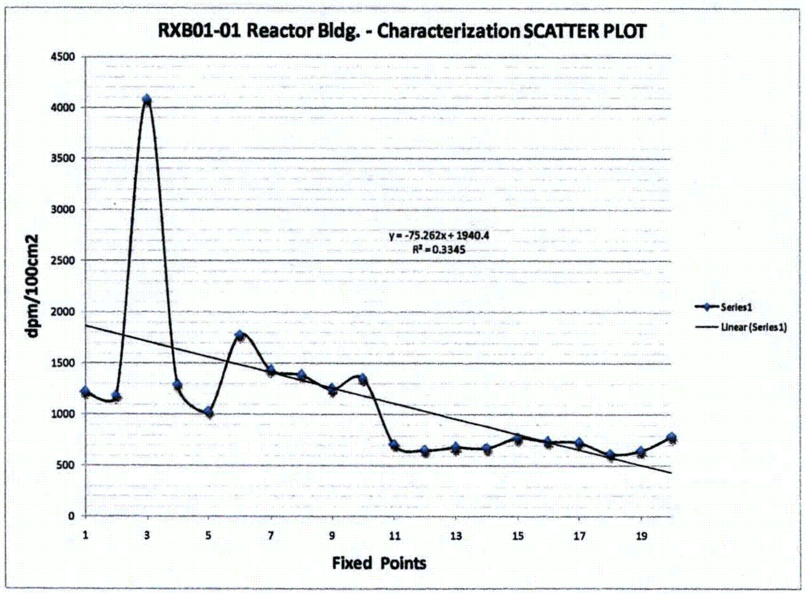
Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-001-F-M	Floor	590	9/10/2008 11:18	335	c	60	log scalar	189090	SE	1220
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-002-F-M	Floor	590	9/10/2008 11:21	325	c	60	log scalar	189090	SE	1183
43-68	PR178065	5/29/2008	Sheet Metal	CHAR-RXB01-01-003-F-M	Floor	590	9/10/2008 11:23	1121	c	60	log scalar	189090	SE	4081
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-004-F-M	Floor	590	9/10/2008 11:27	354	c	60	log scalar	189090	SE	1289
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-005-F-M	Floor	590	9/10/2008 11:29	282	c	60	log scalar	189090	SE	1027
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-006-F-M	Floor	590	9/10/2008 11:31	488	c	60	log scalar	189090	SE	1776
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-007-F-M	Floor	590	9/10/2008 11:33	394	c	60	log scalar	189090	SE	1434
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-008-F-M	Floor	590	9/10/2008 11:35	381	c	60	log scalar	189090	SE	1387
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-009-F-M	Floor	590	9/10/2008 11:37	343	c	60	log scalar	189090	SE	1249
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-010-F-M	Floor	590	9/10/2008 11:39	372	c	60	log scalar	189090	SE	1354
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-011-F-M	Wall	590	9/10/2008 13:56	195	c	60	log scalar	189090	SE	710
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-012-F-M	Wall	590	9/10/2008 13:58	179	c	60	log scalar	189090	SE	652
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-013-F-M	Wall	590	9/10/2008 14:00	187	c	60	log scalar	189090	SE	681
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-014-F-M	Wall	590	9/10/2008 14:03	185	c	60	log scalar	189090	SE	673
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-015-F-M	Wall	590	9/10/2008 14:07	212	c	60	log scalar	189090	SE	772
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-016-F-M	Wall	590	9/10/2008 14:09	203	c	60	log scalar	189090	SE	739
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-017-F-M	Wall	590	9/10/2008 14:12	200	c	60	log scalar	189090	SE	728
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-018-F-M	Wall	590	9/10/2008 14:14	169	c	60	log scalar	189090	SE	615
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-019-F-M	Wall	590	9/10/2008 14:17	178	c	60	log scalar	189090	SE	648
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-020-F-M	Wall	590	9/10/2008 14:19	216	c	60	log scalar	189090	SE	786

	cpm	dpm/100cm2
Average =	315.95	1150
Median =	249.00	906
STDEV =	211.48	770
Minimum =	169.00	615
Maximum =	1121.00	4081

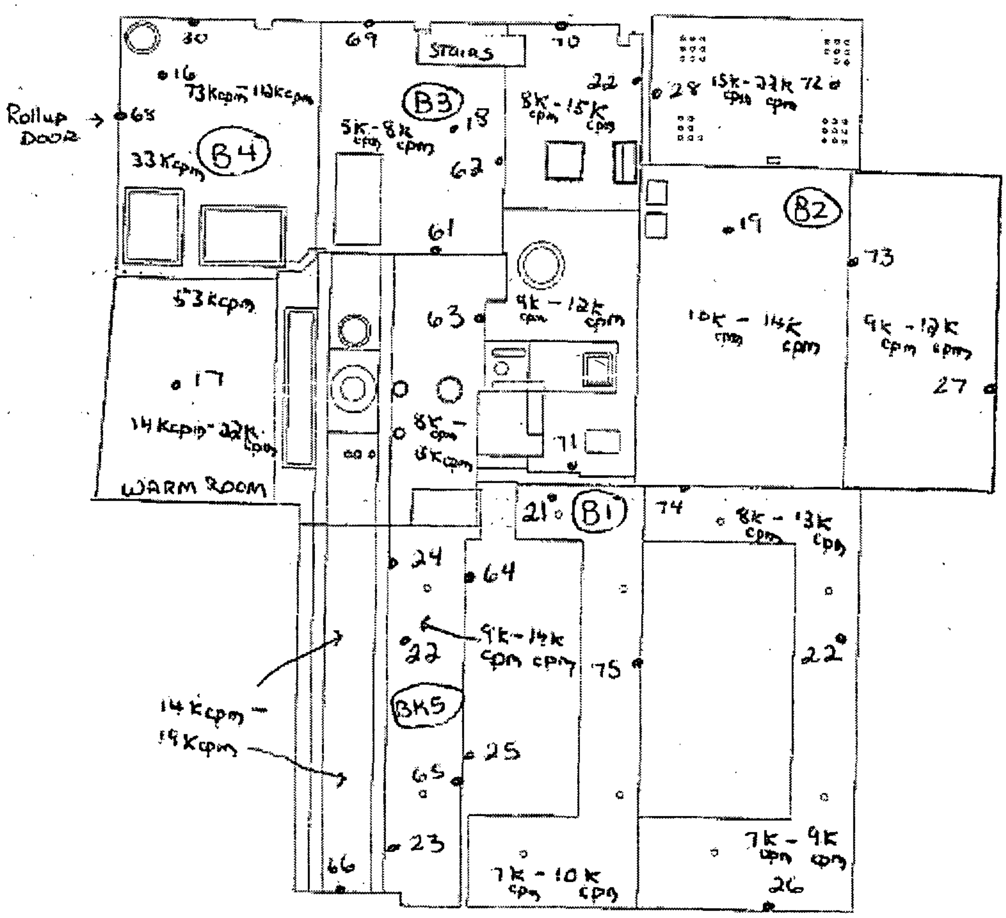
Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	2350(-1) Serial N	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-021-F-M	Wall >6ft	590	9/11/2008 10:21	183	c	60	log scalar	186199	DP/SE	666
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-022-F-M	Wall >6ft	590	9/11/2008 10:23	244	c	60	log scalar	186199	DP/SE	888
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-023-F-M	Wall >6ft	590	9/11/2008 10:26	214	c	60	log scalar	186199	DP/SE	779
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-024-F-M	Wall >6ft	590	9/11/2008 10:28	199	c	60	log scalar	186199	DP/SE	724
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-025-F-M	Wall >6ft	590	9/11/2008 10:30	193	c	60	log scalar	186199	DP/SE	703
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-026-F-M	Wall >6ft	590	9/11/2008 10:34	233	c	60	log scalar	186199	DP/SE	848
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-027-F-M	Wall >6ft	590	9/11/2008 10:35	262	c	60	log scalar	186199	DP/SE	954
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-028-F-M	Wall >6ft	590	9/11/2008 10:37	231	c	60	log scalar	186199	DP/SE	841
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-029-F-M	Wall >6ft	590	9/11/2008 10:39	237	c	60	log scalar	186199	DP/SE	863
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-030-F-M	Wall >6ft	590	9/11/2008 10:43	238	c	60	log scalar	186199	DP/SE	866
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-031-F-M	Wall >6ft	590	9/11/2008 10:44	201	c	60	log scalar	186199	DP/SE	732
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-032-F-M	Wall >6ft	590	9/11/2008 10:46	225	c	60	log scalar	186199	DP/SE	819
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-033-F-M	Wall >6ft	590	9/11/2008 10:48	212	c	60	log scalar	186199	DP/SE	772
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-034-F-M	Wall >6ft	590	9/11/2008 10:49	241	c	60	log scalar	186199	DP/SE	877
43-68	PR178065	5/29/2008	Concrete	CHAR-RXB01-01-035-F-M	Wall >6ft	590	9/11/2008 10:51	265	c	60	log scalar	186199	DP/SE	965
													dpm/100cm2	
								Average = 225.20					**Average = 820**	
								Median = 231.00					**Median = 841**	
								STDEV = 24.39					**STDEV = 89**	
								Minimum = 183.00					**Minimum = 666**	
								Maximum = 265.00					**Maximum = 965**	


RXB01-02 Reactor Bldg. Outer Annulus SCATTER PLOT
y = -20.979x + 1146.3
R² = 0.0669
dpm/100cm2
Fixed Points
Series1
Linear (Series1)


RXB01-01 Reactor Bldg. - >6 FT - SCATTER PLOT
y = 8.5678x + 751.26
R² = 0.1862
dpm/100cm2
Fixed Points
Series1
Linear (Series1)


RXB01-01 Reactor Bldg. - Characterization SCATTER PLOT
y = -75.262x + 1940.4
R² = 0.3345
dpm/100cm2
Fixed Points
Series1
Linear (Series1)

FRB01 590' elev.



Instrument / Serial No.
2350-1 / 186199

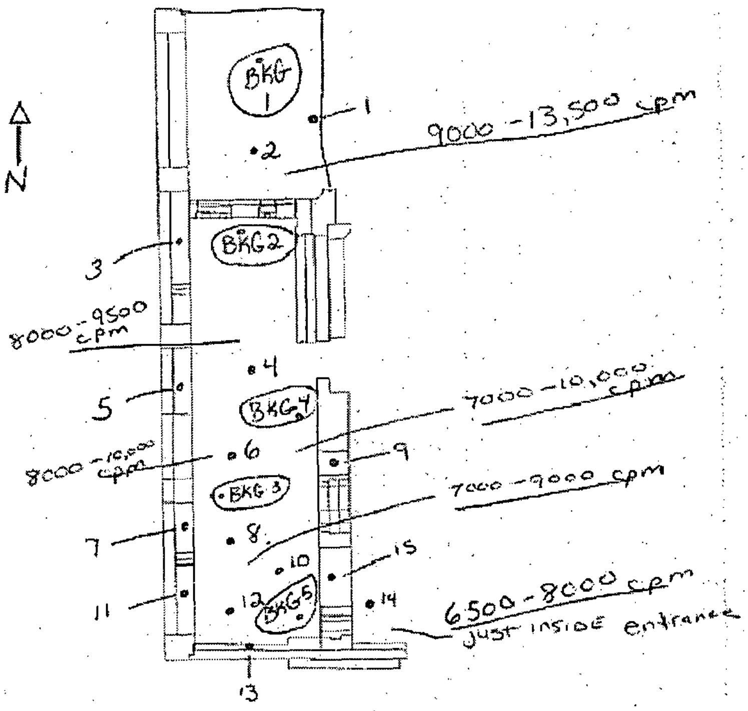
Probe No. / Serial No.
D3-4368 / 178065
D1-SPA3 / 2081

Reactor Power 100 %
Hydrogen Water
Chemistry Inject. Rate 93SCFM @ 1020
1635

Comments: 9/17/08 DP/Se
(B#) = BACKGROUND
060 - on rollupdoor cover shield in Trestle way
066 - on rollupdoor by warm room
(B4) and locations 016, 068, 069, 030 - near rolloff .05mR/hr

CHARACTERIZATION

FRB-01 Maintenance Pit



Reactor Power 100%
Hydrogen Water Chem Inject Rate 93 scfm
@ 0845 and 1645

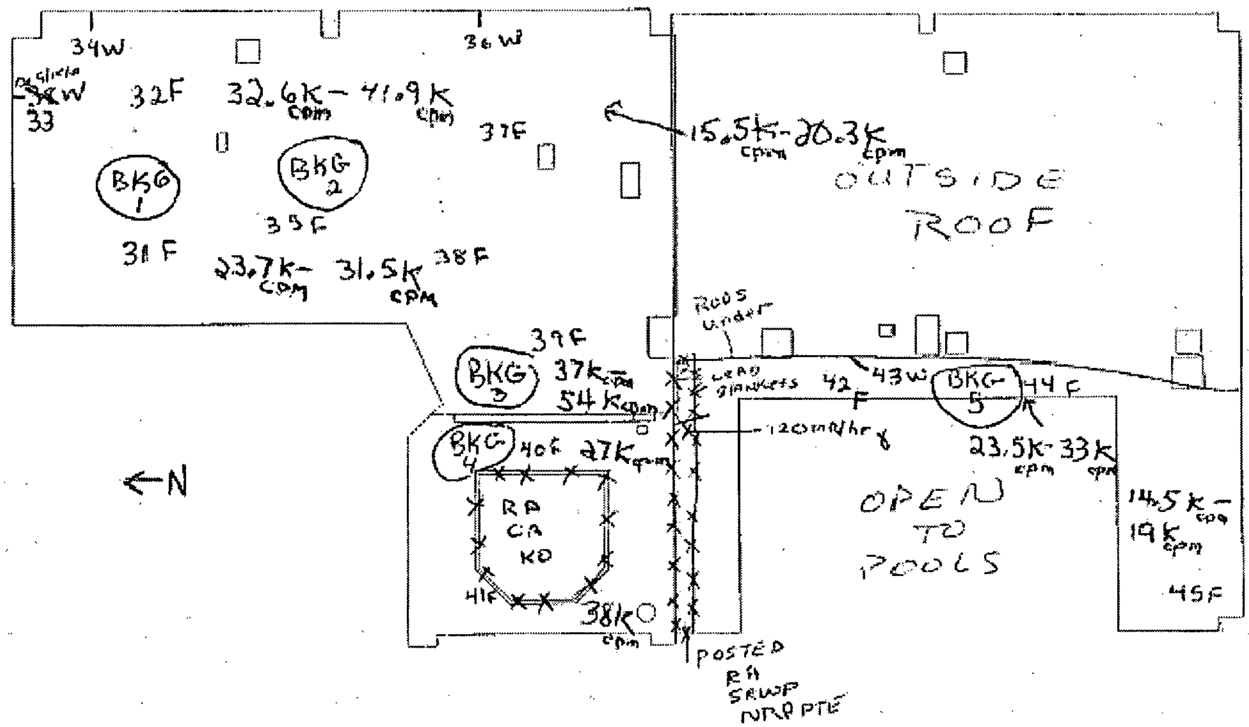
Instrument / Serial No.
2350-1 / 189090

D3-4368 / PR178065

Instrument / Serial No.
2350-1 / 186199
Probe No / Serial No.
Spa3 D-3 / 2081

Surveyed on 9/22/08 by DP/SC
See fixed point paper for more details
Spa3 Daily BKG@0826 7732cpm Source 44891 SAT
End of Shift BKG @1624 7360cpm Source 44706 SAT

FRB01 Mezzanine



W = CW = Corregated ASBESTOS TRAS. wall

F Floor Concrete

Surveyed on 9/18/09
DP / Se

Rx Power 100%
Hydrogen Water
Chem Inj Rate
935cfm
@ 0730
1606

BKG/source –
SEE
FRB01-MZ FM
page

Instrument/ Serial NO.
2350-1 / 189090
D 3/4368/ PR-178065
2350-1 / 156199
SPA3 01 / 2051

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete Floor	CHAR-FRB-01-016-F-M	<6ft 590' EL	9/17/2008 16:10	680	c	60	log scalar	186199	DP/SE	2514
43-68	PR178065	5/29/2008	Concrete Floor	CHAR-FRB-01-017-F-M	<6ft 590' EL	9/17/2008 16:30	566	c	60	log scalar	186199	DP/SE	2092
43-68	PR178065	5/29/2008	Concrete Floor	CHAR-FRB-01-018-F-M	<6ft 590' EL	9/17/2008 16:14	748	c	60	log scalar	186199	DP/SE	2765
43-68	PR178065	5/29/2008	Concrete Floor	CHAR-FRB-01-019-F-M	<6ft 590' EL	9/17/2008 16:20	394	c	60	log scalar	186199	DP/SE	1457
43-68	PR178065	5/29/2008	Concrete Floor	CHAR-FRB-01-020-F-M	<6ft 590' EL	9/17/2008 16:23	470	c	60	log scalar	186199	DP/SE	1738
43-68	PR178065	5/29/2008	Concrete Floor	CHAR-FRB-01-021-F-M	<6ft 590' EL	9/17/2008 16:26	419	c	60	log scalar	186199	DP/SE	1549
43-68	PR178065	5/29/2008	Concrete Floor	CHAR-FRB-01-022-F-M	<6ft 590' EL	9/17/2008 16:07	595	c	60	log scalar	186199	DP/SE	2200
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-023-F-M	<6ft 590' EL	9/17/2008 16:05	434	c	60	log scalar	186199	DP/SE	1604
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-024-F-M	<6ft 590' EL	9/17/2008 16:08	438	c	60	log scalar	186199	DP/SE	1619
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-025-F-M	<6ft 590' EL	9/17/2008 16:28	405	c	60	log scalar	186199	DP/SE	1497
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-026-F-M	<6ft 590' EL	9/17/2008 16:25	332	c	60	log scalar	186199	DP/SE	1227
43-68	PR178065	5/29/2008	Corr. Transient	CHAR-FRB-01-027-F-M	<6ft 590' EL	9/17/2008 16:21	470	c	60	log scalar	186199	DP/SE	1738
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-028-F-M	<6ft 590' EL	9/17/2008 16:18	367	c	60	log scalar	186199	DP/SE	1357
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-029-F-M	<6ft 590' EL	9/17/2008 16:16	491	c	60	log scalar	186199	DP/SE	1815
43-68	PR178065	5/29/2008	Corr. Transient	CHAR-FRB-01-030-F-M	<6ft 590' EL	9/17/2008 16:12	1329	c	60	log scalar	186199	DP/SE	4913

Average = 542.53
Median = 470.00
STDEV = 246.43
Minimum = 332.00
Maximum = 1329.00

Average = 2006
Median = 1738
STDEV = 911
Minimum = 1227
Maximum = 4913

Model No.	Serial No.	Cal Date	Survey Mat.	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-001-F-M	Wall	MN	9/22/2008 14:26	336	c	60	log scalar	189090	SE	1242
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-002-F-M	Floor	MN	9/22/2008 14:20	1400	c	60	log scalar	189090	SE	5176
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-003-F-M	Wall	MN	9/22/2008 14:17	328	c	60	log scalar	189090	SE	1213
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-004-F-M	Floor	MN	9/22/2008 14:13	520	c	60	log scalar	189090	SE	1922
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-005-F-M	Wall	MN	9/22/2008 14:10	331	c	60	log scalar	189090	SE	1224
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-006-F-M	Floor	MN	9/22/2008 14:06	605	c	60	log scalar	189090	SE	2237
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-007-F-M	Wall	MN	9/22/2008 14:03	338	c	60	log scalar	189090	SE	1250
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-008-F-M	Floor	MN	9/22/2008 14:00	543	c	60	log scalar	189090	SE	2007
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-009-F-M	Wall	MN	9/22/2008 13:57	350	c	60	log scalar	189090	SE	1294
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-010-F-M	Floor	MN	9/22/2008 13:53	426	c	60	log scalar	189090	SE	1575
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-011-F-M	Wall	MN	9/22/2008 13:48	299	c	60	log scalar	189090	SE	1105
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-012-F-M	Floor	MN	9/22/2008 13:45	398	c	60	log scalar	189090	SE	1471
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-013-F-M	Wall	MN	9/22/2008 13:43	306	c	60	log scalar	189090	SE	1131
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-014-F-M	Floor	MN	9/22/2008 13:29	383	c	60	log scalar	189090	SE	1416
43-68	PR178065	5/29/2008	Concrete	CHAR-FRB-01-015-F-M	Wall	MN	9/22/2008 13:40	286	c	60	log scalar	189090	SE	1057

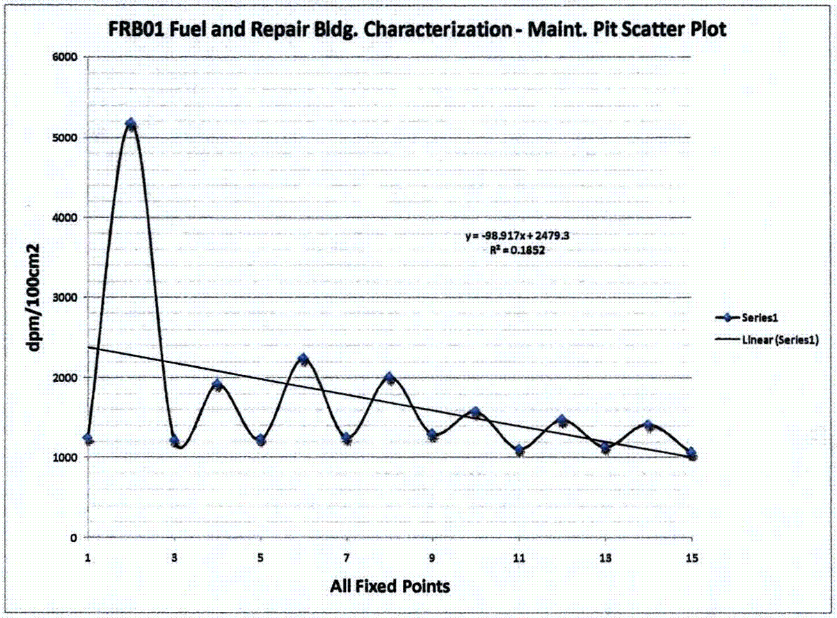
MN = Maintenance Pit

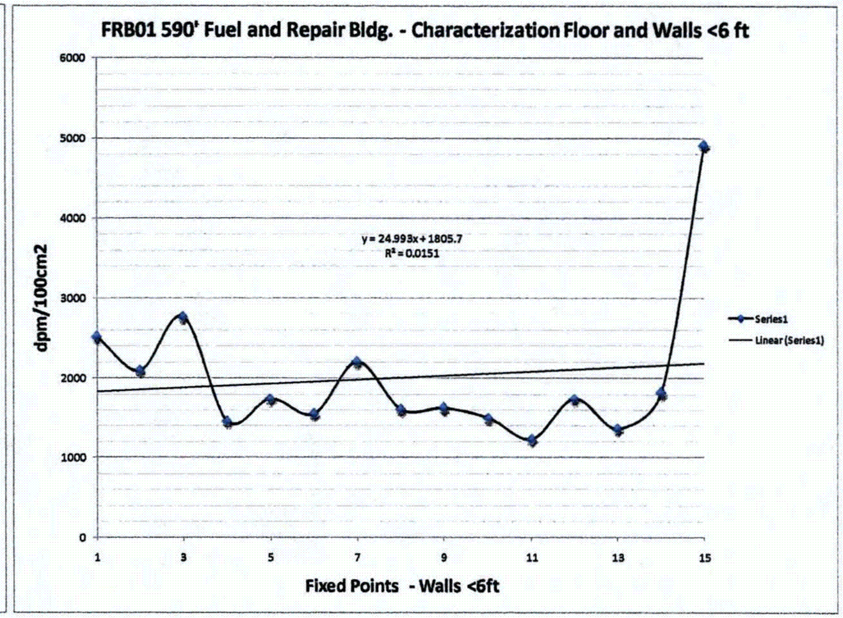
Average = 456.60
Median = 350.00
STDEV = 278.03
Minimum = 286.00
Maximum = 1400.00

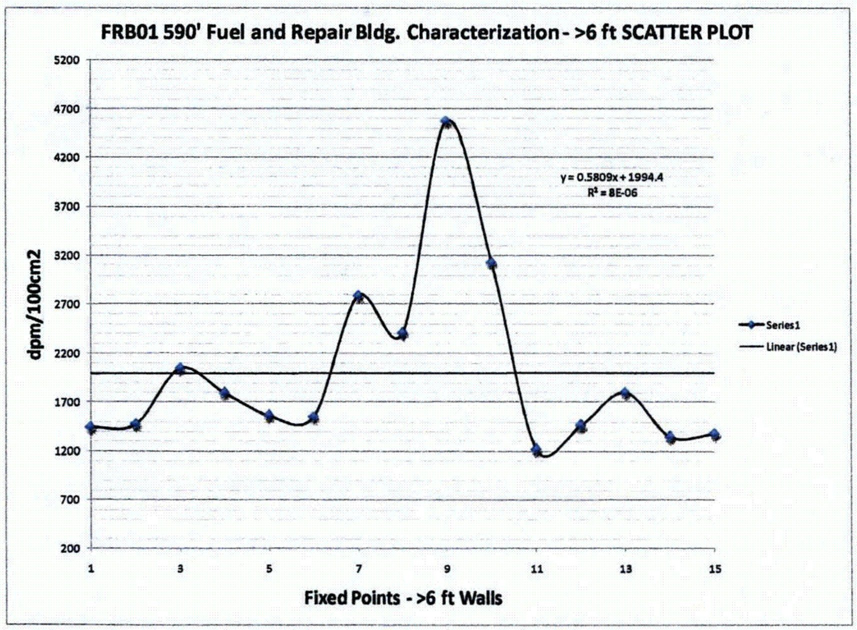
Average = 1688
Median = 1294
STDEV = 1028
Minimum = 1057
Maximum = 5176

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-061-F-M	>6 ft 590' EL	9/17/2008 13:20	390	c	60	log scalar	186199	DP/SE	1442
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-062-F-M	>6 ft 590' EL	9/17/2008 13:24	399	c	60	log scalar	186199	DP/SE	1475
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-063-F-M	>6 ft 590' EL	9/17/2008 13:29	553	c	60	log scalar	186199	DP/SE	2044
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-064-F-M	>6 ft 590' EL	9/17/2008 13:37	486	c	60	log scalar	186199	DP/SE	1797
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-065-F-M	>6 ft 590' EL	9/17/2008 13:41	423	c	60	log scalar	186199	DP/SE	1564
43-68	PR178065	5/29/2008	Cover shield	CHAR-FRB-01-066-F-M	>6 ft 590' EL	9/17/2008 13:45	420	c	60	log scalar	186199	DP/SE	1553
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-067-F-M	>6 ft 590' EL	9/17/2008 13:52	754	c	60	log scalar	186199	DP/SE	2787
43-68	PR178065	5/29/2008	Roll-up Door	CHAR-FRB-01-068-F-M	>6 ft 590' EL	9/17/2008 13:57	651	c	60	log scalar	186199	DP/SE	2407
43-68	PR178065	5/29/2008	Corr. Transient	CHAR-FRB-01-069-F-M	>6 ft 590' EL	9/17/2008 14:10	1238	c	60	log scalar	186199	DP/SE	4577
43-68	PR178065	5/29/2008	Corr. Transient	CHAR-FRB-01-070-F-M	>6 ft 590' EL	9/17/2008 14:20	846	c	60	log scalar	186199	DP/SE	3128
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-071-F-M	>6 ft 590' EL	9/17/2008 14:26	330	c	60	log scalar	186199	DP/SE	1220
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-072-F-M	>6 ft 590' EL	9/17/2008 14:34	396	c	60	log scalar	186199	DP/SE	1464
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-073-F-M	>6 ft 590' EL	9/17/2008 14:39	487	c	60	log scalar	186199	DP/SE	1800
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-074-F-M	>6 ft 590' EL	9/17/2008 14:43	365	c	60	log scalar	186199	DP/SE	1349
43-68	PR178065	5/29/2008	Concrete Wall	CHAR-FRB-01-075-F-M	>6 ft 590' EL	9/17/2008 14:47	373	c	60	log scalar	186199	DP/SE	1379

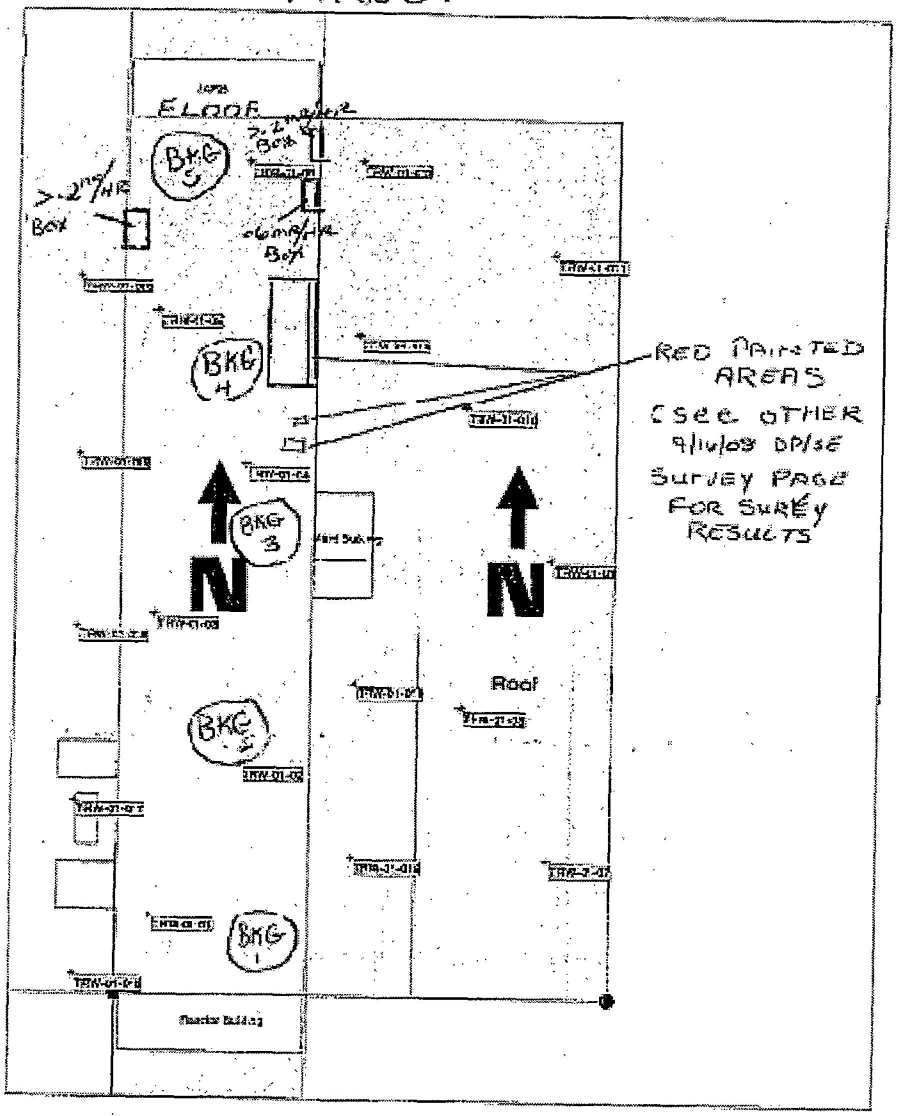
	Logged Reading		Last column
Average =	**540.73**	**Average =**	**1999**
Median =	**423.00**	**Median =**	**1564**
STDEV =	**244.75**	**STDEV =**	**905**
Minimum =	**330.00**	**Minimum =**	**1220**
Maximum =	**1238.00**	**Maximum =**	**4577**


FRB01 Fuel and Repair Bldg. Characterization - Maint. Pit Scatter Plot
dpm/100cm2
y = -98.917x + 2479.3
R² = 0.1852
Series1
Linear (Series1)
All Fixed Points


FRB01 590' Fuel and Repair Bldg. - Characterization Floor and Walls <6 ft
dpm/100cm2
y = 24.993x + 1805.7
R² = 0.0151
Series1
Linear (Series1)
Fixed Points - Walls <6ft


FRB01 590' Fuel and Repair Bldg. Characterization - >6 ft SCATTER PLOT
dpm/100cm2
y = 0.5809x + 1994.4
R² = 8E-06
Series1
Linear (Series1)
Fixed Points - >6 ft Walls

TRW01



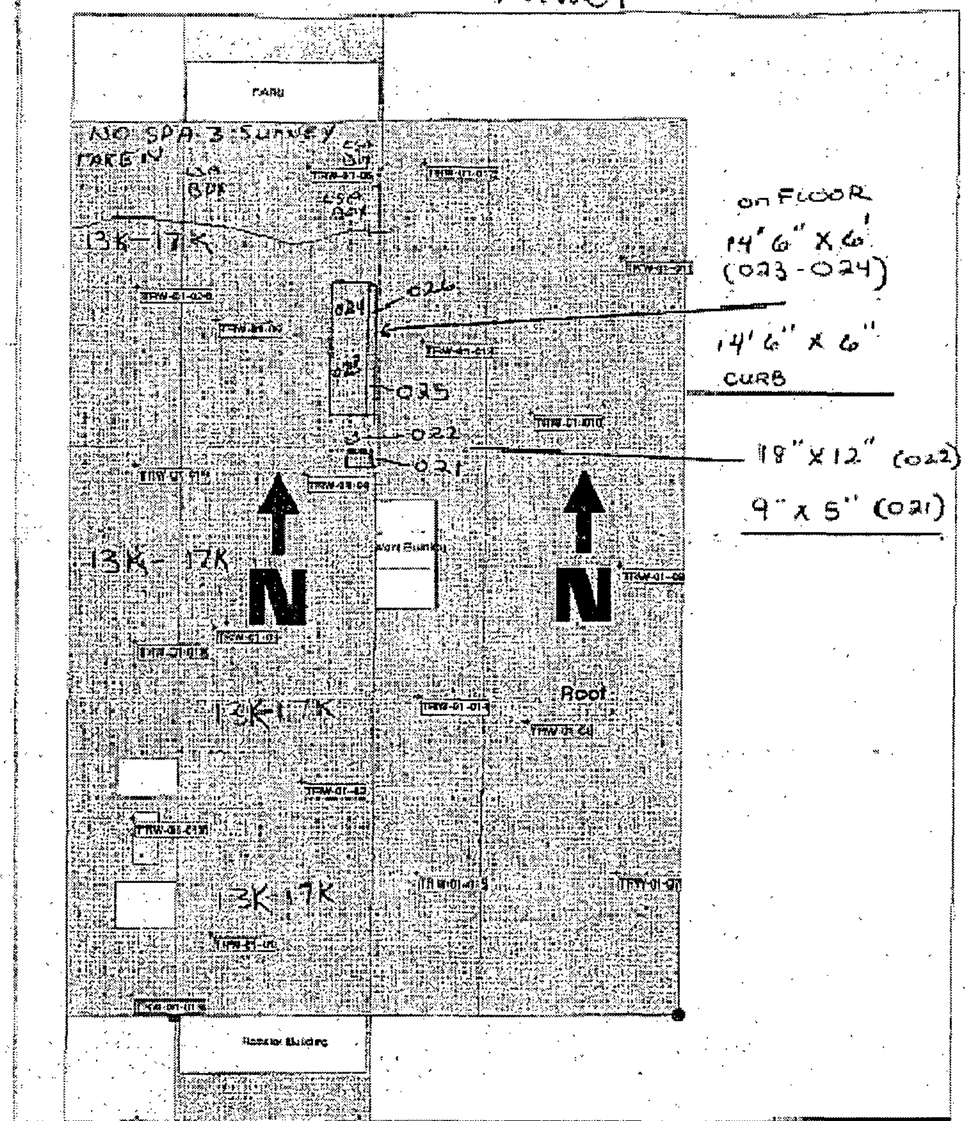
Instrument / Serial No.
2350-1 / 189090

Probe No. / Serial No.
D3 43-68 / PR178065

Reactor Power 100 %
Hydrogen Water
Chemistry Inject. Rate 93 SCFM @ 0715
1550

Comments: BACKGROUND READINGS TAKEN
DP/SE 9/15/08

TRW01



Instrument / Serial No.
2350-1 / 186199

Probe No. / Serial No.
D3 43681 PR 178065

Reactor Power 100 %
Hydrogen Water
Chemistry Inject. Rate 93SCFM @ 0815
1615
9/16/08 DP/se

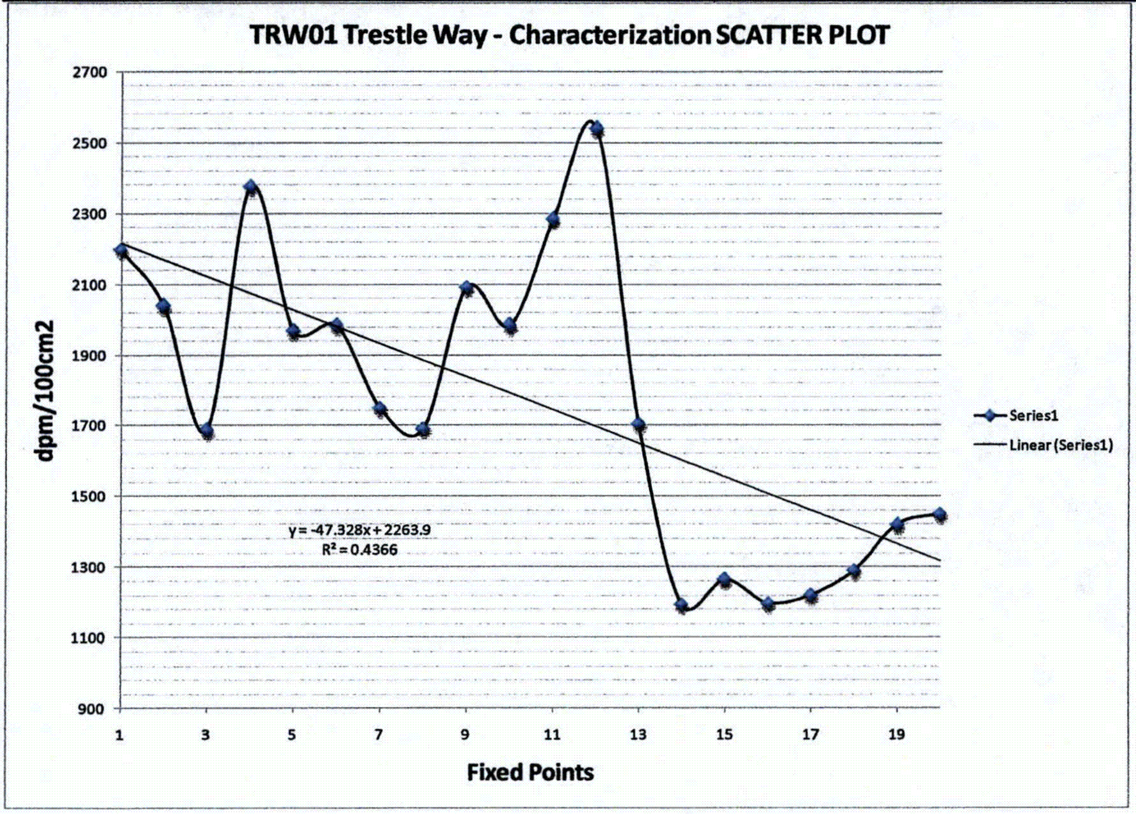
Comments: Survey of red painted areas 021-026

	Time	Fixed Point Results	LOCATION
LOG 1	1046	340	CHAR TRW01-021
LOG 2	1049	417	022
LOG 3	1051	542	023
LOG 4	1053	930	024
LOG 5	1055	397	025
LOG 6	1058	670	026

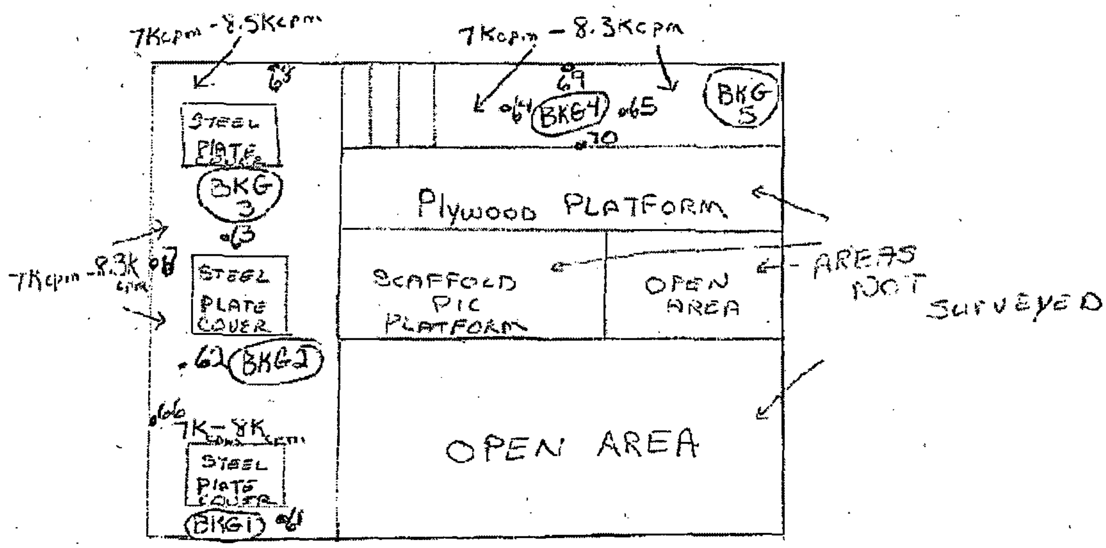
Model No.	Serial No.	Cal Date	Location Code1	Location Code2	Location Code3	Location Code8	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	CHAR-TRW-01-001-F-M	Floor	590	Concrete	9/15/2008 11:29	595	c	60	log scalar	189090	SE	2200
43-68	PR178065	5/29/2008	CHAR-TRW-01-002-F-M	Floor	590	Concrete	9/15/2008 11:33	552	c	60	log scalar	189090	SE	2041
43-68	PR178065	5/29/2008	CHAR-TRW-01-003-F-M	Floor	590	Concrete	9/15/2008 14:09	456	c	60	log scalar	189090	SE	1686
43-68	PR178065	5/29/2008	CHAR-TRW-01-004-F-M	Floor	590	Concrete	9/15/2008 14:11	643	c	60	log scalar	189090	SE	2377
43-68	PR178065	5/29/2008	CHAR-TRW-01-005-F-M	Floor	590	Concrete	9/15/2008 14:17	533	c	60	log scalar	189090	SE	1970
43-68	PR178065	5/29/2008	CHAR-TRW-01-006-F-M	Floor	590	Concrete	9/15/2008 14:23	537	c	60	log scalar	189090	SE	1985
43-68	PR178065	5/29/2008	CHAR-TRW-01-007-F-M	Ceiling	590	Asbestos	9/15/2008 10:42	473	c	60	log scalar	189090	SE	1749
43-68	PR178065	5/29/2008	CHAR-TRW-01-008-F-M	Ceiling	590	Asbestos	9/15/2008 10:45	457	c	60	log scalar	189090	SE	1689
43-68	PR178065	5/29/2008	CHAR-TRW-01-009-F-M	Ceiling	590	Sky light	9/15/2008 10:48	566	c	60	log scalar	189090	SE	2092
43-68	PR178065	5/29/2008	CHAR-TRW-01-010-F-M	Ceiling	590	Asbestos	9/15/2008 10:51	537	c	60	log scalar	189090	SE	1985
43-68	PR178065	5/29/2008	CHAR-TRW-01-011-F-M	Ceiling	590	Asbestos	9/15/2008 10:54	618	c	60	log scalar	189090	SE	2285
43-68	PR178065	5/29/2008	CHAR-TRW-01-012-F-M	Wall	590	Asbestos	9/15/2008 14:25	687	c	60	log scalar	189090	SE	2540
43-68	PR178065	5/29/2008	CHAR-TRW-01-013-F-M	Wall	590	Asbestos	9/15/2008 14:15	461	c	60	log scalar	189090	SE	1704
43-68	PR178065	5/29/2008	CHAR-TRW-01-014-F-M	Wall	590	Asbestos	9/15/2008 14:05	323	c	60	log scalar	189090	SE	1194
43-68	PR178065	5/29/2008	CHAR-TRW-01-015-F-M	Wall	590	Asbestos	9/15/2008 11:30	342	c	60	log scalar	189090	SE	1264
43-68	PR178065	5/29/2008	CHAR-TRW-01-016-F-M	Wall	590	Asbestos	9/15/2008 11:27	324	c	60	log scalar	189090	SE	1198
43-68	PR178065	5/29/2008	CHAR-TRW-01-017-F-M	Wall	590	Asbestos	9/15/2008 11:32	330	c	60	log scalar	189090	SE	1220
43-68	PR178065	5/29/2008	CHAR-TRW-01-018-F-M	Wall	590	Asbestos	9/15/2008 14:07	349	c	60	log scalar	189090	SE	1290
43-68	PR178065	5/29/2008	CHAR-TRW-01-019-F-M	Wall	590	Asbestos	9/15/2008 14:13	384	c	60	log scalar	189090	SE	1420
43-68	PR178065	5/29/2008	CHAR-TRW-01-020-F-M	Wall	590	Wood wall	9/15/2008 14:21	392	c	60	log scalar	189090	SE	1449

Average = 477.95
Median = 467.00
STDEV = 114.63
Minimum = 323.00
Maximum = 687.00

Average = 1767
Median = 1726
STDEV = 424
Minimum = 1194
Maximum = 2540


TRW01 Trestle Way - Characterization SCATTER PLOT
dpm/100cm2
2700
2500
2300
2100
1900
1700
1500
1300
1100
900
1
3
5
7
9
11
13
15
17
19
Fixed Points
y = -47.328x + 2263.9
R² = 0.4366
Series1
Linear (Series1)

CHARACTERIZATION
NAB01- NaK Room Mezzanine



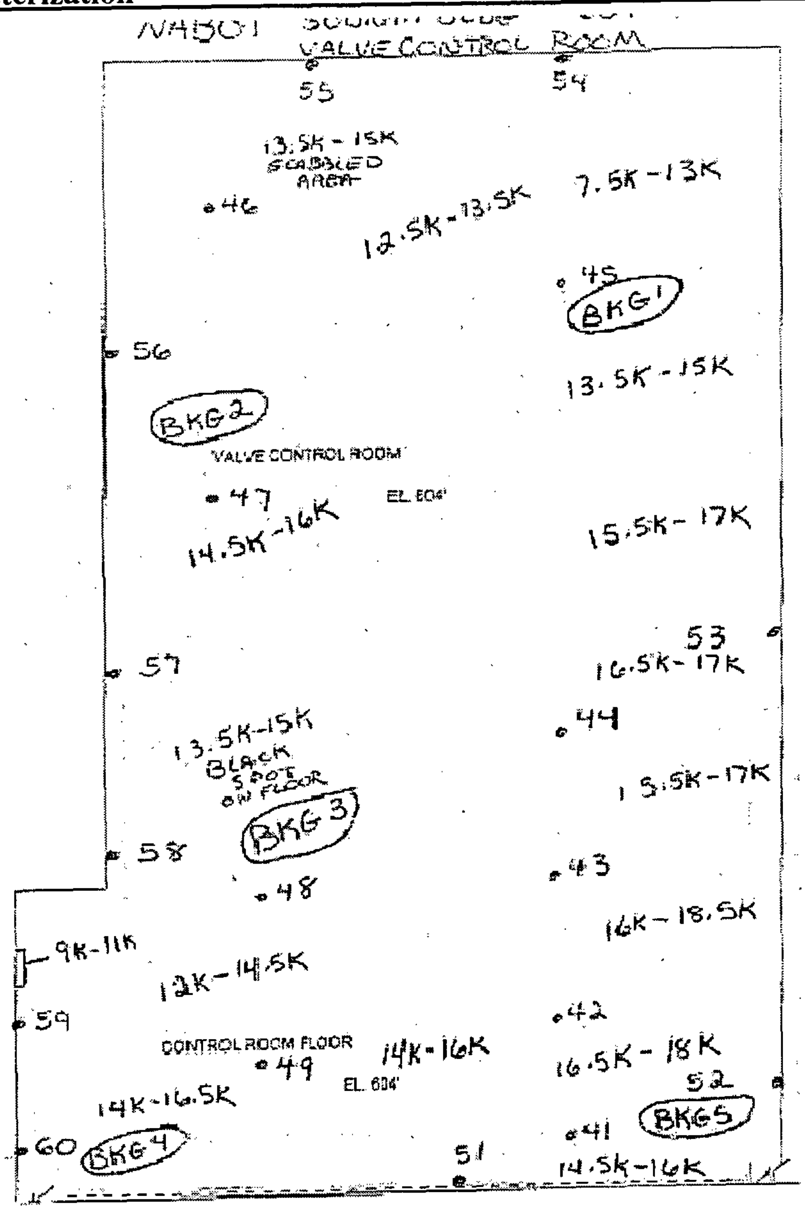
Instrument / Serial No.
2350-1 / 189090 *2
2350-1 / 186199 *1
Probe No. / Serial No.
DP SPA3I 2081 *2
03-4368 / PR178065 *1

Reactor Power 100 %
Hydrogen Water Chemistry Inject. Rate 13 SCFM @ 0915
1630

Comments:

Time	Daily BKG	Source	End of Shift	BKG	Source
0747 *1	228	1263	Time 1558	272	1232
0745 *2	7160	44085	by DP pass	7088	45787

pass by DP
All Survey Points - Concrete
10/01/08 DP/ [illegible]



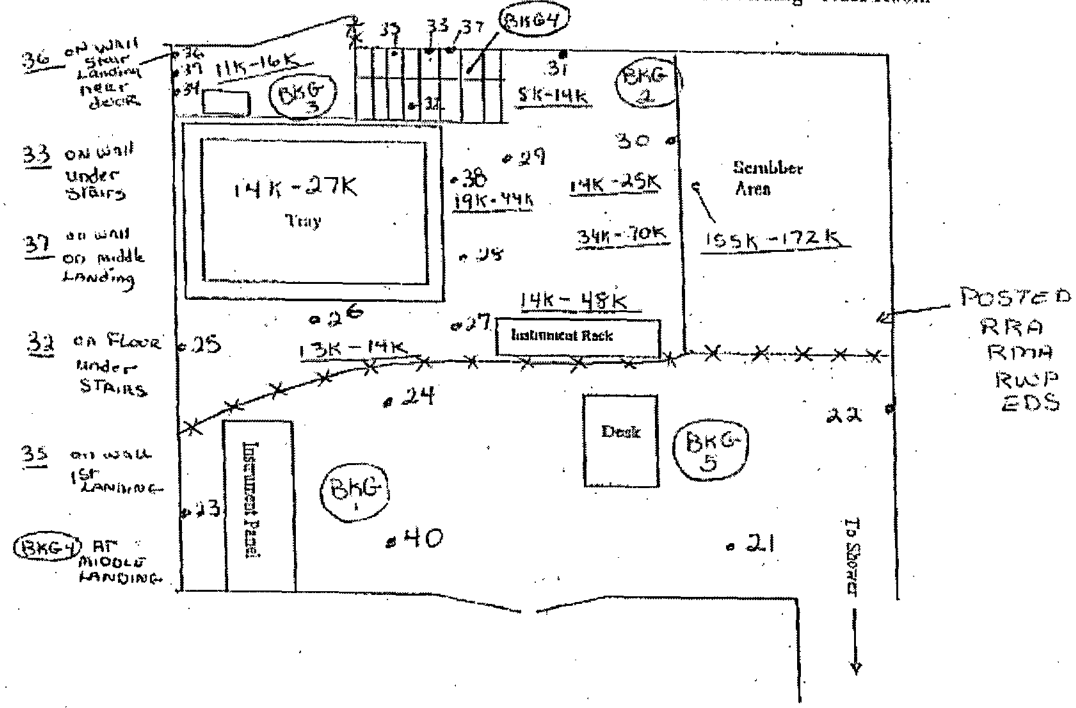
Instrument / Serial No.
2350-1 / 189090
2350-1 / 186199
Probe No. / Serial No.
4368 031 / PR178065
SPA 3 D1 / 2081

Reactor Power 100 %
Hydrogen Water Chemistry Inject. Rate 93SCFM @ 0900
1700

Comments: AREA POSTED: RRA, RMA, RWP, EDS
ALL SPA READINGS ARE K-cpm
BKG = Where Background Taken
SEE NAB01 DATA SHEET FIXED MEAS. FOR MORE INFO

9/23/08 DP/

Characterization NAB01 - Sodium Building - NaK Room



SURVEYED ON: 9/25/08 by: DP/so

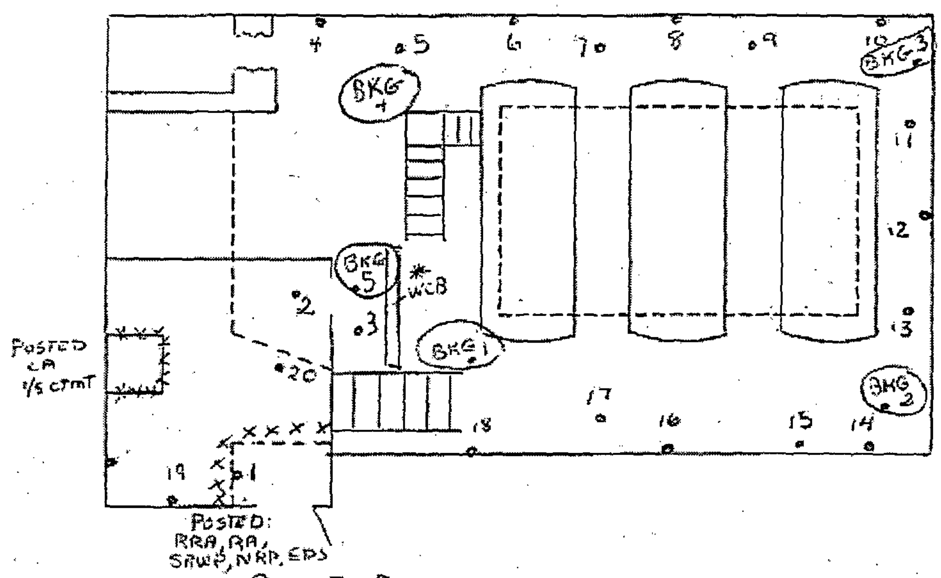
Reactor Power - 100%
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 0820
1610

Instrument / Serial No.
2350-1 / 189090
2350-1 / 186199
Probe No. / Serial No.
43-68 / PR 170605
DL SPA 3 / 2051

Comments: See Fixed Meas Data Sheet NAB01 Sodium Bld NaK Room for more info.

NAB01 Sodium BLDG NA22 Storage Room

[ ] - Indicates Platform Areas



SPA 3 Readings Taken at Survey Points

•20 158 Kcpm	•6 475 Kcpm	•8 493 Kcpm	•10 380 Kcpm
•19	•3 607 Kcpm		•12 543 Kcpm
•1 56 Kcpm	•18 488 Kcpm	•17 578 Kcpm	•15 534 Kcpm
•2			

Instrument / Serial No.
2350-1 / 186199
2350-1 / 189090
Probe No. / Serial No.
D3 4368 / PR 178065
D1 SPA3 / 2081

Reactor Power 100 %
Hydrogen Water
Chemistry Inject. Rate 93 SCFM @ 0920
1615

Comments: 9/24/08 DP/SC
* WCB = Concrete Block Wall - 4'5" Tall
SPA 3 Daily BKG 7493 cpm / Source 44370 @ 1412
End of Shift BKG 7535 cpm / Source 44703 @ 1613

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-001-F-M	Wall	NS	9/24/2008 14:47	422	c	60	log scalar	186199	DP/SE	1560
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-002-F-M	Floor	NS	9/24/2008 14:49	1387	c	60	log scalar	186199	DP/SE	5128
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-003-F-M	Floor	NS	9/24/2008 14:50	1289	c	60	log scalar	186199	DP/SE	4765
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-004-F-M	Wall	NS	9/24/2008 14:53	1606	c	60	log scalar	186199	DP/SE	5937
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-005-F-M	Floor	NS	9/24/2008 14:56	1172	c	60	log scalar	186199	DP/SE	4333
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-006-F-M	Wall	NS	9/24/2008 14:58	4712	c	60	log scalar	186199	DP/SE	17420
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-007-F-M	Floor	NS	9/24/2008 15:01	2497	c	60	log scalar	186199	DP/SE	9231
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-008-F-M	Wall	NS	9/24/2008 15:03	6216	c	60	log scalar	186199	DP/SE	22980
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-009-F-M	Floor	NS	9/24/2008 15:06	2040	c	60	log scalar	186199	DP/SE	7542
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-010-F-M	Wall	NS	9/24/2008 15:08	3608	c	60	log scalar	186199	DP/SE	13338
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-011-F-M	Floor	NS	9/24/2008 15:10	1824	c	60	log scalar	186199	DP/SE	6743
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-012-F-M	Wall	NS	9/24/2008 15:12	5390	c	60	log scalar	186199	DP/SE	19926
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-013-F-M	Floor	NS	9/24/2008 15:14	1908	c	60	log scalar	186199	DP/SE	7054
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-014-F-M	Wall	NS	9/24/2008 15:16	3129	c	60	log scalar	186199	DP/SE	11567
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-015-F-M	Floor	NS	9/24/2008 15:18	2068	c	60	log scalar	186199	DP/SE	7645
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-016-F-M	Wall	NS	9/24/2008 15:20	4271	c	60	log scalar	186199	DP/SE	15789
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-017-F-M	Floor	NS	9/24/2008 15:22	2076	c	60	log scalar	186199	DP/SE	7675
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-018-F-M	Wall	NS	9/24/2008 15:28	5272	c	60	log scalar	186199	DP/SE	19490
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-019-F-M	Wall	NS	9/24/2008 15:30	1524	c	60	log scalar	186199	DP/SE	5634
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-020-F-M	Floor	NS	9/24/2008 15:32	1512	c	60	log scalar	186199	DP/SE	5590

NS = Na22 Storage Room
Note: Storage Tanks contain sodium used for processing.
High BKG due to tanks. No scans possible at this time.

Average = 2696.15
Median = 2054.00
STDEV = 1648.42
Minimum = 422.00
Maximum = 6216.00

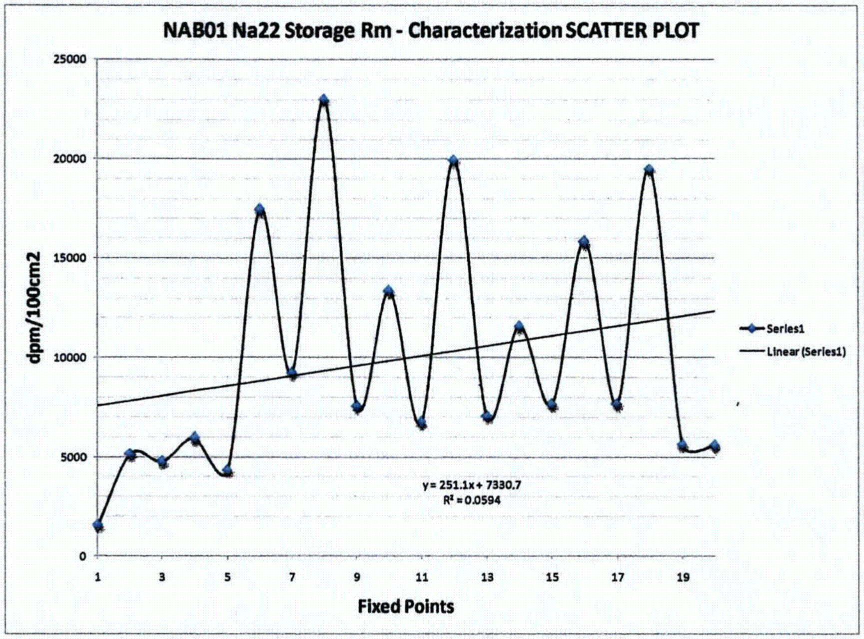
Average = 9967
Median = 7593
STDEV = 6094
Minimum = 1560
Maximum = 22980

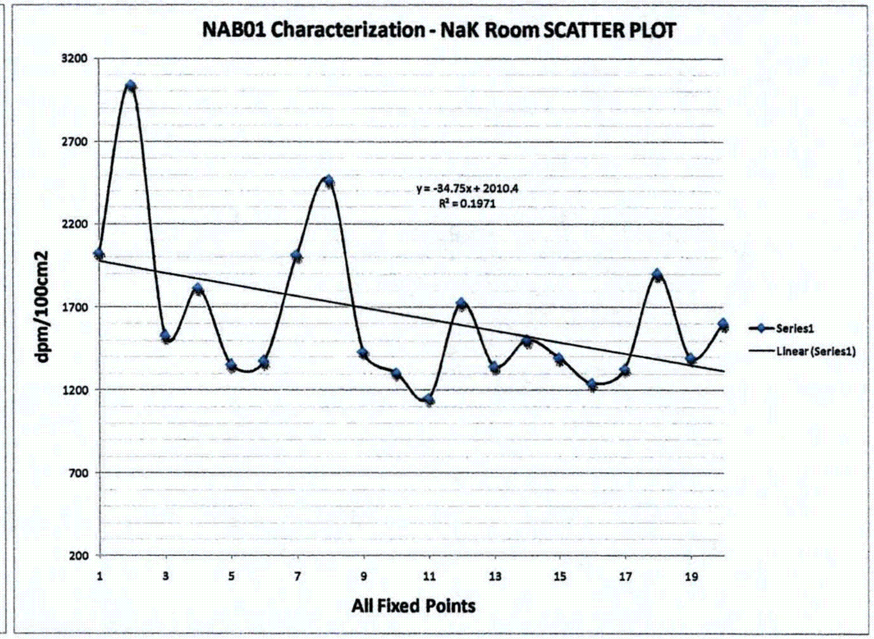
Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-021-F-M	Floor	NR	9/25/2008 14:09	547	c	60	log scalar	186199	DP/SE	2022
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-022-F-M	Wall	NR	9/25/2008 15:13	822	c	60	log scalar	186199	DP/SE	3039
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-023-F-M	Conc. Block Wall	NR	9/25/2008 15:10	413	c	60	log scalar	186199	DP/SE	1527
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-024-F-M	Floor	NR	9/25/2008 14:15	491	c	60	log scalar	186199	DP/SE	1815
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-025-F-M	Wall	NR	9/25/2008 15:07	366	c	60	log scalar	186199	DP/SE	1353
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-026-F-M	Floor	NR	9/25/2008 14:26	371	c	60	log scalar	186199	DP/SE	1372
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-027-F-M	Floor	NR	9/25/2008 14:28	544	c	60	log scalar	186199	DP/SE	2011
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-028-F-M	Floor	NR	9/25/2008 14:31	666	c	60	log scalar	186199	DP/SE	2462
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-029-F-M	Floor	NR	9/25/2008 14:34	387	c	60	log scalar	186199	DP/SE	1431
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-030-F-M	Wall	NR	9/25/2008 14:56	353	c	60	log scalar	186199	DP/SE	1305
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-031-F-M	Wall	NR	9/25/2008 14:53	311	c	60	log scalar	186199	DP/SE	1150
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-032-F-M	Floor	NR	9/25/2008 14:40	467	c	60	log scalar	186199	DP/SE	1726
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-033-F-M	Wall	NR	9/25/2008 14:58	363	c	60	log scalar	186199	DP/SE	1342
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-034-F-M	Wall	NR	9/25/2008 15:04	406	c	60	log scalar	186199	DP/SE	1501
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-035-F-M	Wall	NR	9/25/2008 14:50	377	c	60	log scalar	186199	DP/SE	1394
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-036-F-M	Wall	NR	9/25/2008 14:47	335	c	60	log scalar	186199	DP/SE	1238
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-037-F-M	Wall	NR	9/25/2008 14:44	359	c	60	log scalar	186199	DP/SE	1327
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-038-F-M	Floor	NR	9/25/2008 14:37	514	c	60	log scalar	186199	DP/SE	1900
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-039-F-M	Wall	NR	9/25/2008 15:01	377	c	60	log scalar	186199	DP/SE	1394
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-040-F-M	Floor	NR	9/25/2008 14:14	433	c	60	log scalar	186199	DP/SE	1601

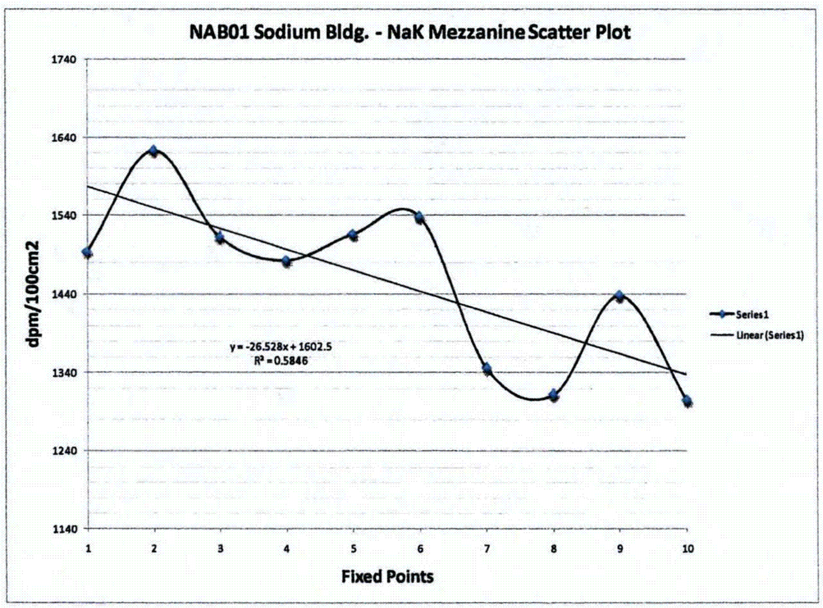
Average = 445.10
Median = 396.50
STDEV = 125.28
Minimum = 311.00
Maximum = 822.00

Average = 1645
Median = 1466
STDEV = 463
Minimum = 1150
Maximum = 3039

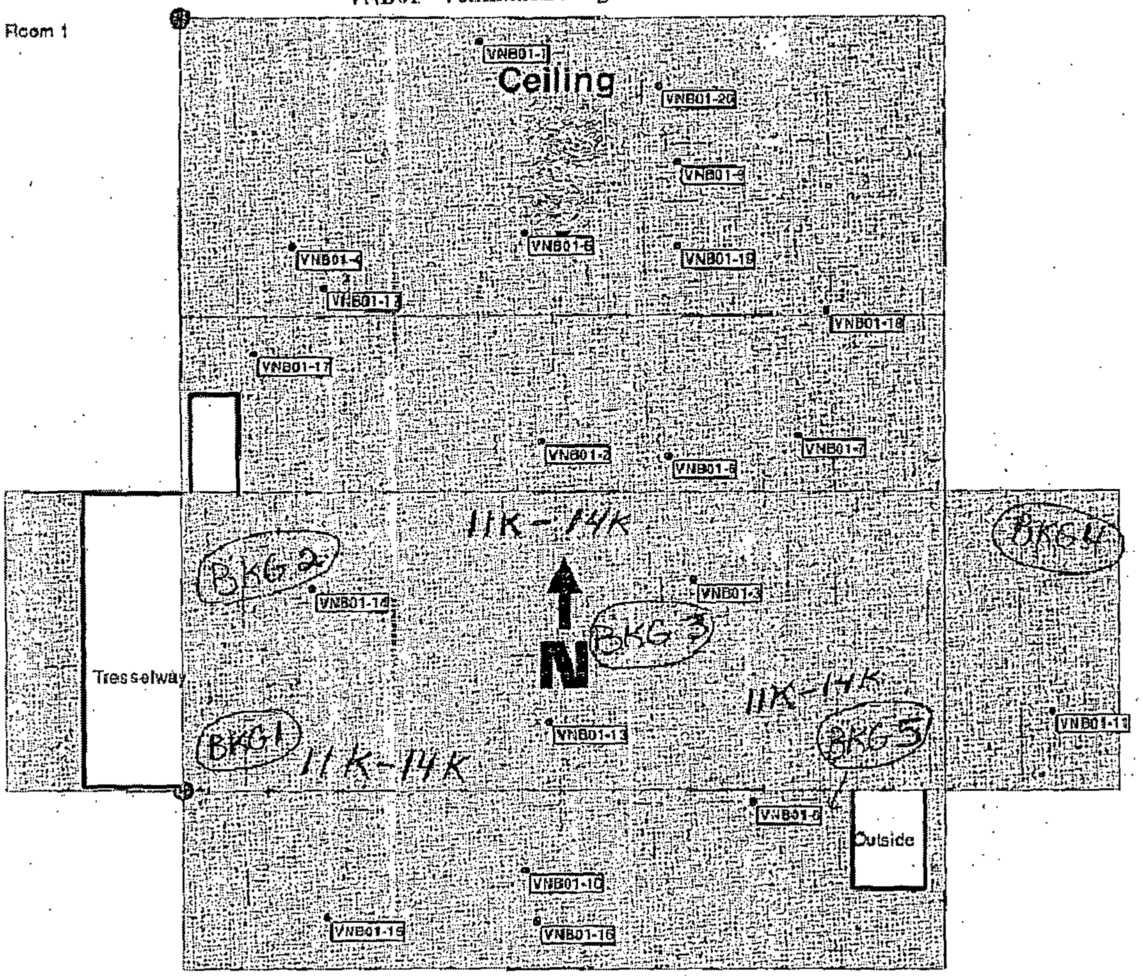
Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-061-F-M	Floor	MZ	10/1/2008 10:12	404	c	60	log scalar	186199	DP/SE	1494
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-062-F-M	Floor	MZ	10/1/2008 10:17	439	c	60	log scalar	186199	DP/SE	1623
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-063-F-M	Floor	MZ	10/1/2008 10:20	409	c	60	log scalar	186199	DP/SE	1512
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-064-F-M	Floor	MZ	10/1/2008 10:25	401	c	60	log scalar	186199	DP/SE	1482
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-065-F-M	Floor	MZ	10/1/2008 10:30	410	c	60	log scalar	186199	DP/SE	1516
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-066-F-M	Wall	MZ	10/1/2008 10:50	416	c	60	log scalar	186199	DP/SE	1538
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-067-F-M	Wall	MZ	10/1/2008 10:47	364	c	60	log scalar	186199	DP/SE	1346
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-068-F-M	Wall	MZ	10/1/2008 10:44	355	c	60	log scalar	186199	DP/SE	1312
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-069-F-M	Wall	MZ	10/1/2008 10:40	389	c	60	log scalar	186199	DP/SE	1438
43-68	PR178065	5/29/2008	Concrete	CHAR-NAB-01-070-F-M	Wall	MZ	10/1/2008 10:35	353	c	60	log scalar	186199	DP/SE	1305
							Average =	394.00					Average =	1457
							Median =	402.50					Median =	1488
							STDEV =	28.41					STDEV =	105
							Minimum =	353.00					Minimum =	1305
							Maximum =	439.00					Maximum =	1623


NAB01 Na22 Storage Rm - Characterization SCATTER PLOT
dpm/100cm2
25000
20000
15000
10000
5000
0
1
3
5
7
9
11
13
15
17
19
Fixed Points
y = 251.1x + 7330.7
R² = 0.0594
Series1
Linear (Series1)


NAB01 Characterization - NaK Room SCATTER PLOT
dpm/100cm2
3200
2700
2200
1700
1200
700
200
1
3
5
7
9
11
13
15
17
19
All Fixed Points
y = -34.75x + 2010.4
R² = 0.1971
Series1
Linear (Series1)


NAB01 Sodium Bldg. - NaK Mezzanine Scatter Plot
dpm/100cm2
1740
1640
1540
1440
1340
1240
1140
1
2
3
4
5
6
7
8
9
10
Fixed Points
y = -26.528x + 1602.5
R² = 0.5846
Series1
Linear (Series1)

Characterization
VNB01 - Ventilation Bldg -



SURVEYED ON: 9/16/08 by: DP/SE

Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 0820
1615

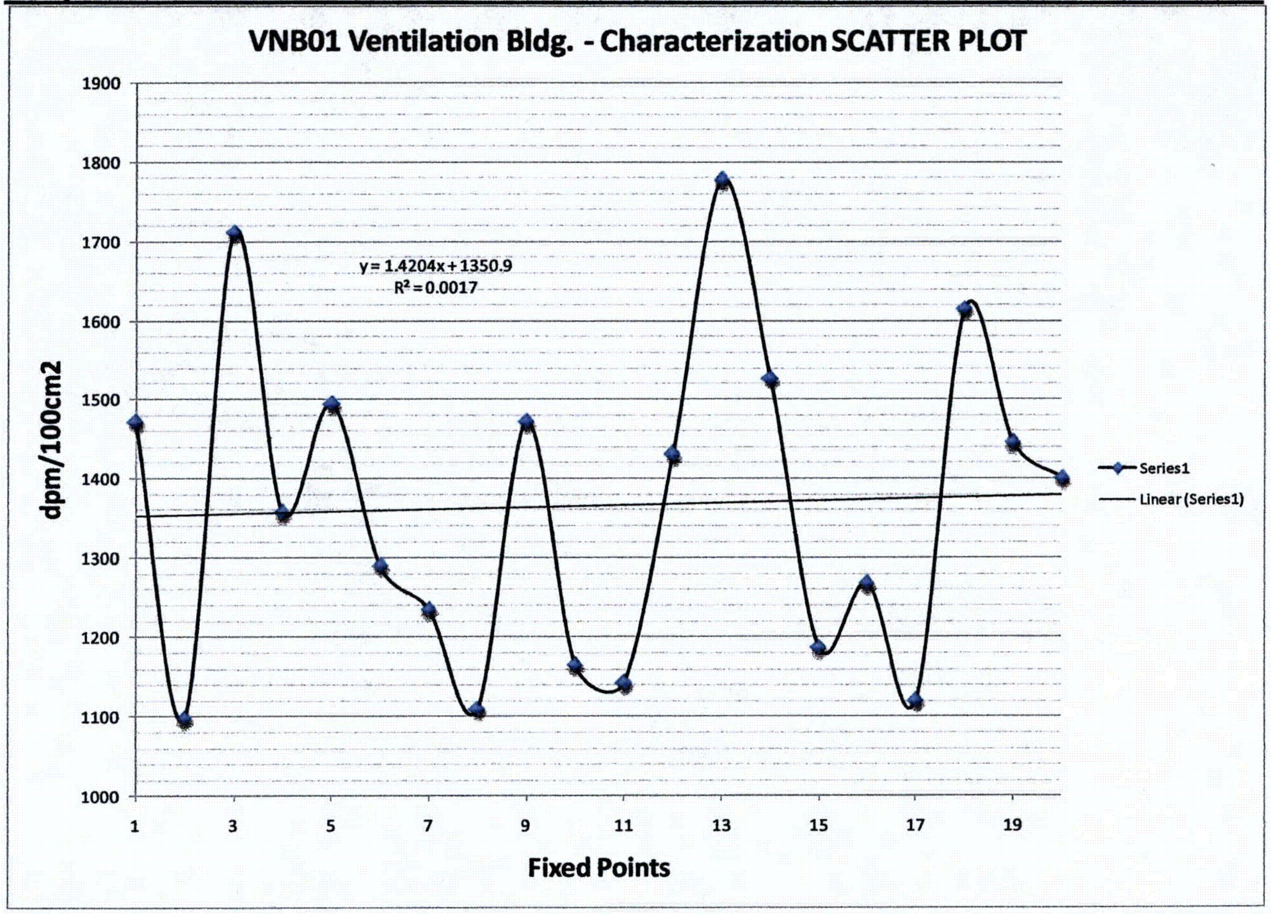
Instrument / Serial No.
2350-1 / 189090
2350-1 / 186199
Probe No. / Serial No.
D1 SPA3 / 2081
D3 43/68 / PR178065

Comments:

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Ser. No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Corrugated Steel	CHAR-VNB-01-001-F-M	Ceiling	590	9/16/2008 14:22	398	c	60	log scalar	186199	DP/SE	1471
43-68	PR178065	5/29/2008	Concrete Block	CHAR-VNB-01-002-F-M	Wall 1	590	9/16/2008 13:48	297	c	60	log scalar	186199	DP/SE	1098
43-68	PR178065	5/29/2008	Concrete	CHAR-VNB-01-003-F-M	Floor	590	9/16/2008 13:35	463	c	60	log scalar	186199	DP/SE	1712
43-68	PR178065	5/29/2008	Corrugated Steel	CHAR-VNB-01-004-F-M	Ceiling	590	9/16/2008 14:15	367	c	60	log scalar	186199	DP/SE	1357
43-68	PR178065	5/29/2008	Corrugated Steel	CHAR-VNB-01-005-F-M	Ceiling	590	9/16/2008 14:20	404	c	60	log scalar	186199	DP/SE	1494
43-68	PR178065	5/29/2008	Concrete Block	CHAR-VNB-01-006-F-M	Wall 1	590	9/16/2008 13:38	349	c	60	log scalar	186199	DP/SE	1290
43-68	PR178065	5/29/2008	Concrete Block	CHAR-VNB-01-007-F-M	Wall 1	590	9/16/2008 13:41	334	c	60	log scalar	186199	DP/SE	1235
43-68	PR178065	5/29/2008	Concrete Block	CHAR-VNB-01-008-F-M	Wall 3	590	9/16/2008 13:32	300	c	60	log scalar	186199	DP/SE	1109
43-68	PR178065	5/29/2008	Corrugated Steel	CHAR-VNB-01-009-F-M	Ceiling	590	9/16/2008 14:26	398	c	60	log scalar	186199	DP/SE	1471
43-68	PR178065	5/29/2008	Concrete Block	CHAR-VNB-01-010-F-M	Wall 3	590	9/16/2008 14:03	315	c	60	log scalar	186199	DP/SE	1165
43-68	PR178065	5/29/2008	Concrete Block	CHAR-VNB-01-011-F-M	Wall 2	590	9/16/2008 13:29	309	c	60	log scalar	186199	DP/SE	1142
43-68	PR178065	5/29/2008	Corrugated Steel	CHAR-VNB-01-012-F-M	Ceiling	590	9/16/2008 14:17	387	c	60	log scalar	186199	DP/SE	1431
43-68	PR178065	5/29/2008	Concrete	CHAR-VNB-01-013-F-M	Floor	590	9/16/2008 13:51	481	c	60	log scalar	186199	DP/SE	1778
43-68	PR178065	5/29/2008	Concrete	CHAR-VNB-01-014-F-M	Floor	590	9/16/2008 13:57	413	c	60	log scalar	186199	DP/SE	1527
43-68	PR178065	5/29/2008	Concrete Block	CHAR-VNB-01-015-F-M	Wall 3	590	9/16/2008 14:00	321	c	60	log scalar	186199	DP/SE	1187
43-68	PR178065	5/29/2008	Concrete Block	CHAR-VNB-01-016-F-M	Wall 3	590	9/16/2008 14:06	343	c	60	log scalar	186199	DP/SE	1268
43-68	PR178065	5/29/2008	Concrete Block	CHAR-VNB-01-017-F-M	Wall 1	590	9/16/2008 13:54	303	c	60	log scalar	186199	DP/SE	1120
43-68	PR178065	5/29/2008	Corrugated Steel	CHAR-VNB-01-018-F-M	Ceiling	590	9/16/2008 14:30	437	c	60	log scalar	186199	DP/SE	1616
43-68	PR178065	5/29/2008	Corrugated Steel	CHAR-VNB-01-019-F-M	Ceiling	590	9/16/2008 14:24	391	c	60	log scalar	186199	DP/SE	1445
43-68	PR178065	5/29/2008	Corrugated Steel	CHAR-VNB-01-020-F-M	Ceiling	590	9/16/2008 14:28	379	c	60	log scalar	186199	DP/SE	1401

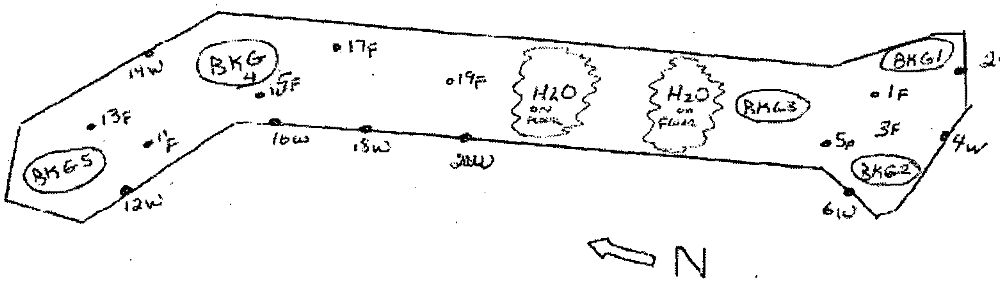
Average = 369.45
Median = 373.00
STDEV = 54.86
Minimum = 297.00
Maximum = 481.00

Average = 1366
Median = 1379
STDEV = 203
Minimum = 1098
Maximum = 1778


VNB01 Ventilation Bldg. - Characterization SCATTER PLOT
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
dpm/100cm2
y = 1.4204x + 1350.9
R² = 0.0017
1
3
5
7
9
11
13
15
17
19
Fixed Points
Series1
Linear (Series1)

NAT01 – Sodium Tunnel

Area 3



SURVEYED ON: 10/6/08 by: DP/SA

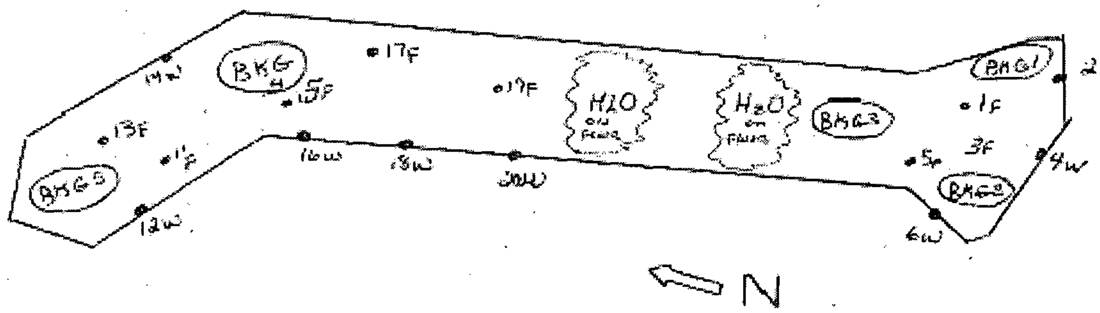
Comments: See NAT01 Field Map/Points for more info
No SMAS readings taken

Reactor Power - 100 %
Hydrogen Water Chemistry Inject. Rate - 13 scfm @ 0800
1210

Instrument / Serial No.
2350-1 / 186193

Probe No. / Serial No.
43 / 4368 / PR178065

NAT01 – Sodium Tunnel



Comments: See NAT01 field Meas./Points for more info
No Smears performed taken

SURVEYED ON: 10/6/08 by: DP/SD

Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate 93 scfm @ 0800
1710

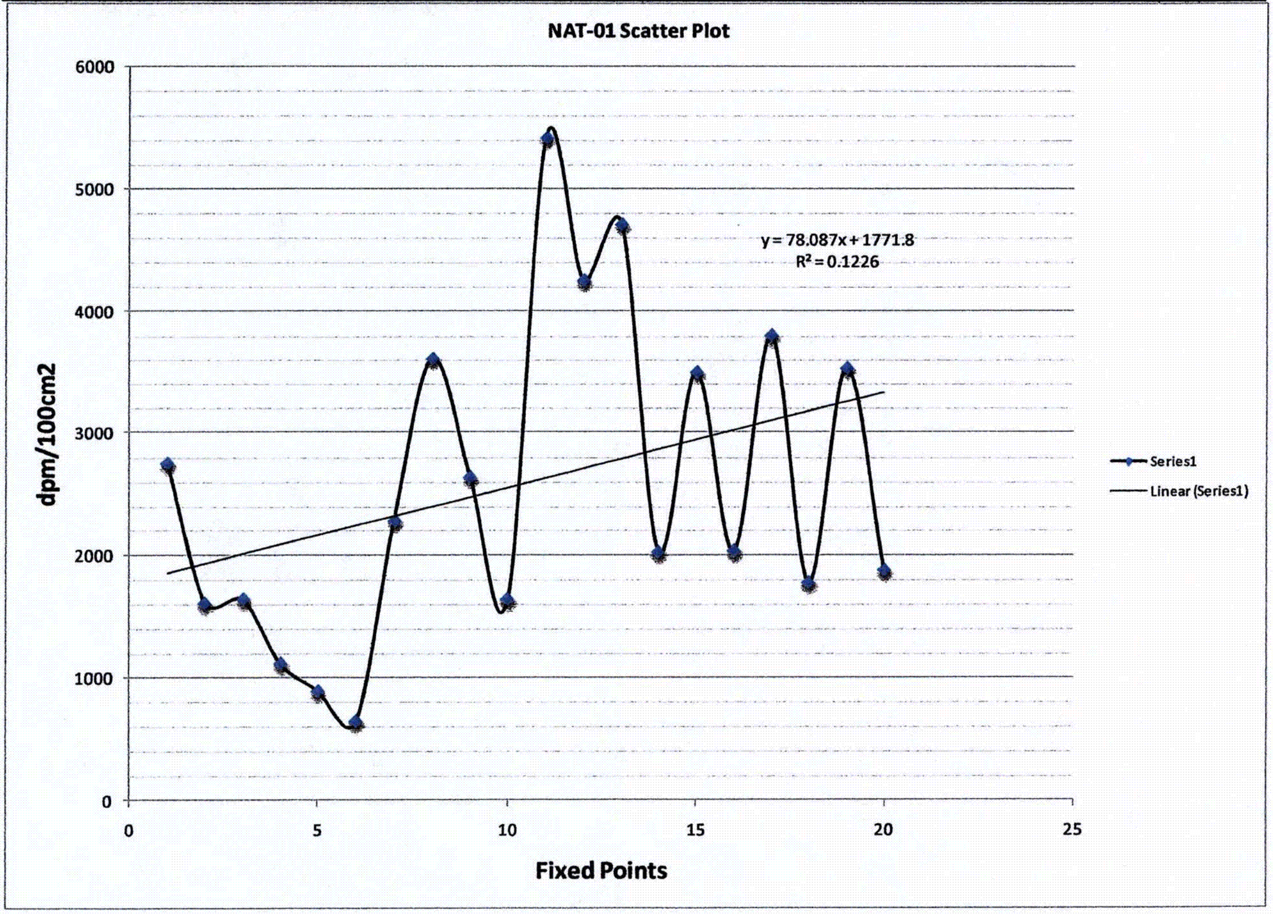
Instrument / Serial No.
2350-1 / 186193

Probe No. / Serial No.
43 / 4368 / PR178065

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-001-F-M	Floor	NAT	10/6/2008 14:58	745	c	60	log scalar	186193	DP/SE	2754
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-002-F-M	Wall	NAT	10/6/2008 15:01	437	c	60	log scalar	186193	DP/SE	1616
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-003-F-M	Floor	NAT	10/6/2008 15:04	444	c	60	log scalar	186193	DP/SE	1641
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-004-F-M	Wall	NAT	10/6/2008 15:08	302	c	60	log scalar	186193	DP/SE	1116
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-005-F-M	Floor	NAT	10/6/2008 15:11	243	c	60	log scalar	186193	DP/SE	898
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-006-F-M	Wall	NAT	10/6/2008 15:15	174	c	60	log scalar	186193	DP/SE	643
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-007-F-M	Floor	NAT	10/6/2008 15:20	617	c	60	log scalar	186193	DP/SE	2281
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-008-F-M	Wall	NAT	10/6/2008 15:23	979	c	60	log scalar	186193	DP/SE	3619
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-009-F-M	Floor	NAT	10/6/2008 15:27	715	c	60	log scalar	186193	DP/SE	2643
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-010-F-M	Wall	NAT	10/6/2008 15:29	444	c	60	log scalar	186193	DP/SE	1641
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-011-F-M	Floor	NAT	10/6/2008 16:07	1467	c	60	log scalar	186193	DP/SE	5423
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-012-F-M	Wall	NAT	10/6/2008 16:09	1151	c	60	log scalar	186193	DP/SE	4255
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-013-F-M	Floor	NAT	10/6/2008 16:13	1277	c	60	log scalar	186193	DP/SE	4721
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-014-F-M	Wall	NAT	10/6/2008 16:16	549	c	60	log scalar	186193	DP/SE	2030
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-015-F-M	Floor	NAT	10/6/2008 16:21	949	c	60	log scalar	186193	DP/SE	3508
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-016-F-M	Wall	NAT	10/6/2008 16:23	550	c	60	log scalar	186193	DP/SE	2033
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-017-F-M	Floor	NAT	10/6/2008 16:27	1029	c	60	log scalar	186193	DP/SE	3804
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-018-F-M	Wall	NAT	10/6/2008 16:29	482	c	60	log scalar	186193	DP/SE	1782
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-019-F-M	Floor	NAT	10/6/2008 16:32	957	c	60	log scalar	186193	DP/SE	3538
43-68	PR178065	5/29/2008	Rusted Steel	CHAR-NAT-01-020-F-M	Wall	NAT	10/6/2008 16:34	510	c	60	log scalar	186193	DP/SE	1885

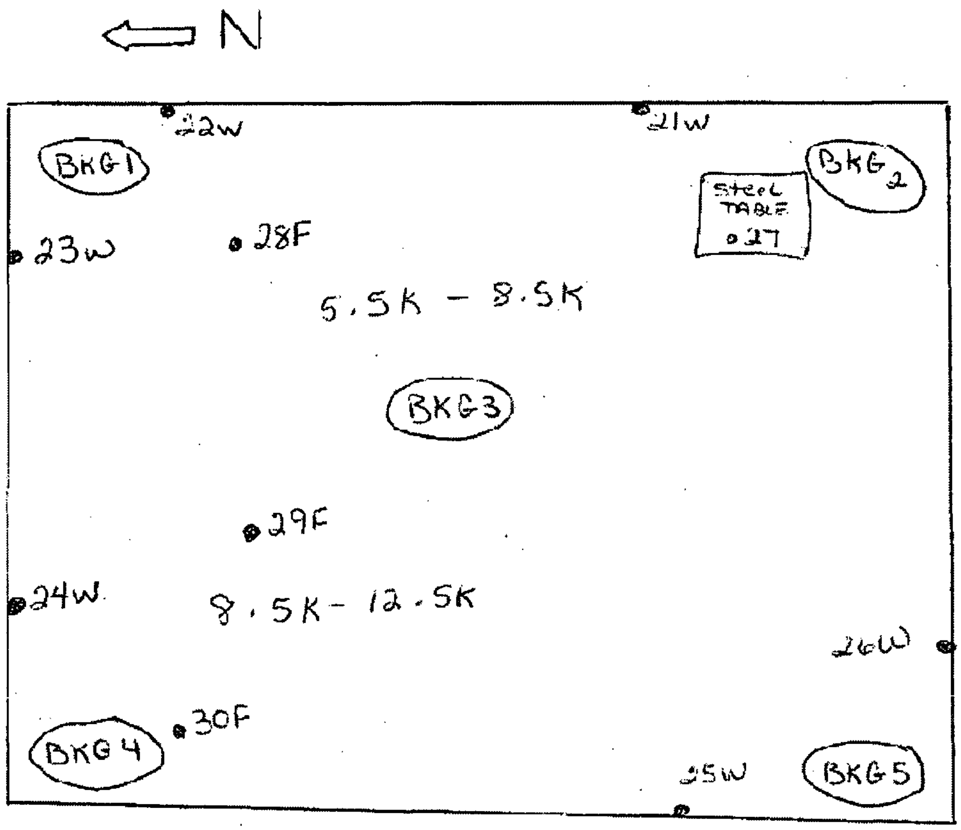
Average = 701.05
Median = 583.50
STDEV = 356.96
Minimum = 174.00
Maximum = 1467.00

Average = 2592
Median = 2157
STDEV = 1320
Minimum = 643
Maximum = 5423


NAT-01 Scatter Plot
y = 78.087x + 1771.8
R² = 0.1226
dpm/100cm2
Fixed Points
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
25
Series1
Linear (Series1)

Characterization

ESG01 - Fission Product Detector (FPD) Building



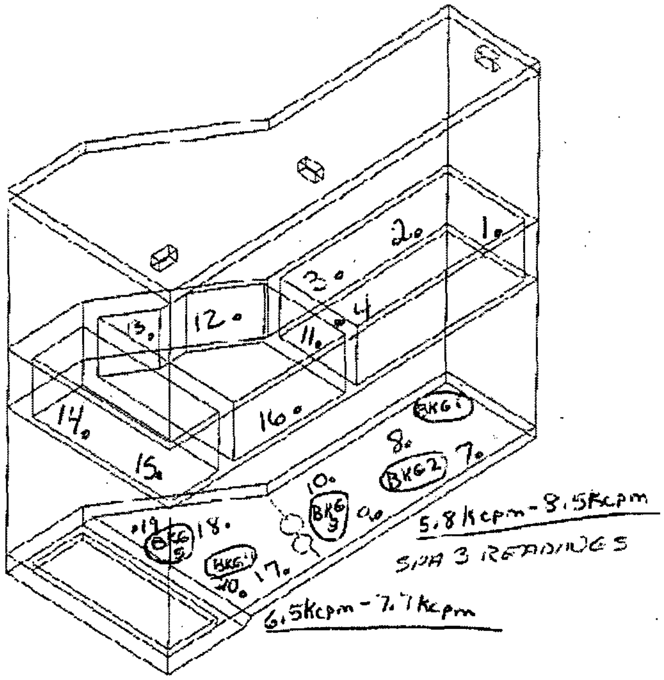
SURVEYED ON: 2/13/08 by: DP/sa

Instrument / Serial No.
2350-1 / 186199
2350-1 / 159090

Probe No. / Serial No.
D3 4368 / PR178065
B1 SP03 / 2081

Comments: See ESG01 FPD BLDG Fixed Points and Scans data sheet for more info

ESG01 (East Sodium Gallery) Exploded



Reactor Power - 100 % Hydrogen Water Chemistry Inject. Rate - 94 scfm @ ~~1330~~ 10/13/08	Instrument / Serial No. 2350-1/ 156193 2350-1/ 186199
	Probe No. / Serial No. D3 43-68/ PR178065
SURVEYED ON: 10/16/08 by: DP/se	D1 SPA3/ 2081

Comments: Smears Taken 10/13/08
see data sheet comments for ESG Fixed Points and Scans
for more info

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-021-F-M	Wall	FPD	10/13/2008 14:29	273	c	60	log scalar	186199	DP/SE	1009
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-022-F-M	Wall	FPD	10/13/2008 14:32	266	c	60	log scalar	186199	DP/SE	983
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-023-F-M	Wall	FPD	10/13/2008 14:34	261	c	60	log scalar	186199	DP/SE	965
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-024-F-M	Wall	FPD	10/13/2008 14:37	301	c	60	log scalar	186199	DP/SE	1113
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-025-F-M	Wall	FPD	10/13/2008 14:40	276	c	60	log scalar	186199	DP/SE	1020
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-026-F-M	Wall	FPD	10/13/2008 14:43	267	c	60	log scalar	186199	DP/SE	987
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-027-F-M	Steel Table	FPD	10/13/2008 14:46	209	c	60	log scalar	186199	DP/SE	773
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-028-F-M	Floor	FPD	10/13/2008 14:50	332	c	60	log scalar	186199	DP/SE	1227
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-029-F-M	Floor	FPD	10/13/2008 14:53	357	c	60	log scalar	186199	DP/SE	1320
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-030-F-M	Floor	FPD	10/13/2008 14:56	402	c	60	log scalar	186199	DP/SE	1486

FPD = Fission Product Detector Building

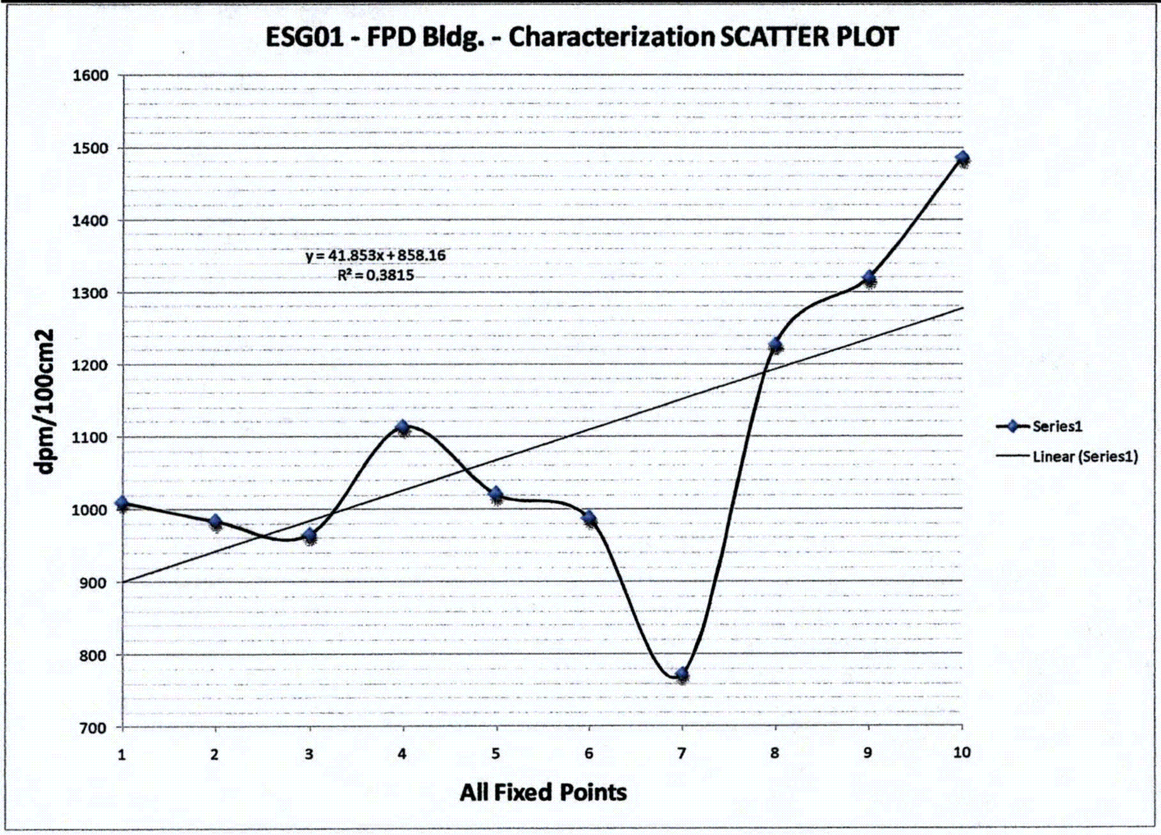
Average = 294.40
Median = 274.50
STDEV = 55.49
Minimum = 209.00
Maximum = 402.00

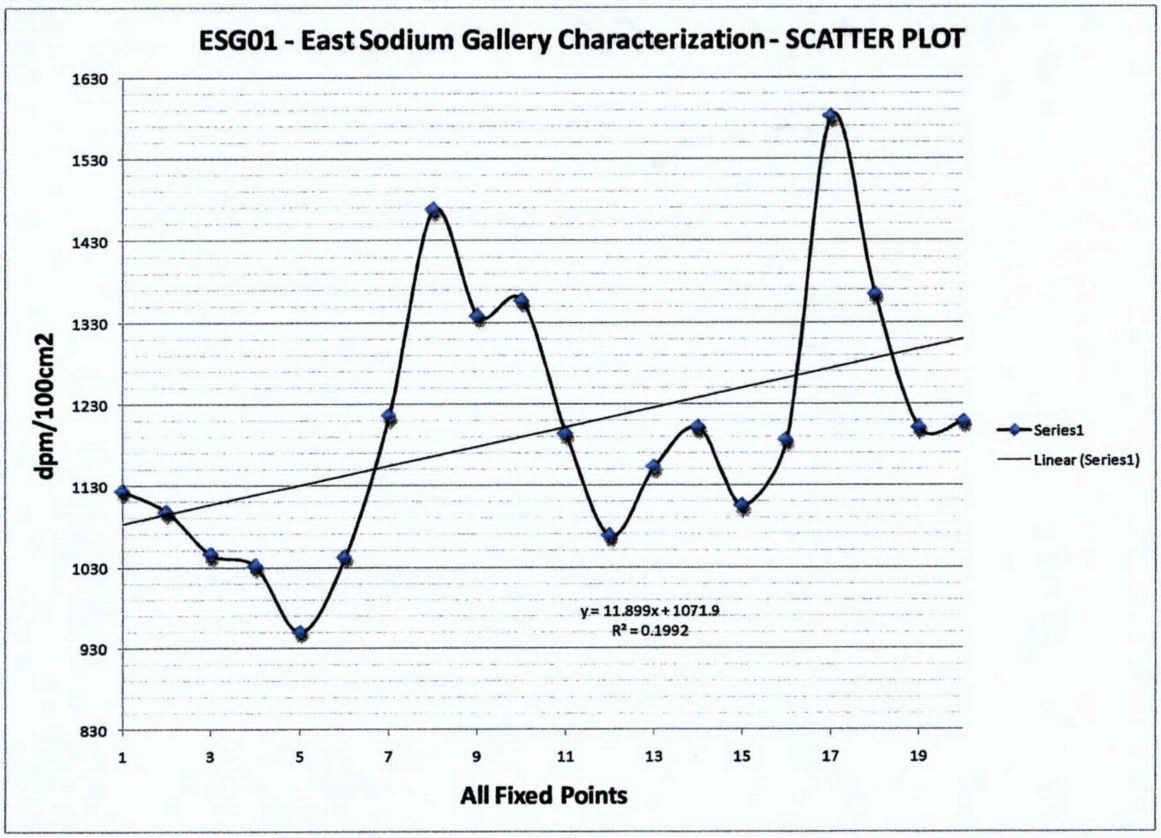
Average = 1088
Median = 1015
STDEV = 205
Minimum = 773
Maximum = 1486

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-001-F-M	Wall	ESG	10/16/2008 9:34	304	c	60	log scalar	186193	DP/SE	1124
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-002-F-M	Wall	ESG	10/16/2008 9:37	297	c	60	log scalar	186193	DP/SE	1098
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-003-F-M	Wall	ESG	10/16/2008 9:18	283	c	60	log scalar	186193	DP/SE	1046
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-004-F-M	Wall	ESG	10/16/2008 9:15	279	c	60	log scalar	186193	DP/SE	1031
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-005-F-M	Wall	ESG	10/16/2008 9:21	257	c	60	log scalar	186193	DP/SE	950
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-006-F-M	Wall	ESG	10/16/2008 9:30	282	c	60	log scalar	186193	DP/SE	1043
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-007-F-M	Floor	ESG	10/16/2008 9:40	329	c	60	log scalar	186193	DP/SE	1216
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-008-F-M	Floor	ESG	10/16/2008 9:42	397	c	60	log scalar	186193	DP/SE	1468
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-009-F-M	Floor	ESG	10/16/2008 9:45	362	c	60	log scalar	186193	DP/SE	1338
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-010-F-M	Floor	ESG	10/16/2008 9:47	367	c	60	log scalar	186193	DP/SE	1357
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-011-F-M	Wall	ESG	10/16/2008 10:04	323	c	60	log scalar	186193	DP/SE	1194
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-012-F-M	Wall	ESG	10/16/2008 10:23	289	c	60	log scalar	186193	DP/SE	1068
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-013-F-M	Wall	ESG	10/16/2008 10:18	312	c	60	log scalar	186193	DP/SE	1153
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-014-F-M	Wall	ESG	10/16/2008 10:13	325	c	60	log scalar	186193	DP/SE	1201
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-015-F-M	Wall	ESG	10/16/2008 10:09	299	c	60	log scalar	186193	DP/SE	1105
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-016-F-M	Wall	ESG	10/16/2008 10:06	321	c	60	log scalar	186193	DP/SE	1187
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-017-F-M	Floor	ESG	10/16/2008 10:27	428	c	60	log scalar	186193	DP/SE	1582
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-018-F-M	Floor	ESG	10/16/2008 10:25	369	c	60	log scalar	186193	DP/SE	1364
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-019-F-M	Floor	ESG	10/16/2008 10:32	325	c	60	log scalar	186193	DP/SE	1201
43-68	PR178065	5/29/2008	Concrete	CHAR-ESG-01-020-F-M	Floor	ESG	10/16/2008 10:30	327	c	60	log scalar	186193	DP/SE	1209

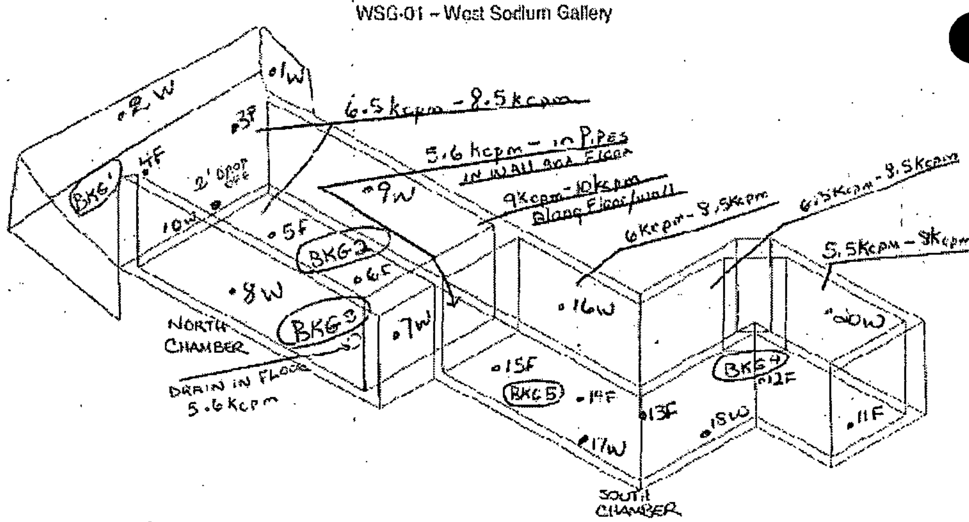
Average = 323.75
Median = 322.00
STDEV = 42.67
Minimum = 257.00
Maximum = 428.00

Average = 1197
Median = 1190
STDEV = 158
Minimum = 950
Maximum = 1582


ESG01 - FPD Bldg. - Characterization SCATTER PLOT
1600
1500
1400
1300
1200
1100
1000
900
800
700
dpm/100cm2
y = 41.853x + 858.16
R² = 0.3815
1
2
3
4
5
6
7
8
9
10
All Fixed Points
Series1
Linear (Series1)


ESG01 - East Sodium Gallery Characterization - SCATTER PLOT
1630
1530
1430
1330
1230
1130
1030
930
830
dpm/100cm2
y = 11.899x + 1071.9
R² = 0.1992
1
3
5
7
9
11
13
15
17
19
All Fixed Points
Series1
Linear (Series1)

WSG-01 – West Sodium Gallery



NORTH CHAMBER
SURVEYED ON: 10/16/08 by: DP/Se

Reactor Power - 100%
Hydrogen Water
Chemistry Inject. Rate - 94 scfm @ 0800
1630

Instrument / Serial No.
#1 2350-1/ 186193
#2 2350-1/ 186199
Probe No. / Serial No.
#1 D3 43-6W PR178065
#2 D1 SPA3 / 2081

*1 *2 SEE WSG01 N.C. Fixed Points and Scans

	Instrument	Time	BKG	SOURCE	Sat/Unsat	Initials
Daily						
End of Shift						
Daily						
End of Shift						

SOUTH CHAMBER
SURVEYED ON: by:

Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 94 scfm @ 0800
1130

Instrument / Serial No.
#1 2350-1/ 186193
#2 2350-1/ 186199
Probe No. / Serial No.
#1 D3 43-6W PR178065
#2 D1 SPA3 / 2081

*1 *2 - See WSG01 SC Fixed Points and Scans

	Instrument	Time	BKG	SOURCE	Sat/Unsat	Initials
Daily						
End of Shift						
Daily						
End of Shift						

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-001-F-M	Wall	NC	10/16/2008 15:16	317	c	60	log scalar	186193	DP/SE	1172
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-002-F-M	Wall	NC	10/16/2008 15:20	333	c	60	log scalar	186193	DP/SE	1231
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-003-F-M	Floor	NC	10/16/2008 15:23	311	c	60	log scalar	186193	DP/SE	1150
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-004-F-M	Floor	NC	10/16/2008 15:27	322	c	60	log scalar	186193	DP/SE	1190
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-005-F-M	Floor	NC	10/16/2008 15:42	347	c	60	log scalar	186193	DP/SE	1283
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-006-F-M	Floor	NC	10/16/2008 15:44	342	c	60	log scalar	186193	DP/SE	1264
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-007-F-M	Wall	NC	10/16/2008 15:52	339	c	60	log scalar	186193	DP/SE	1253
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-008-F-M	Wall	NC	10/16/2008 15:50	335	c	60	log scalar	186193	DP/SE	1238
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-009-F-M	Wall	NC	10/16/2008 15:47	298	c	60	log scalar	186193	DP/SE	1102
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-010-F-M	Wall	NC	10/16/2008 15:39	286	c	60	log scalar	186193	DP/SE	1057

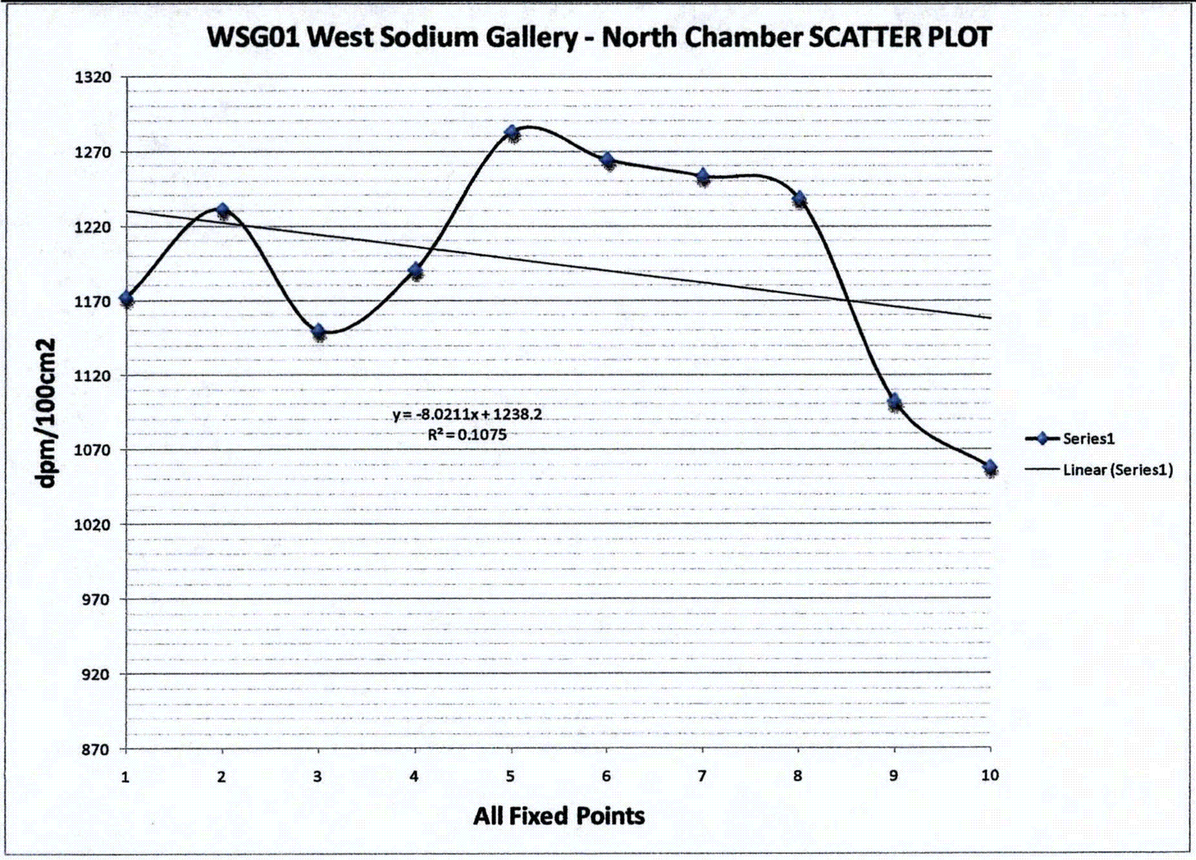
Average = 323.00
Median = 327.50
STDEV = 20.03
Minimum = 286.00
Maximum = 347.00

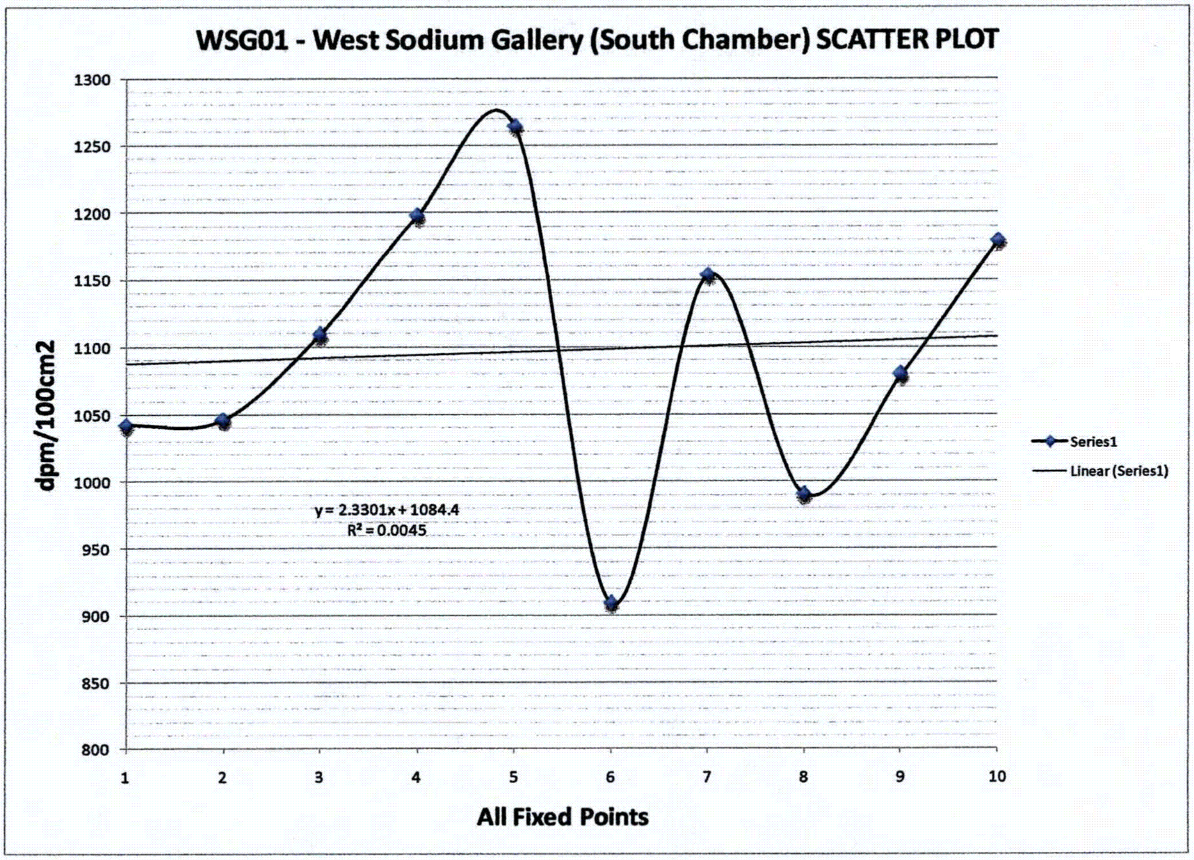
Average = 1194
Median = 1211
STDEV = 74
Minimum = 1057
Maximum = 1283

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-011-F-M	Floor	SC	10/21/2008 9:52	282	c	60	log scalar	186193	DP/SE	1043
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-012-F-M	Floor	SC	10/21/2008 9:55	283	c	60	log scalar	186193	DP/SE	1046
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-013-F-M	Floor	SC	10/21/2008 9:57	300	c	60	log scalar	186193	DP/SE	1109
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-014-F-M	Floor	SC	10/21/2008 10:00	324	c	60	log scalar	186193	DP/SE	1198
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-015-F-M	Floor	SC	10/21/2008 10:02	342	c	60	log scalar	186193	DP/SE	1264
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-016-F-M	Wall	SC	10/21/2008 10:05	246	c	60	log scalar	186193	DP/SE	909
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-017-F-M	Wall	SC	10/21/2008 10:07	312	c	60	log scalar	186193	DP/SE	1153
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-018-F-M	Wall	SC	10/21/2008 10:09	268	c	60	log scalar	186193	DP/SE	991
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-019-F-M	Wall	SC	10/21/2008 10:12	292	c	60	log scalar	186193	DP/SE	1079
43-68	PR178065	5/29/2008	Concrete	CHAR-WSG-01-020-F-M	Wall	SC	10/21/2008 10:16	319	c	60	log scalar	186193	DP/SE	1179

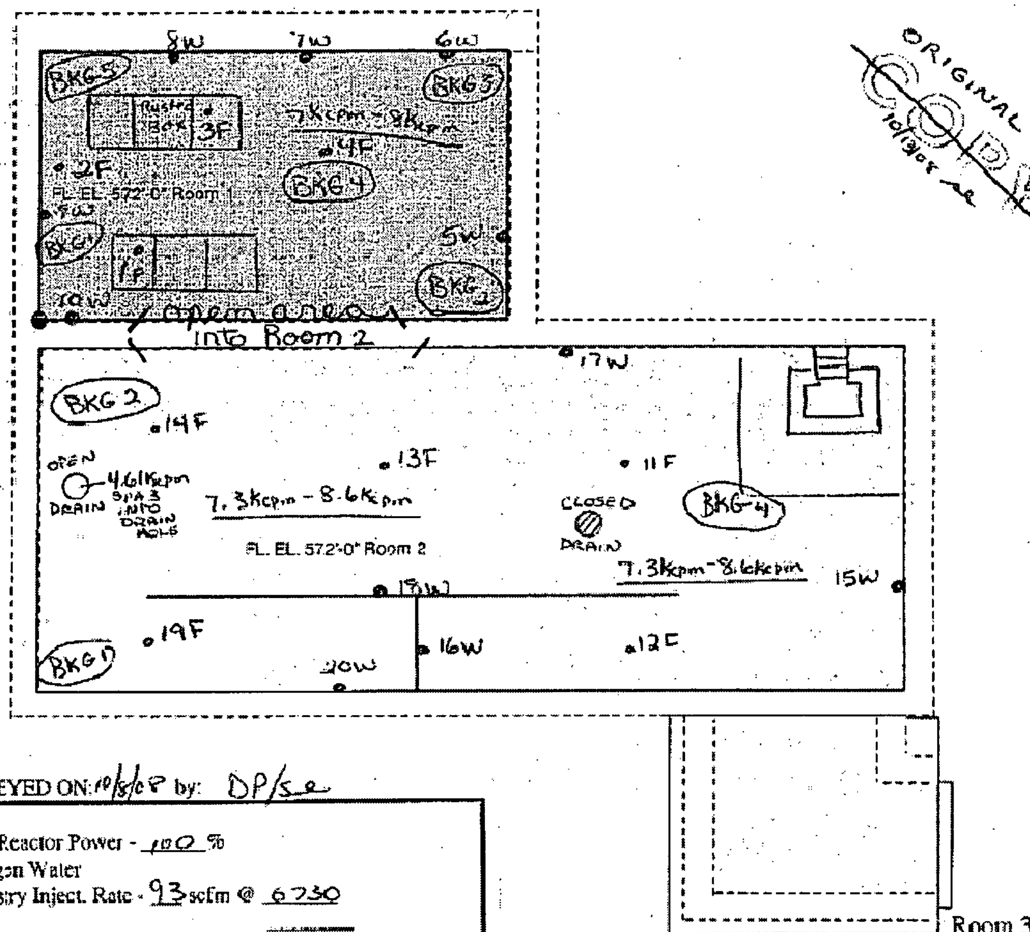
Average = 296.80
Median = 296.00
STDEV = 28.60
Minimum = 246.00
Maximum = 342.00

Average = 1097
Median = 1094
STDEV = 106
Minimum = 909
Maximum = 1264


WSG01 West Sodium Gallery - North Chamber SCATTER PLOT
1320
1270
1220
1170
1120
1070
1020
970
920
870
dpm/100cm2
y = -8.0211x + 1238.2
R² = 0.1075
Series1
Linear (Series1)
1
2
3
4
5
6
7
8
9
10
All Fixed Points


WSG01 - West Sodium Gallery (South Chamber) SCATTER PLOT
1300
1250
1200
1150
1100
1050
1000
950
900
850
800
dpm/100cm2
y = 2.3301x + 1084.4
R² = 0.0045
Series1
Linear (Series1)
1
2
3
4
5
6
7
8
9
10
All Fixed Points

WGB-01 – Waste Gas Building (elev. 572')



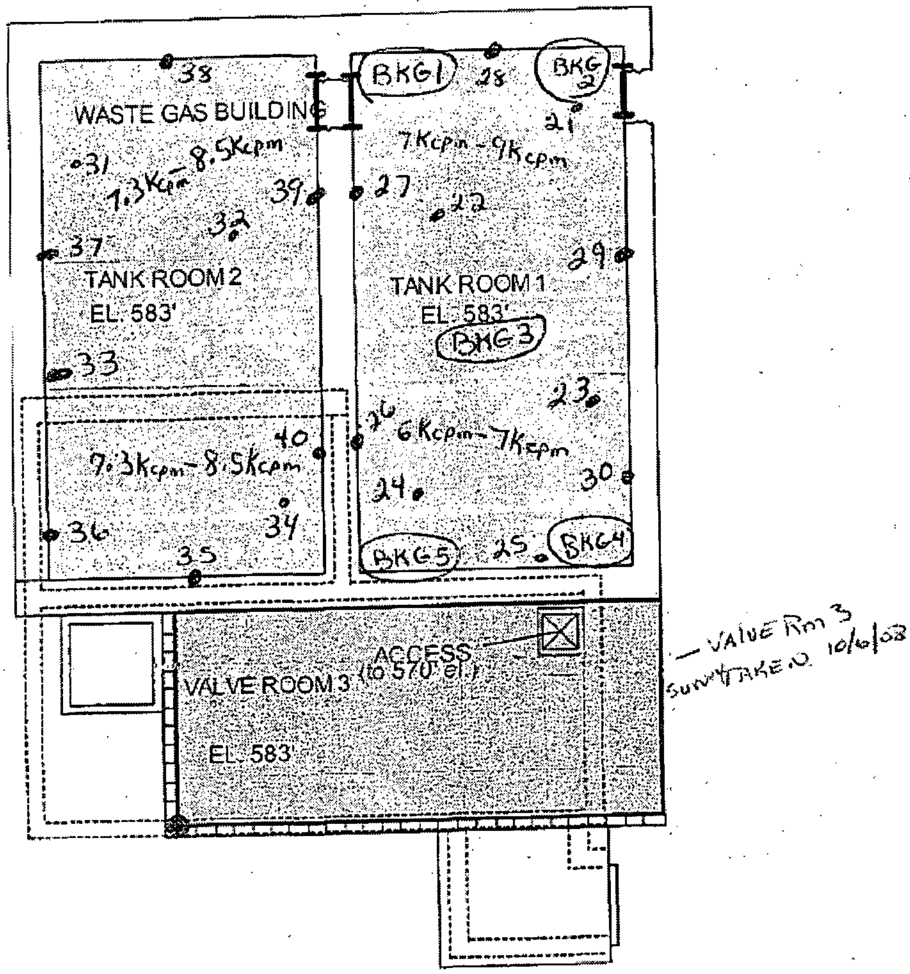
SURVEYED ON: 10/8/08 by: DP/se

Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 6730

Instrument / Serial No.	
2350-1/	186199
2361 /	189090
Probe No. / Serial No.	
D3 43-68/	PR178065
D1 SPA3/	2081

Comments: Survey points 1 and 3 on concrete foundation 2'x2'
See WGB01 Elev 572' Fixed Points data sheet for more info

WGB-01 – Waste Gas Building (elev. 583')



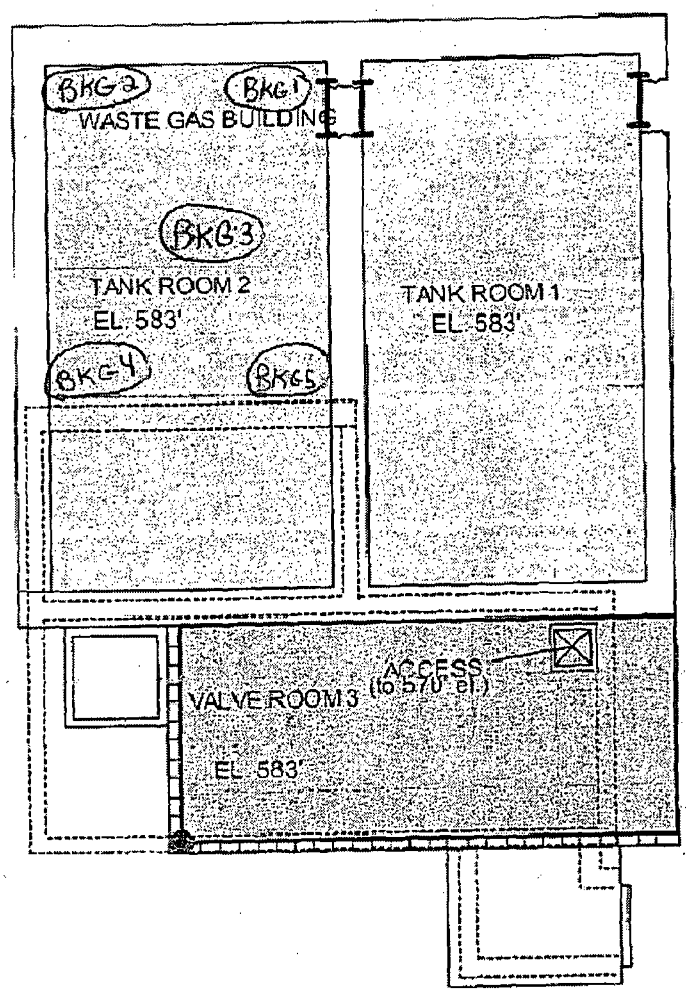
SURVEYED ON: 10/1/08 by: DP/se

Reactor Power - 100%
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 0915
1630

Instrument / Serial No.
2350-1/ 186199
2350-1/ 189090
Probe No. / Serial No.
D3 43-68/ PR178065
D1 SPA3/ 2081

Comments:
Smears taken 9/28/08

WGB-01 – Waste Gas Building (elev. 583')



SURVEYED ON: 10/2/08 by: DP/SE

Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 0745
0345

Instrument / Serial No.
2350-1/ 186193
Probe No. / Serial No.
D3 43-68/ 178065

Comments: BKG 1-5 TAKEN THNK Rm 2 See 10/1/08 MAP
FOR SURVEY Point LOCATIONS
TANK Room 1 Surveyed 10/1/08
VALVE ROOM

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-001-F-M	FF	R1	10/8/2008 14:53	340	c	60	log scalar	186199	DP/SE	1257
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-002-F-M	F	R1	10/8/2008 15:27	350	c	60	log scalar	186199	DP/SE	1294
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-003-F-M	FF	R1	10/8/2008 15:05	355	c	60	log scalar	186199	DP/SE	1312
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-004-F-M	F	R1	10/8/2008 15:25	330	c	60	log scalar	186199	DP/SE	1220
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-005-F-M	W	R1	10/8/2008 15:20	336	c	60	log scalar	186199	DP/SE	1242
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-006-F-M	W	R1	10/8/2008 15:16	344	c	60	log scalar	186199	DP/SE	1272
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-007-F-M	W	R1	10/8/2008 15:12	331	c	60	log scalar	186199	DP/SE	1224
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-008-F-M	W	R1	10/8/2008 15:03	271	c	60	log scalar	186199	DP/SE	1002
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-009-F-M	W	R1	10/8/2008 15:00	313	c	60	log scalar	186199	DP/SE	1157
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-010-F-M	W	R1	10/8/2008 14:56	332	c	60	log scalar	186199	DP/SE	1227

FF = Concrete Foundation Floor
F = Concrete Floor
W = Concrete Wall

Average = 330.20
Median = 334.00
STDEV = 23.88
Minimum = 271.00
Maximum = 355.00

Average = 1221
Median = 1235
STDEV = 88
Minimum = 1002
Maximum = 1312

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-011-F-M	F	R2	10/8/2008 15:43	371	c	60	log scalar	186199	DP/SE	1372
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-012-F-M	F	R2	10/8/2008 15:40	369	c	60	log scalar	186199	DP/SE	1364
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-013-F-M	F	R2	10/8/2008 15:45	376	c	60	log scalar	186199	DP/SE	1390
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-014-F-M	F	R2	10/8/2008 15:48	373	c	60	log scalar	186199	DP/SE	1379
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-015-F-M	W	R2	10/8/2008 15:53	328	c	60	log scalar	186199	DP/SE	1213
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-016-F-M	W	R2	10/8/2008 15:55	366	c	60	log scalar	186199	DP/SE	1353
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-017-F-M	W	R2	10/8/2008 15:58	309	c	60	log scalar	186199	DP/SE	1142
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-018-F-M	W	R2	10/8/2008 16:00	299	c	60	log scalar	186199	DP/SE	1105
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-019-F-M	F	R2	10/8/2008 15:50	365	c	60	log scalar	186199	DP/SE	1349
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-020-F-M	W	R2	10/8/2008 16:03	342	c	60	log scalar	186199	DP/SE	1264

F = Concrete Floor
W = Concrete Wall

Average = 349.80
Median = 365.50
STDEV = 28.51
Minimum = 299.00
Maximum = 376.00

Average = 1293
Median = 1351
STDEV = 105
Minimum = 1105
Maximum = 1390

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-021-F-M	Floor	TR1	10/1/2008 14:28	425	c	60	log scalar	186199	DP/SE	1571
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-022-F-M	Floor	TR1	10/1/2008 14:32	451	c	60	log scalar	186199	DP/SE	1667
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-023-F-M	Floor	TR1	10/1/2008 14:38	441	c	60	log scalar	186199	DP/SE	1630
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-024-F-M	Floor	TR1	10/1/2008 14:43	441	c	60	log scalar	186199	DP/SE	1630
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-025-F-M	Wall	TR1	10/1/2008 14:55	430	c	60	log scalar	186199	DP/SE	1590
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-026-F-M	Wall	TR1	10/1/2008 15:01	416	c	60	log scalar	186199	DP/SE	1538
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-027-F-M	Wall	TR1	10/1/2008 15:07	462	c	60	log scalar	186199	DP/SE	1708
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-028-F-M	Wall	TR1	10/1/2008 15:12	455	c	60	log scalar	186199	DP/SE	1682
43-68	PR178065	5/29/2008	Concrete Block	CHAR-WGB-01-029-F-M	Wall	TR1	10/1/2008 15:23	305	c	60	log scalar	186199	DP/SE	1128
43-68	PR178065	5/29/2008	Concrete Block	CHAR-WGB-01-030-F-M	Wall	TR1	10/1/2008 15:28	373	c	60	log scalar	186199	DP/SE	1379

Average = 419.90
Median = 435.50
STDEV = 47.62
Minimum = 305.00
Maximum = 462.00

Average = 1552
Median = 1610
STDEV = 176
Minimum = 1128
Maximum = 1708

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-031-F-M	Floor	TR2	10/2/2008 10:57	433	c	60	log scalar	186193	DP/SE	1601
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-032-F-M	Floor	TR2	10/2/2008 11:04	435	c	60	log scalar	186193	DP/SE	1608
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-033-F-M	Floor	TR2	10/2/2008 11:07	434	c	60	log scalar	186193	DP/SE	1604
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-034-F-M	Floor	TR2	10/2/2008 11:11	457	c	60	log scalar	186193	DP/SE	1689
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-035-F-M	Floor	TR2	10/2/2008 11:14	425	c	60	log scalar	186193	DP/SE	1571
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-036-F-M	Wall	TR2	10/2/2008 11:20	410	c	60	log scalar	186193	DP/SE	1516
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-037-F-M	Wall	TR2	10/2/2008 11:23	393	c	60	log scalar	186193	DP/SE	1453
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-038-F-M	Wall	TR2	10/2/2008 11:27	405	c	60	log scalar	186193	DP/SE	1497
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-039-F-M	Wall	TR2	10/2/2008 11:29	423	c	60	log scalar	186193	DP/SE	1564
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-040-F-M	Wall	TR2	10/2/2008 11:32	419	c	60	log scalar	186193	DP/SE	1549

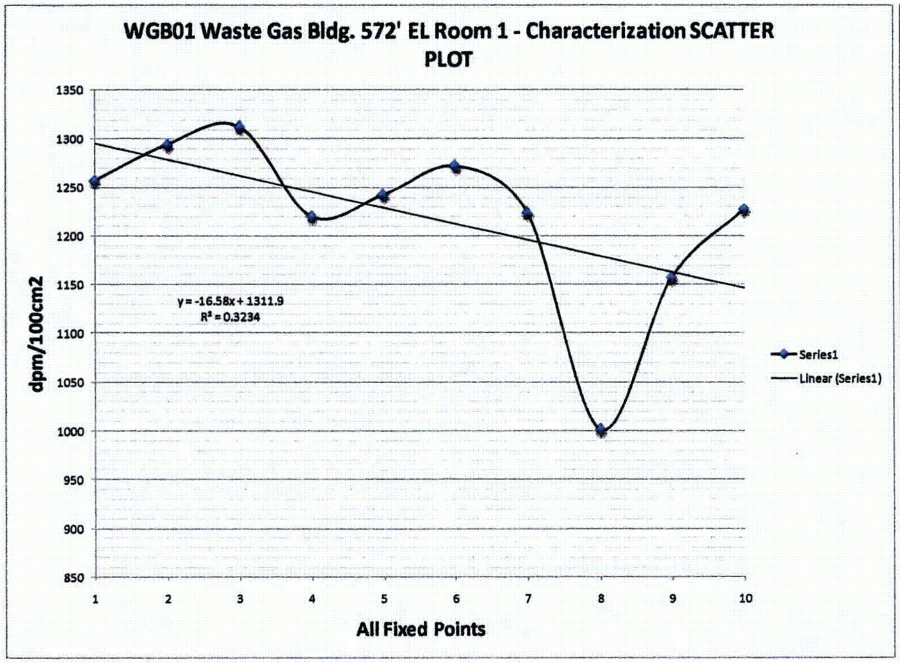
Average = 423.40
Median = 424.00
STDEV = 18.05
Minimum = 393.00
Maximum = 457.00

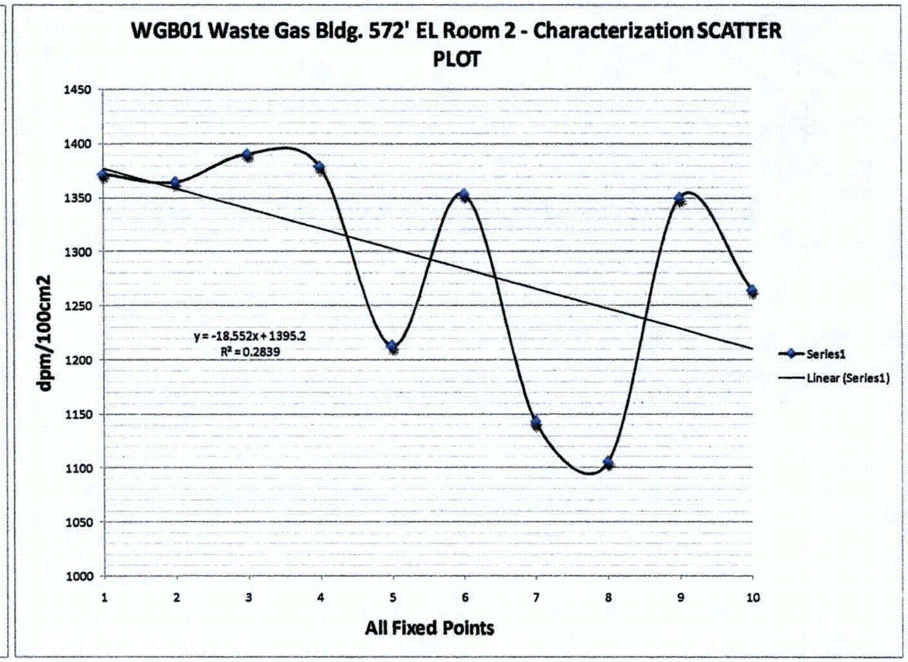
Average = 1565
Median = 1567
STDEV = 67
Minimum = 1453
Maximum = 1689

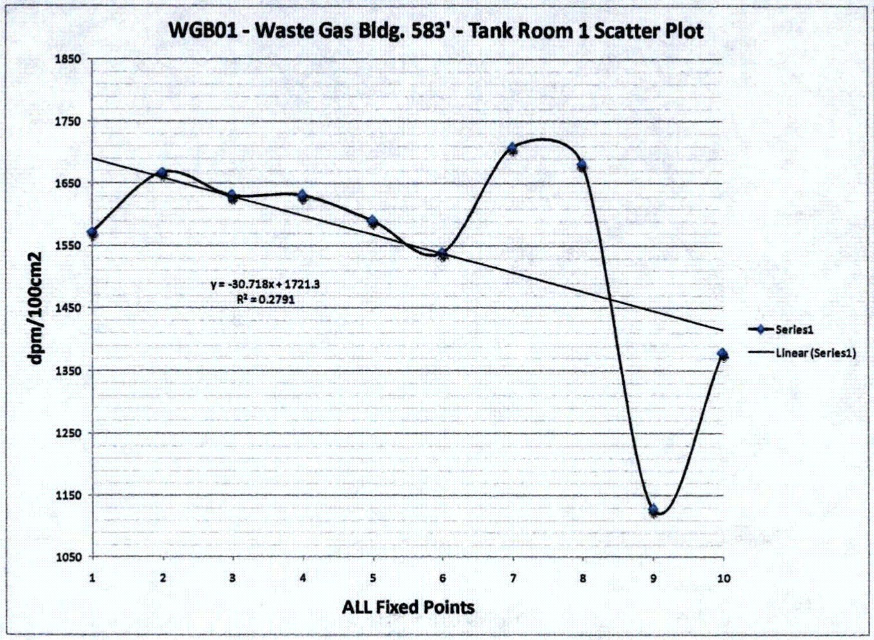
Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-041-F-M	Floor	VR	10/6/2008 11:16	368	c	60	log scalar	186193	DP/SE	1360
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-042-F-M	Floor	VR	10/6/2008 11:19	423	c	60	log scalar	186193	DP/SE	1564
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-043-F-M	Floor	VR	10/6/2008 11:22	348	c	60	log scalar	186193	DP/SE	1287
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-044-F-M	Floor	VR	10/6/2008 11:25	381	c	60	log scalar	186193	DP/SE	1409
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-045-F-M	Wall	VR	10/6/2008 11:29	333	c	60	log scalar	186193	DP/SE	1231
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-046-F-M	Wall	VR	10/6/2008 11:33	303	c	60	log scalar	186193	DP/SE	1120
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-047-F-M	Wall	VR	10/6/2008 11:38	328	c	60	log scalar	186193	DP/SE	1213
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-048-F-M	Wall	VR	10/6/2008 11:41	348	c	60	log scalar	186193	DP/SE	1287
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-049-F-M	Wall	VR	10/6/2008 11:43	333	c	60	log scalar	186193	DP/SE	1231
43-68	PR178065	5/29/2008	Concrete	CHAR-WGB-01-050-F-M	Wall	VR	10/6/2008 11:45	332	c	60	log scalar	186193	DP/SE	1227

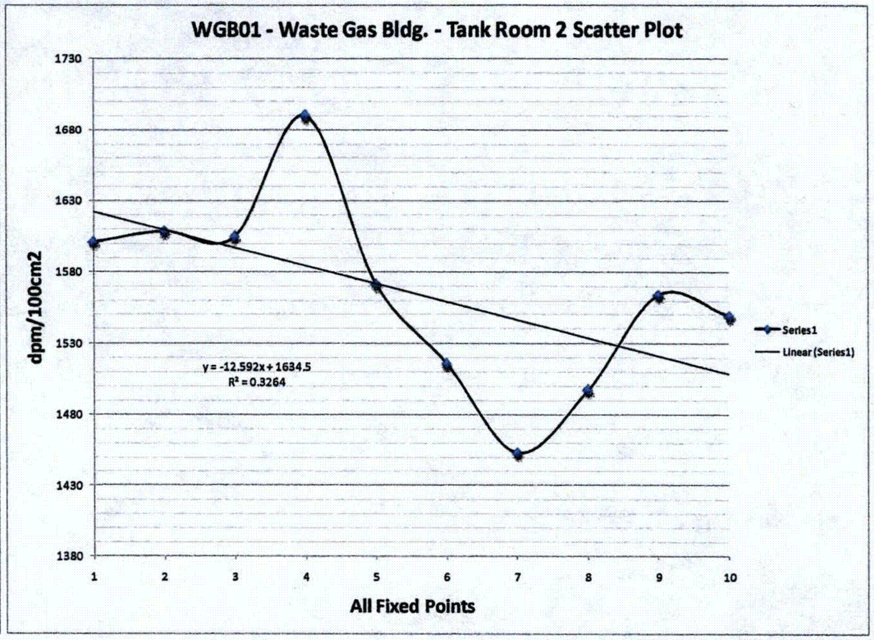
Average = 349.70
Median = 340.50
STDEV = 33.69
Minimum = 303.00
Maximum = 423.00

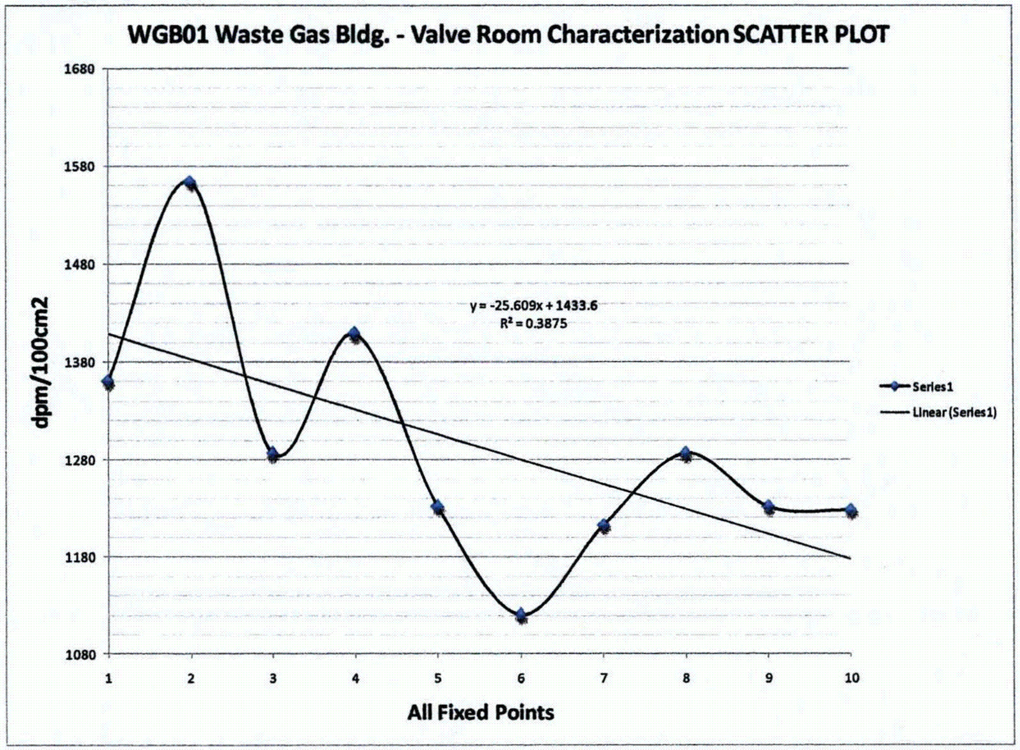
Average = 1293
Median = 1259
STDEV = 125
Minimum = 1120
Maximum = 1564


WGB01 Waste Gas Bldg. 572' EL Room 1 - Characterization SCATTER PLOT
dpm/100cm2
y = -16.58x + 1311.9
R² = 0.3234
Series1
Linear (Series1)
All Fixed Points


WGB01 Waste Gas Bldg. 572' EL Room 2 - Characterization SCATTER PLOT
dpm/100cm2
y = -18.552x + 1395.2
R² = 0.2839
Series1
Linear (Series1)
All Fixed Points

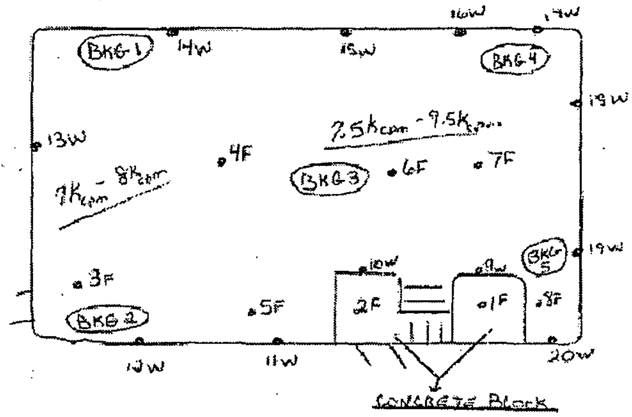

WGB01 - Waste Gas Bldg. 583' - Tank Room 1 Scatter Plot
dpm/100cm2
ALL Fixed Points
y = -30.718x + 1721.3
R² = 0.2791
Series1
Linear (Series1)


WGB01 - Waste Gas Bldg. - Tank Room 2 Scatter Plot
dpm/100cm2
All Fixed Points
y = -12.592x + 1634.5
R² = 0.3264
Series1
Linear (Series1)


WGB01 Waste Gas Bldg. - Valve Room Characterization SCATTER PLOT
1680
1580
1480
1380
1280
1180
1080
dpm/100cm2
y = -25.609x + 1433.6
R² = 0.3875
Series1
Linear (Series1)
1
2
3
4
5
6
7
8
9
10
All Fixed Points

CHARACTERIZATION

IGB01 INERTGASBLDG TANK ROOM



1-2 CONCRETE OVER CONCRETE BLOCKS
9-10 CONCRETE BLOCK WALL
3-8 CONCRETE FLOOR
11-20 CONCRETE WALL

SURVEYED ON: 10/8/08 by: DP

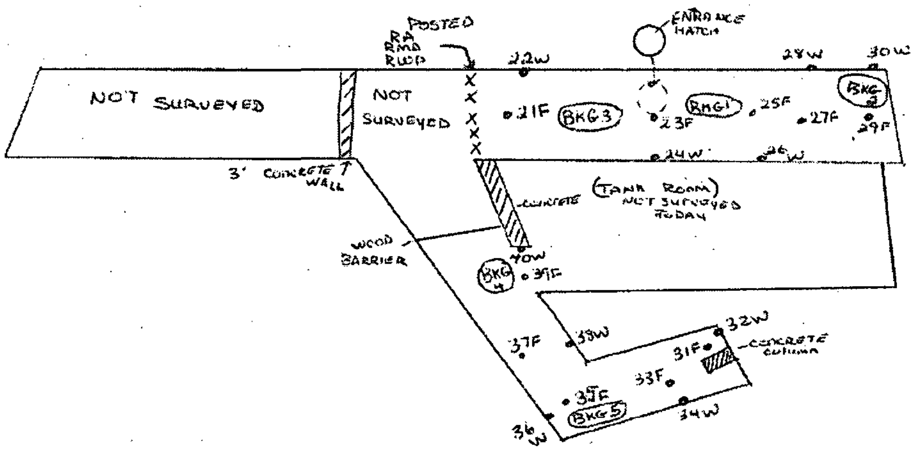
Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 93 scfm @ 0730

Comments:	Time	BKG	SOURCE	DF3 4368
Daily	0739	253	1283	
End of Day	1631	258	1267	
Daily	0739	7845	45331	SPA 3 D1
End of Day	1629	7539	46835	

SPA 3 SURVEY ALONG FLOOR/WALL JUNCTURES 8Kcpm - 9Kcpm
ALONG CONCRETE BLOCK/FLOOR JUNCTURES 9Kcpm - 10Kcpm

Instrument / Serial No.
2350-1 / 186199
2350-1 / 180090
Probe No. / Serial No.
D3 - 4368 / PR-178065
D1 - SPA 3 / 2081

IGB-01 Tunnel & Tank Room North



SURVEYED ON: 10/7/08 by: DP/se

Reactor Power - 100 %
Hydrogen Water Chemistry Inject. Rate - 93 scfm @ 1310 1630

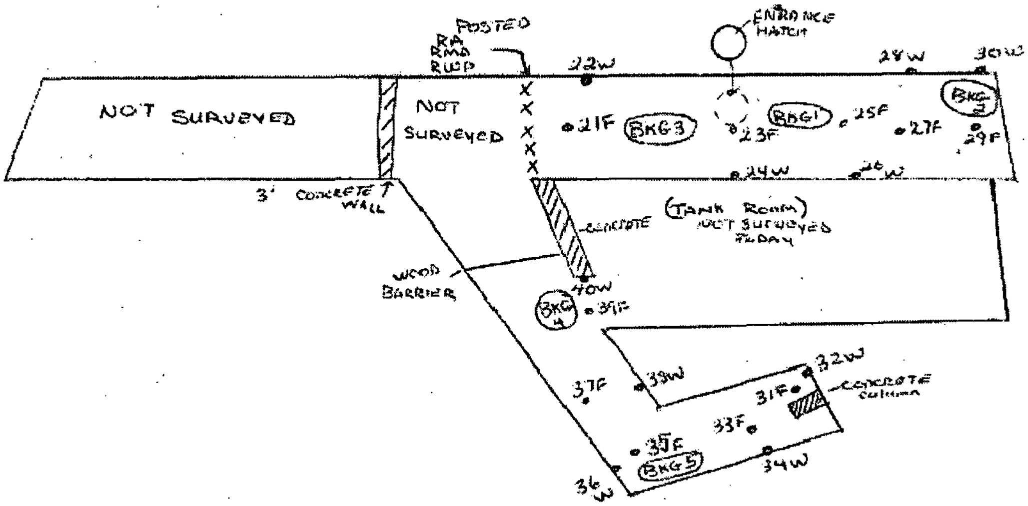
Comments:	Time	BKG	Source	
Daily -	0832	230	1295	> pass
End of Day -	1625	266	1295	

~~DO~~ SPA 3 READINGS NOT TAKEN IN TUNNELS (10/8/08 ...)

Instrument / Serial No. 2350-1 / 186193

Probe No. / Serial No. D3 43&8 / PR178065

IGB-01 Tunnel & Tank Room North



SURVEYED ON: 10/7/08 by: DP/se

Reactor Power - 100 %
Hydrogen Water Chemistry Inject. Rate - 93 scfm @ 1310 1630

Comments:	Time	BKG	Source	
Daily	0832	230	1295	
End of Day	1625	266	1295	
~~DO~~ SPA3 READINGS NOT TAKEN IN TUNNELS (10/8/08 se)				

Instrument / Serial No.
2350-1 / 186193
Probe No. / Serial No.
D3 43-68 / PR 178065

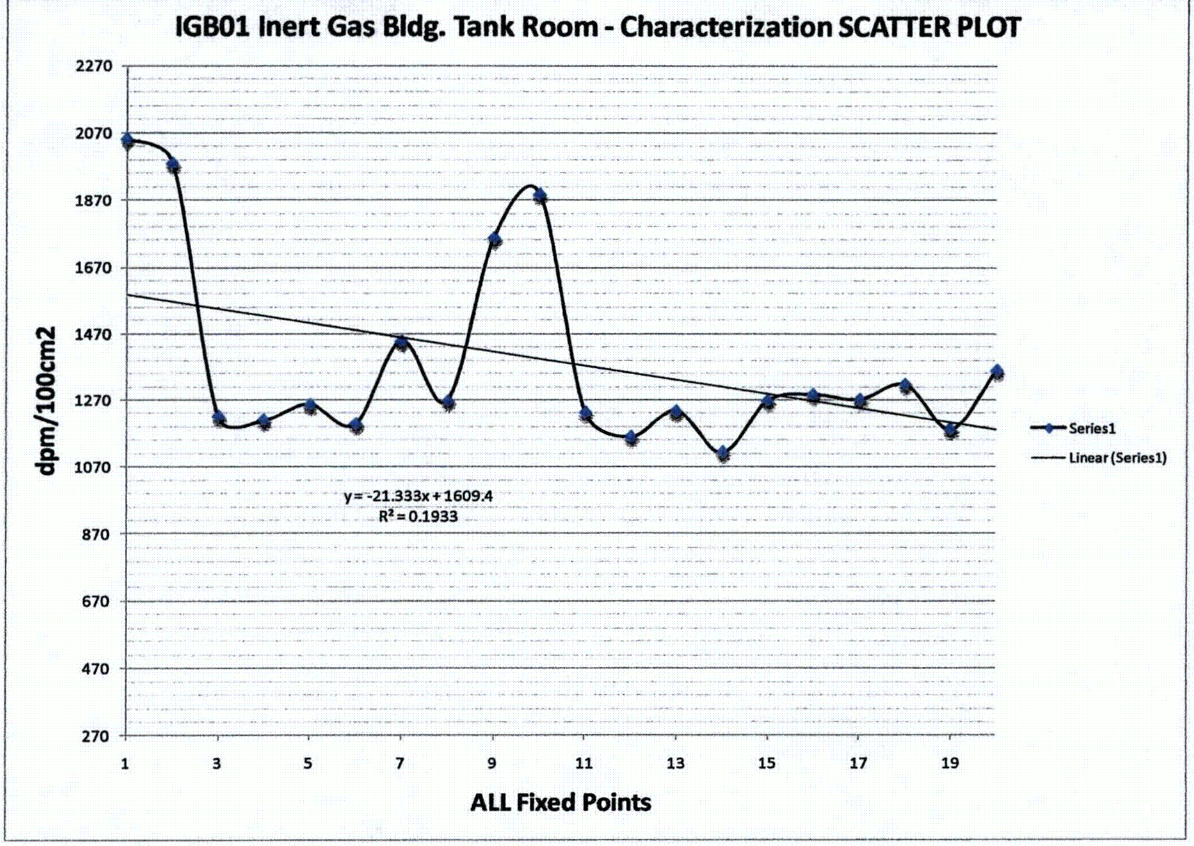
Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-001-F-M	CBF	TR	10/8/2008 8:43	555	c	60	log scalar	186199	DP/SE	2052
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-002-F-M	CBF	TR	10/8/2008 8:51	535	c	60	log scalar	186199	DP/SE	1978
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-003-F-M	CF	TR	10/8/2008 13:12	330	c	60	log scalar	186199	DP/SE	1220
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-004-F-M	CF	TR	10/8/2008 13:15	327	c	60	log scalar	186199	DP/SE	1209
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-005-F-M	CF	TR	10/8/2008 13:18	340	c	60	log scalar	186199	DP/SE	1257
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-006-F-M	CF	TR	10/8/2008 13:22	324	c	60	log scalar	186199	DP/SE	1198
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-007-F-M	CF	TR	10/8/2008 13:25	392	c	60	log scalar	186199	DP/SE	1449
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-008-F-M	CF	TR	10/8/2008 13:28	343	c	60	log scalar	186199	DP/SE	1268
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-009-F-M	CBW	TR	10/8/2008 8:47	475	c	60	log scalar	186199	DP/SE	1756
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-010-F-M	CBW	TR	10/8/2008 8:54	511	c	60	log scalar	186199	DP/SE	1889
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-011-F-M	CW	TR	10/8/2008 8:58	334	c	60	log scalar	186199	DP/SE	1235
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-012-F-M	CW	TR	10/8/2008 9:02	314	c	60	log scalar	186199	DP/SE	1161
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-013-F-M	CW	TR	10/8/2008 9:06	335	c	60	log scalar	186199	DP/SE	1238
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-014-F-M	CW	TR	10/8/2008 9:10	301	c	60	log scalar	186199	DP/SE	1113
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-015-F-M	CW	TR	10/8/2008 9:13	343	c	60	log scalar	186199	DP/SE	1268
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-016-F-M	CW	TR	10/8/2008 9:17	348	c	60	log scalar	186199	DP/SE	1287
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-017-F-M	CW	TR	10/8/2008 9:20	344	c	60	log scalar	186199	DP/SE	1272
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-018-F-M	CW	TR	10/8/2008 9:23	356	c	60	log scalar	186199	DP/SE	1316
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-019-F-M	CW	TR	10/8/2008 9:27	320	c	60	log scalar	186199	DP/SE	1183
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-020-F-M	CW	TR	10/8/2008 9:31	368	c	60	log scalar	186199	DP/SE	1360

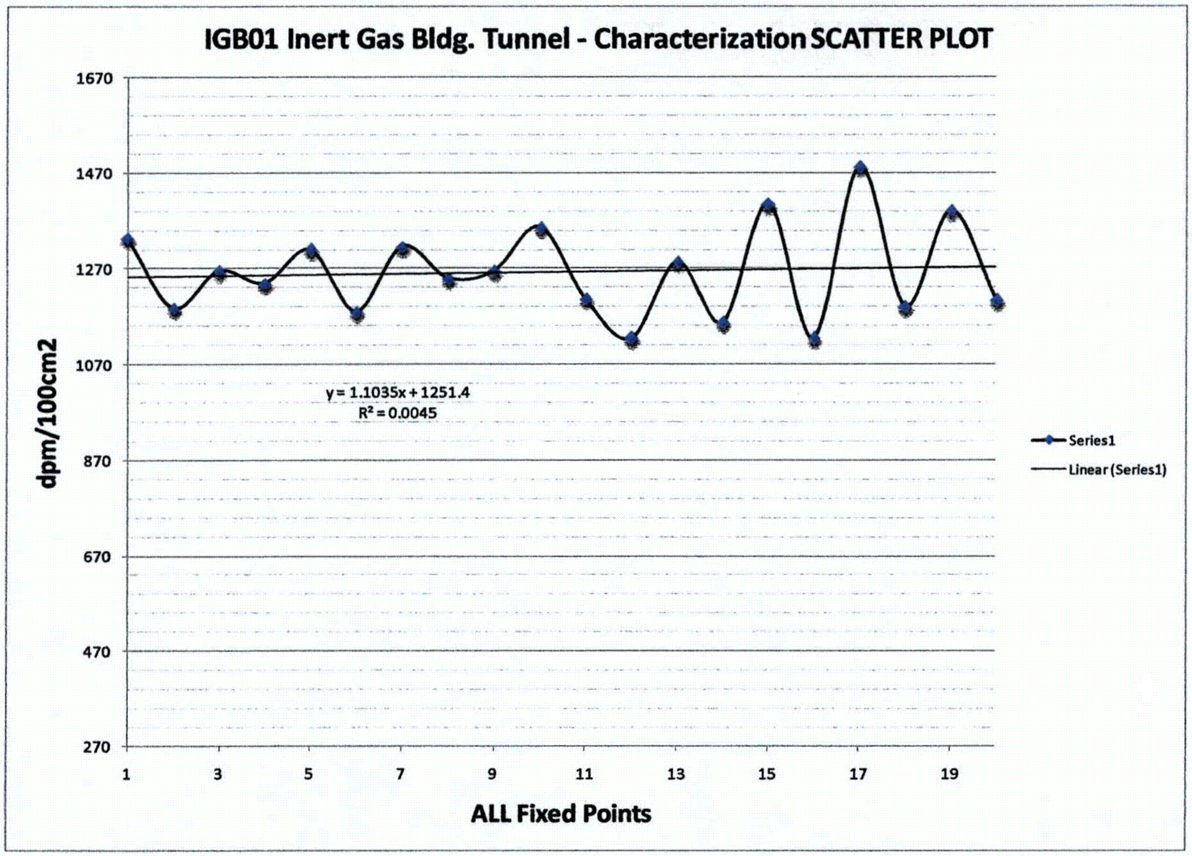
CBF = Concrete poured over concrete blocks	**Average = 374.75**	**Average = 1385**
CBW = Concrete Block Wall	**Median = 343.00**	**Median = 1268**
CW = Concrete Wall	**STDEV = 77.66**	**STDEV = 287**
CF = Concrete Floor	**Minimum = 301.00**	**Minimum = 1113**
	Maximum = 555.00	**Maximum = 2052**

Model No.	Serial No.	Cal Date	Survey Material	Location Code1	Location Code2	Location Code3	Formatted Date	Logged Reading	Units	Count Time	Logging Mode	M2350(-1) Serial No.	M2350(-1) ID	
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-021-F-M	Floor	TU	10/7/2008 14:00	361	c	60	log scalar	186193	DP/SE	1335
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-022-F-M	Wall	TU	10/7/2008 14:03	321	c	60	log scalar	186193	DP/SE	1187
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-023-F-M	Floor	TU	10/7/2008 14:10	342	c	60	log scalar	186193	DP/SE	1264
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-024-F-M	Wall	TU	10/7/2008 14:13	335	c	60	log scalar	186193	DP/SE	1238
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-025-F-M	Floor	TU	10/7/2008 14:17	354	c	60	log scalar	186193	DP/SE	1309
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-026-F-M	Wall	TU	10/7/2008 14:20	319	c	60	log scalar	186193	DP/SE	1179
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-027-F-M	Floor	TU	10/7/2008 14:24	356	c	60	log scalar	186193	DP/SE	1316
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-028-F-M	Wall	TU	10/7/2008 14:27	338	c	60	log scalar	186193	DP/SE	1250
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-029-F-M	Floor	TU	10/7/2008 14:31	342	c	60	log scalar	186193	DP/SE	1264
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-030-F-M	Wall	TU	10/7/2008 14:34	367	c	60	log scalar	186193	DP/SE	1357
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-031-F-M	Floor	TU	10/7/2008 15:37	326	c	60	log scalar	186193	DP/SE	1205
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-032-F-M	Wall	TU	10/7/2008 15:40	304	c	60	log scalar	186193	DP/SE	1124
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-033-F-M	Floor	TU	10/7/2008 15:45	347	c	60	log scalar	186193	DP/SE	1283
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-034-F-M	Wall	TU	10/7/2008 15:48	313	c	60	log scalar	186193	DP/SE	1157
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-035-F-M	Floor	TU	10/7/2008 15:51	380	c	60	log scalar	186193	DP/SE	1405
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-036-F-M	Wall	TU	10/7/2008 15:54	304	c	60	log scalar	186193	DP/SE	1124
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-037-F-M	Floor	TU	10/7/2008 15:58	401	c	60	log scalar	186193	DP/SE	1482
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-038-F-M	Wall	TU	10/7/2008 16:01	322	c	60	log scalar	186193	DP/SE	1190
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-039-F-M	Floor	TU	10/7/2008 16:06	376	c	60	log scalar	186193	DP/SE	1390
43-68	PR178065	5/29/2008	Concrete	CHAR-IGB-01-040-F-M	Wall	TU	10/7/2008 16:09	325	c	60	log scalar	186193	DP/SE	1201

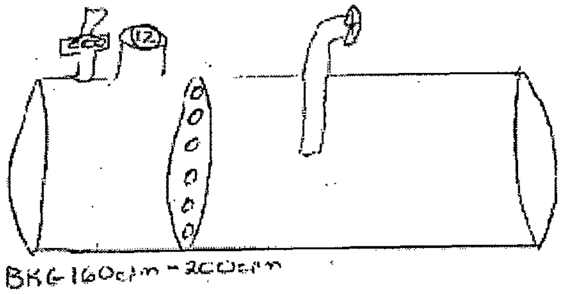
Average = 341.65
Median = 340.00
STDEV = 26.30
Minimum = 304.00
Maximum = 401.00

Average = 1263
Median = 1257
STDEV = 97
Minimum = 1124
Maximum = 1482

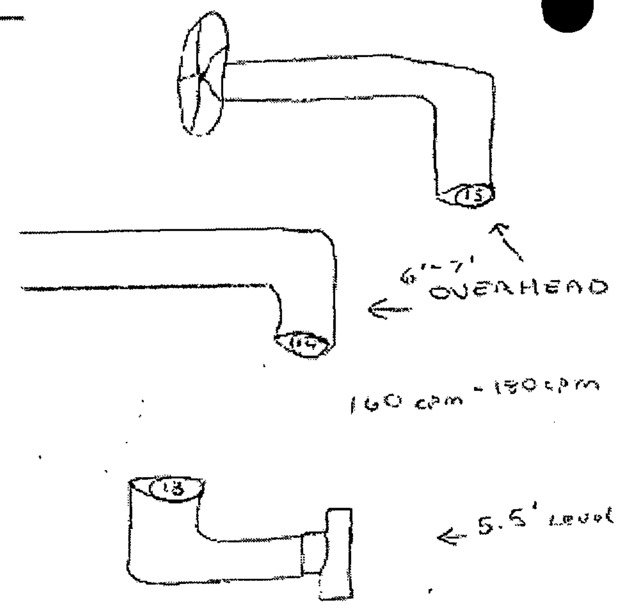

IGB01 Inert Gas Bldg. Tank Room - Characterization SCATTER PLOT
dpm/100cm2
2270
2070
1870
1670
1470
1270
1070
870
670
470
270
1
3
5
7
9
11
13
15
17
19
ALL Fixed Points
y = -21.333x + 1609.4
R² = 0.1933
Series1
Linear (Series1)


IGB01 Inert Gas Bldg. Tunnel - Characterization SCATTER PLOT
dpm/100cm2
1670
1470
1270
1070
870
670
470
270
1
3
5
7
9
11
13
15
17
19
ALL Fixed Points
y = 1.1035x + 1251.4
R² = 0.0045
Series1
Linear (Series1)

TURBINE BLDG CHARACTERIZATION
1st FLOOR



FEED WATER HEATER



Boiler Feed Pump System

SURVEYED ON: by:

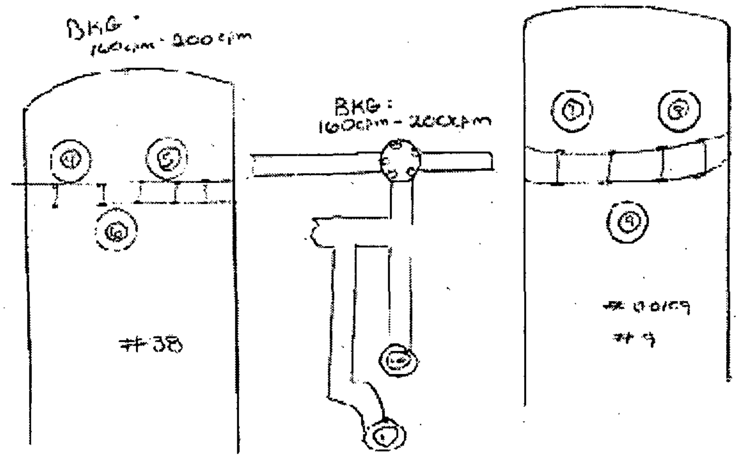
Reactor Power - 100 % Hydrogen Water Chemistry Inject. Rate - 94 scfm @ 0730 1100	Instrument / Serial No. / 1682 Probe No. / Serial No.

Comments: each hole direct

TBN01-04 TURBINE BLD CHARACTERIZATION

2ND FLOOR

LUBE OIL SYSTEM



SURVEYED ON: 10/22/04 by: DP/SO

Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 94 scfm @ 0730
1100

Instrument / Serial No.
2177 / 16382 cd 1/07

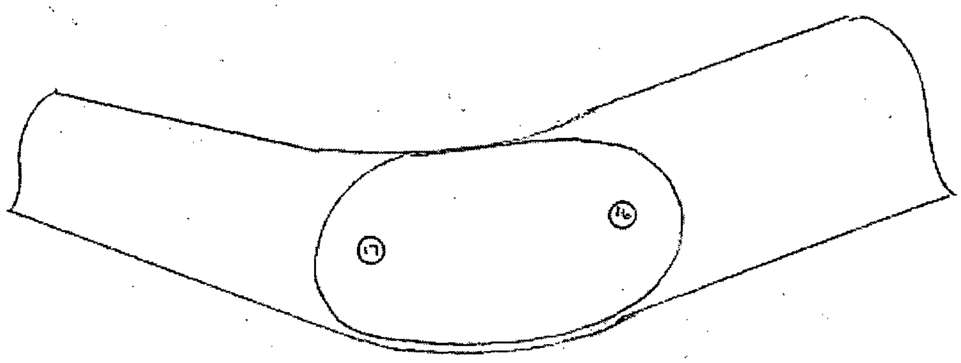
Probe No. / Serial No.
N/A

Comments: 1/2 each hole. Diesel Frisk - NDA > BKG
2ND FLOOR

TBN01-04: TURBINE BLDG. CHARACTERIZATION

2nd FLOOR

CONDENSATE PIPE



BKG - 180cpm - 220cpm

SURVEYED ON: 10/23/07 by: DP / SE

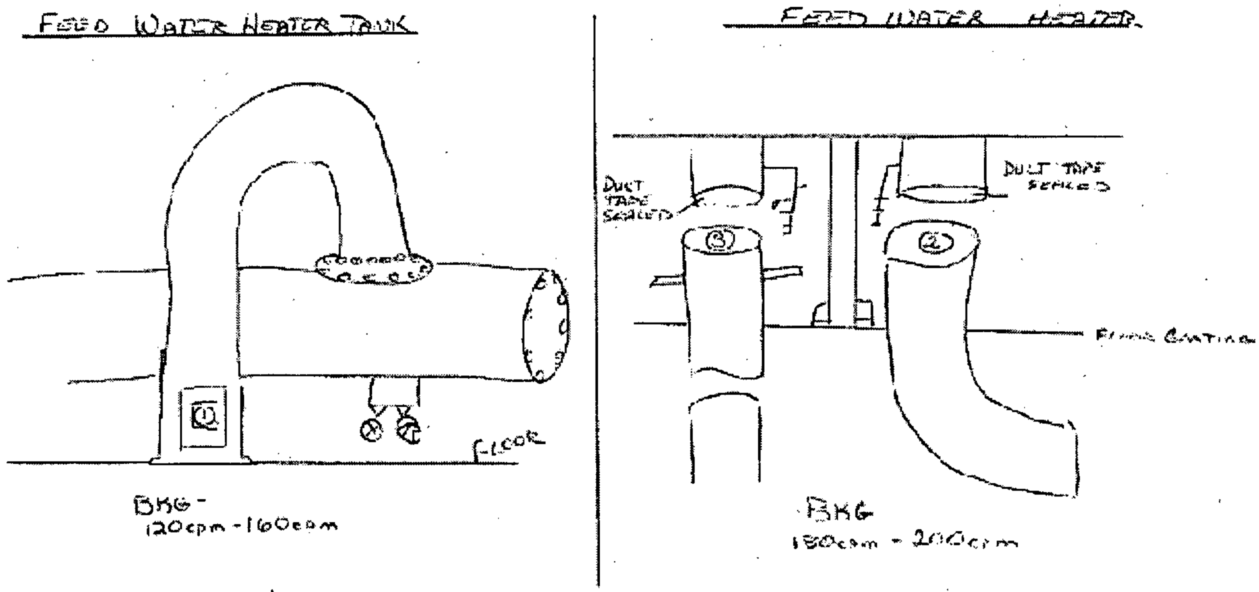
Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 94 scfm @ 0730 1100

Instrument / Serial No.
L177 / 16382 cd 1/08

Probe No. / Serial No.
N/A

Comments: DIRECT FRISK 1/3 PIPE TO 6' BOTH DIRECTIONS
NDA >BKG

TBN01-04 TURBINE BLDG CHARACTERIZATION
3RD FLOOR



SURVEYED ON: 10/22/08 by: D. Lee

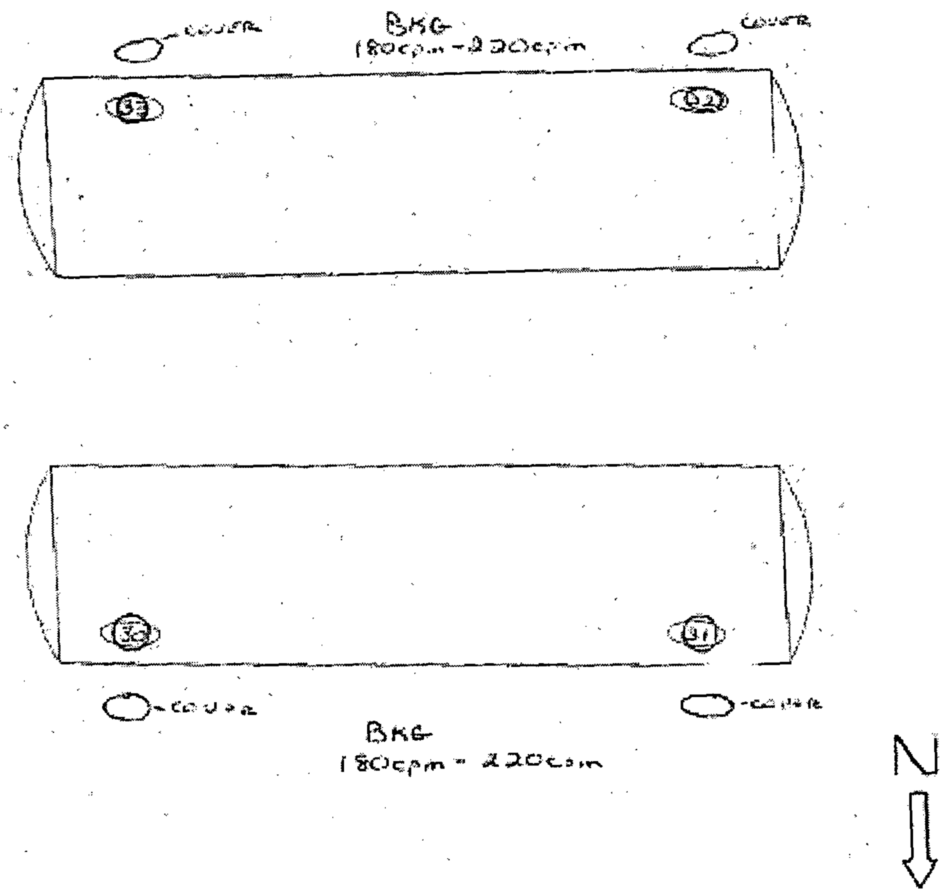
Reactor Power - 100 %
Hydrogen Water
Chemistry Inject. Rate - 94 scfm @ 0730
1100

Instrument / Serial No.
L177 - 16382 cd 1/09

Probe No. / Serial No.
N/A

Comments: [illegible]

TBN01-04: TURBINE BLDG. REHEATER



SURVEYED ON: 10/27/01 by: DP

Reactor Power - ___ %
Hydrogen Water
Chemistry Inject. Rate - ___ scfm @ ___
N/A

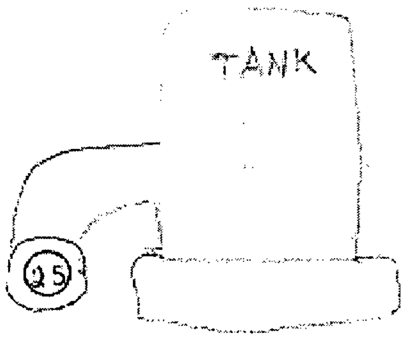
Instrument / Serial No.
E177 / 16382

Probe No. / Serial No.
N/A

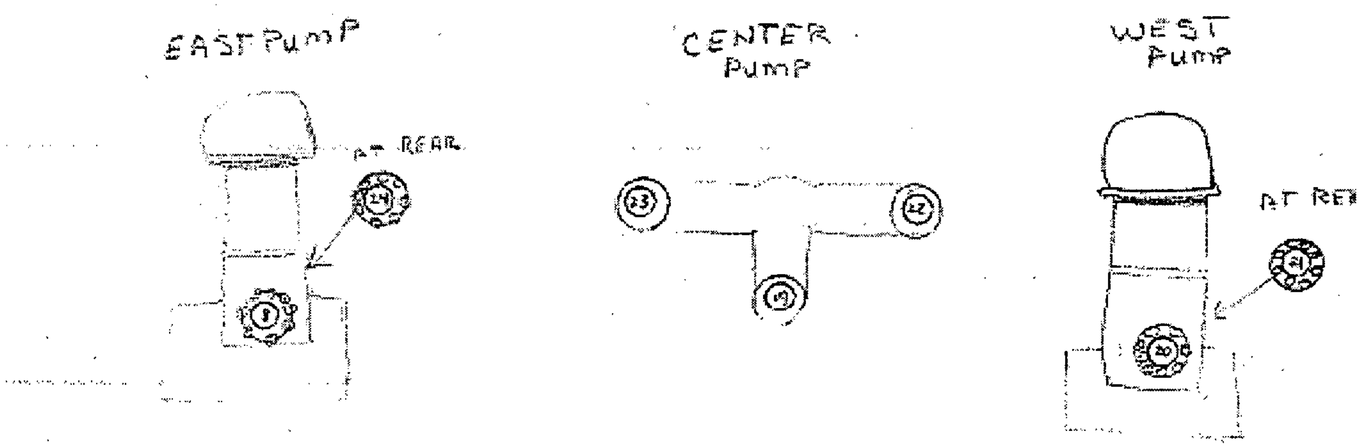
Comments:
Direct Frisk I/s openings NDA > BKG
Direct Frisk I/s covers NDA > BKG

TBN01-04: TURBINE BLDG. CHARACTERIZATION

CONDENSATE PUMPS



BKG: 160cpm-200cpm



SURVEYED ON: 10/27/04 by: DP/

Reactor Power - ___ %
Hydrogen Water
Chemistry Inject Rate - ___ scfm @ ___
N/A

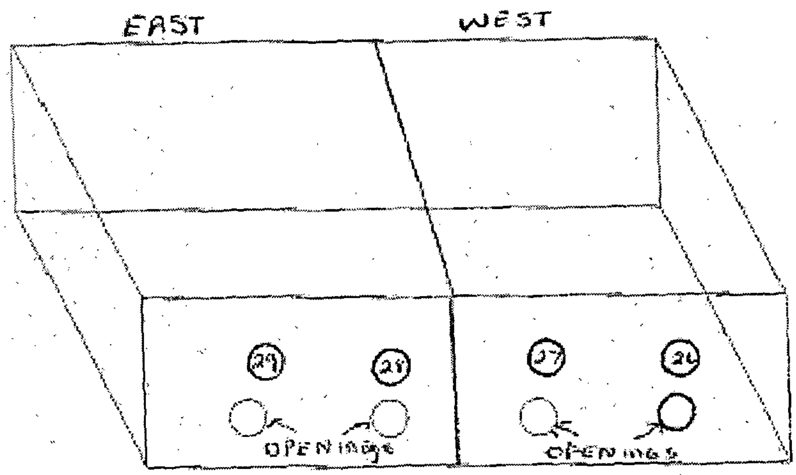
Instrument / Serial No.
2177 / 163?? cd 1/05

Probe No. / Serial No.
N/A

Comments:
Direct Frisk 1/s each opening NDA > BKG

CHARACTERIZATION

TBN01-04 - TURBINE BUILDING HOTWELL



BKG 160cpm - 200cpm

SURVEYED ON: 10/27/07 by: DP/se

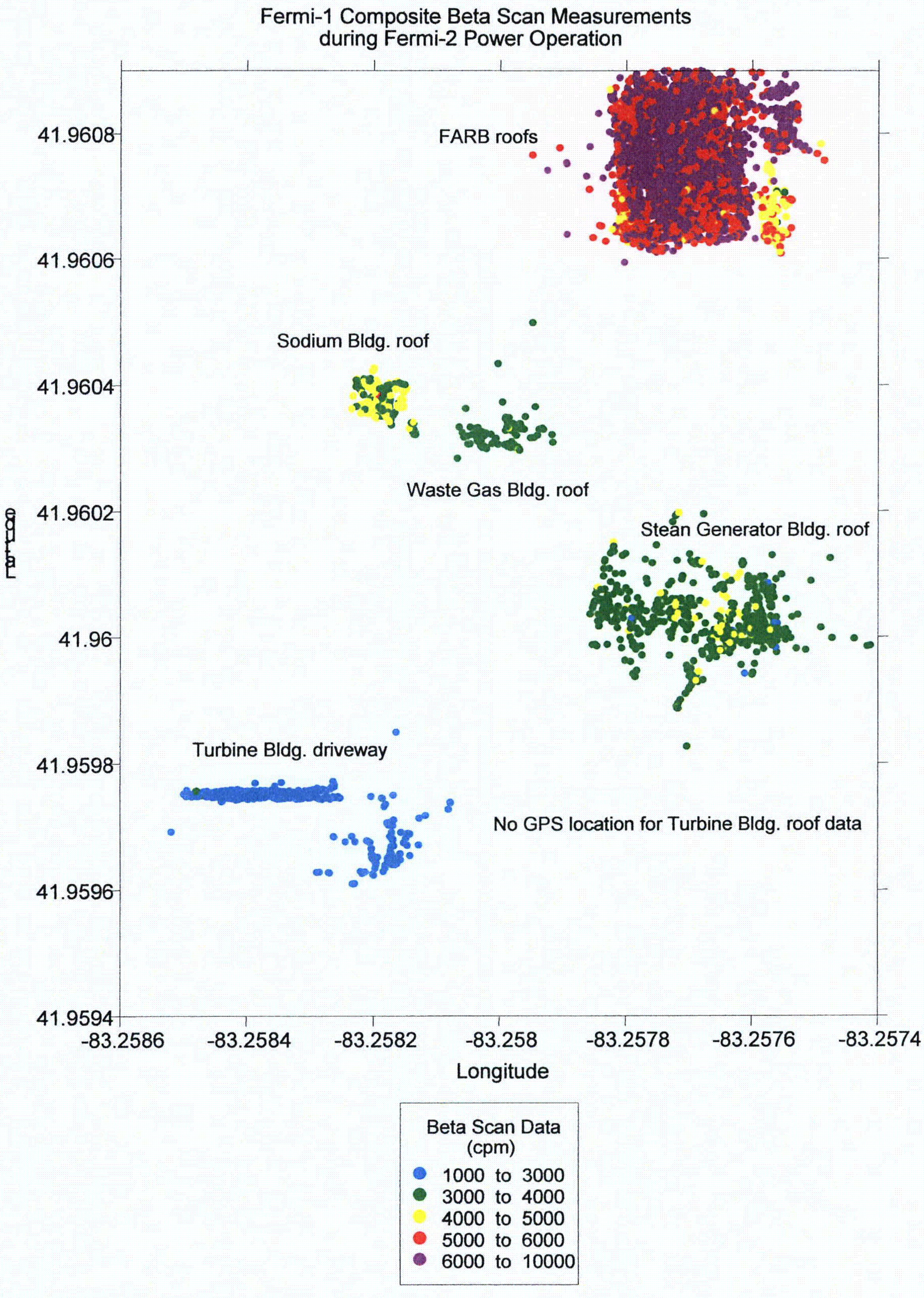
Reactor Power - ____%
Hydrogen Water
Chemistry Inject. Rate ____ scfm @ ____
N/A

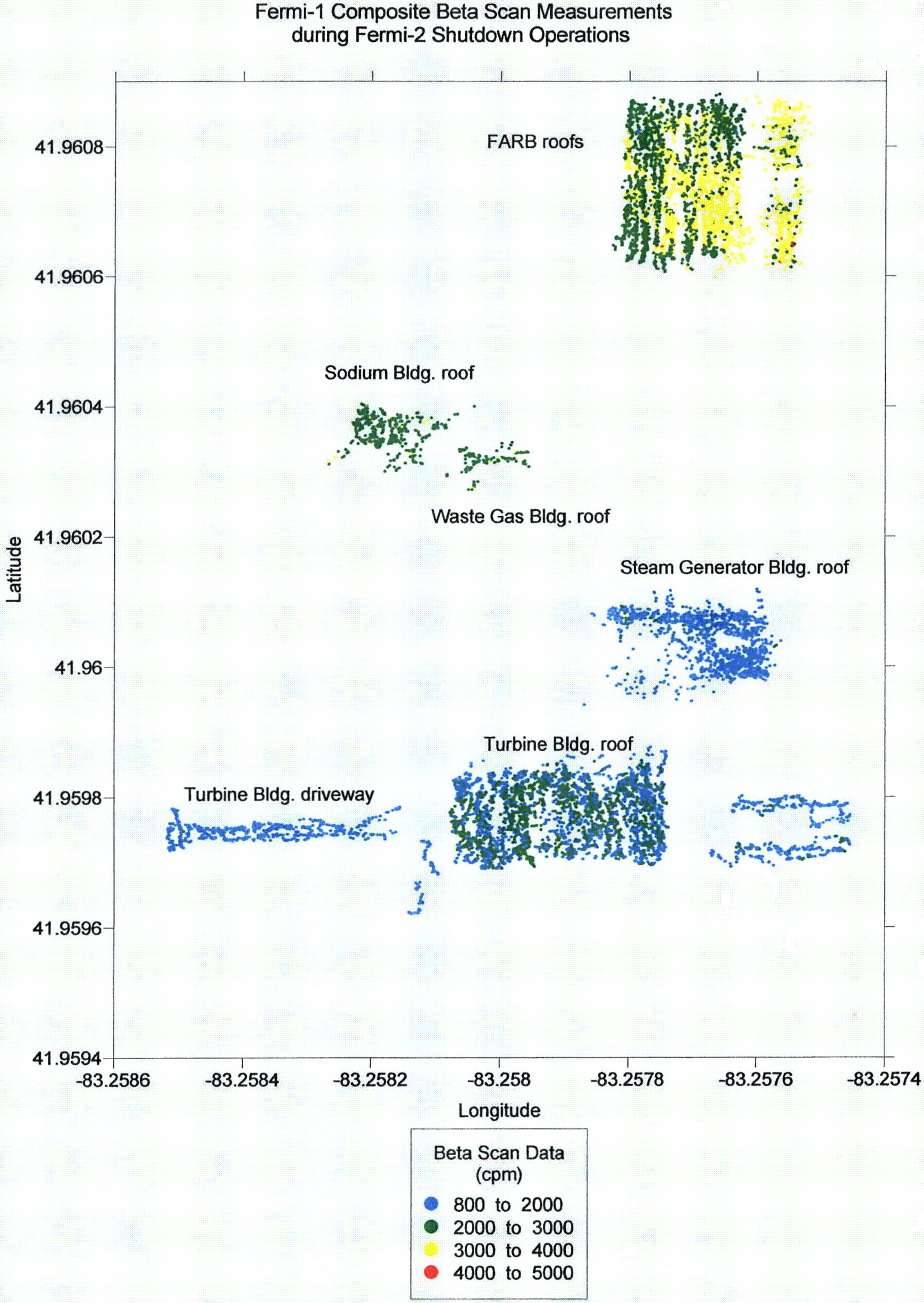
Instrument / Serial No.
2177 / 16382 cd/09

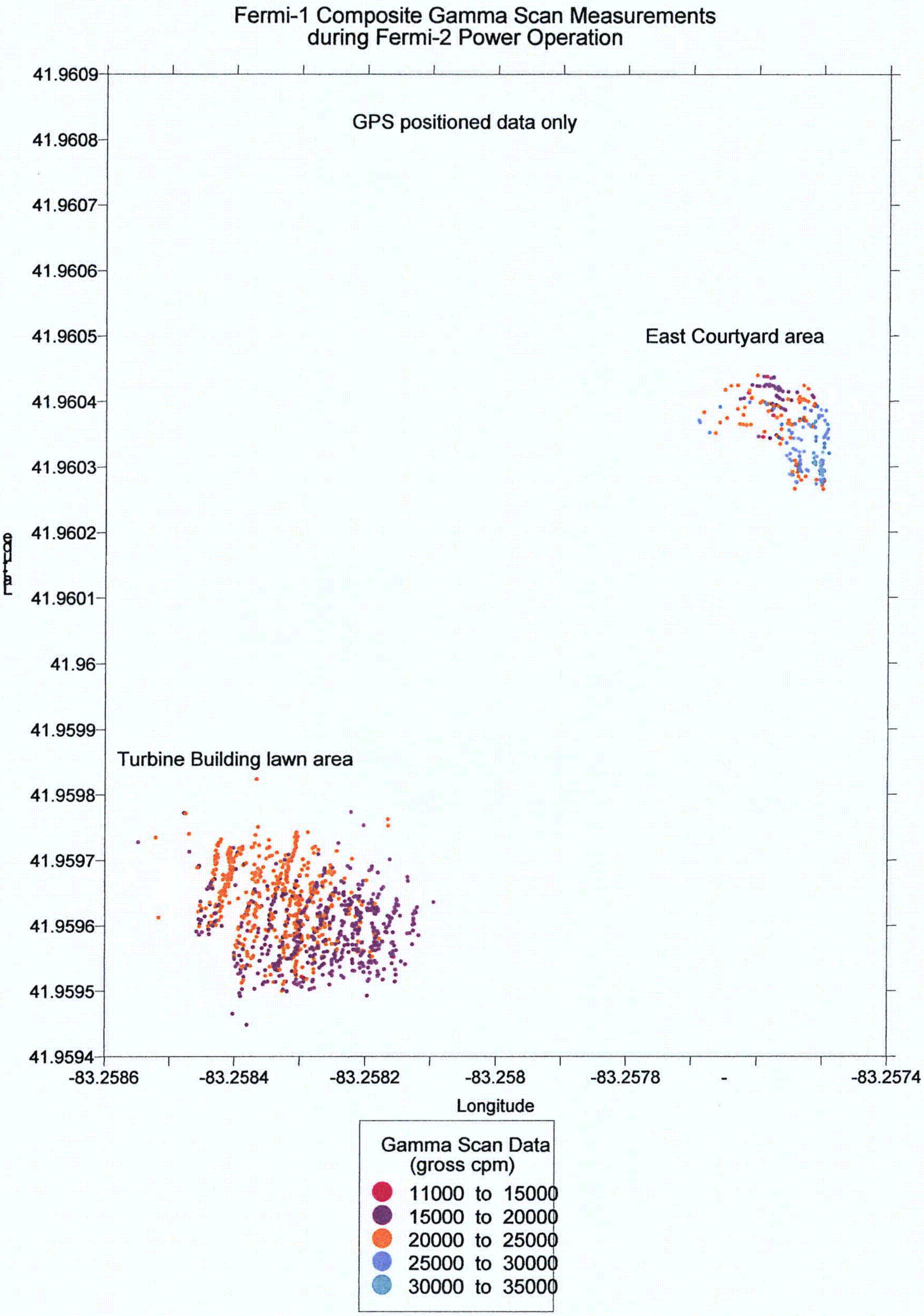
Probe No. / Serial No.
N/A

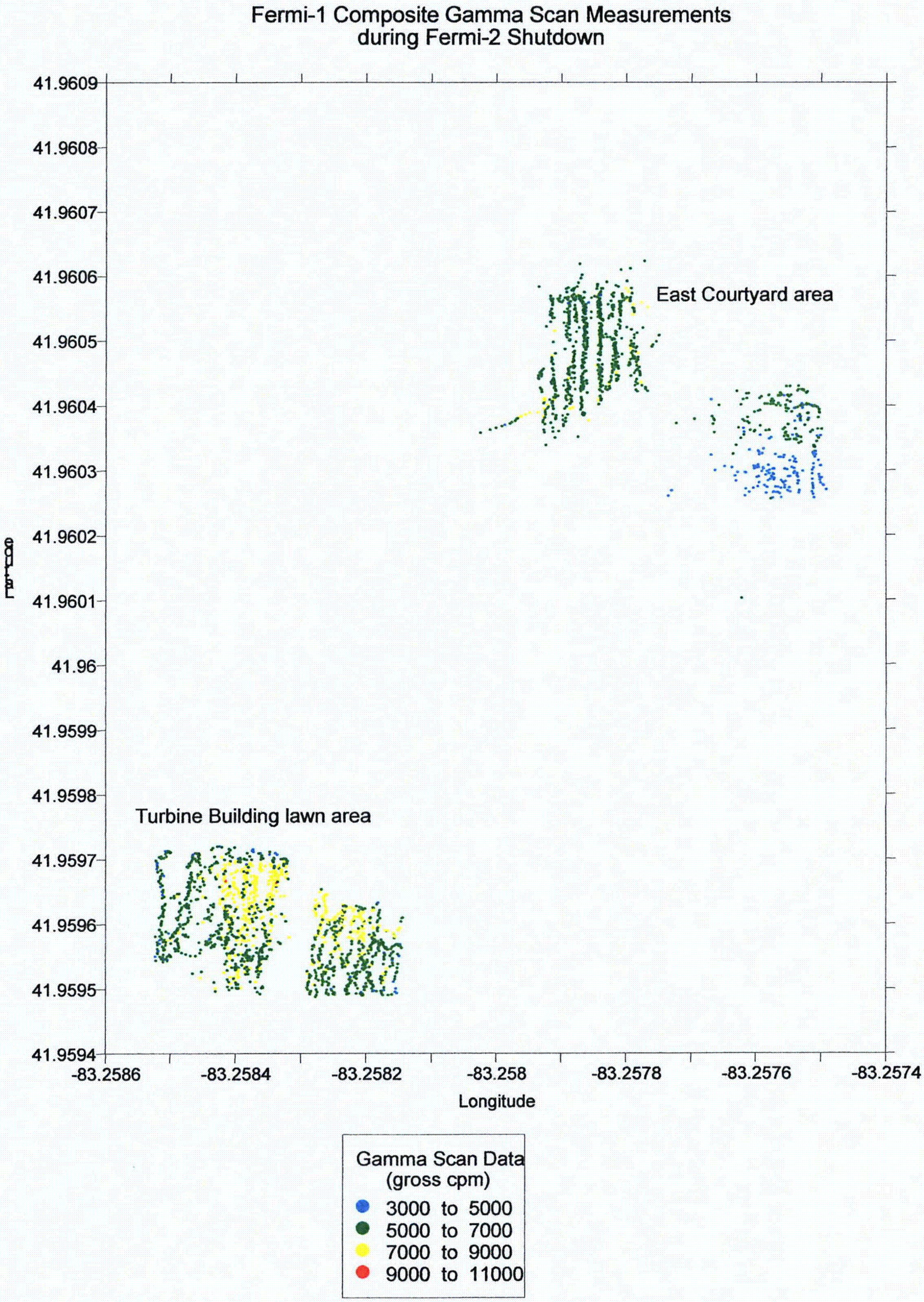
Comments: - 2 1Lt marinellis of RUST Sample TAKEN
- 1 EACH From WEST & EAST HOT WELL SIDE
- DIRECT FRISK 1/3 each opening TO 6' on
FLOORS
NDA > BKG

Appendix 2-C
2004 Characterization Survey


Fermi-1 Composite Beta Scan Measurements
during Fermi-2 Power Operation
FARB roofs
Sodium Bldg. roof
Waste Gas Bldg. roof
Stean Generator Bldg. roof
Turbine Bldg. driveway
No GPS location for Turbine Bldg. roof data
41.9608
41.9606
41.9604
41.9602
41.96
41.9598
41.9596
41.9594
-83.2586
-83.2584
-83.2582
-83.258
-83.2578
-83.2576
-83.2574
Longitude
Beta Scan Data
(cpm)
1000 to 3000
3000 to 4000
4000 to 5000
5000 to 6000
6000 to 10000


Fermi-1 Composite Beta Scan Measurements
during Fermi-2 Shutdown Operations
FARB roofs
Sodium Bldg. roof
Waste Gas Bldg. roof
Steam Generator Bldg. roof
Turbine Bldg. roof
Turbine Bldg. driveway
Latitude
41.9608
41.9606
41.9604
41.9602
41.96
41.9598
41.9596
41.9594
-83.2586
-83.2584
-83.2582
-83.258
-83.2578
-83.2576
-83.2574
Longitude
Beta Scan Data
(cpm)
800 to 2000
2000 to 3000
3000 to 4000
4000 to 5000


Fermi-1 Composite Gamma Scan Measurements
during Fermi-2 Power Operation
GPS positioned data only
East Courtyard area
Turbine Building lawn area
Latitude
41.9609
41.9608
41.9607
41.9606
41.9605
41.9604
41.9603
41.9602
41.9601
41.96
41.9599
41.9598
41.9597
41.9596
41.9595
41.9594
-83.2586
-83.2584
-83.2582
-83.258
-83.2578
-83.2574
Longitude
Gamma Scan Data
(gross cpm)
11000 to 15000
15000 to 20000
20000 to 25000
25000 to 30000
30000 to 35000


Fermi-1 Composite Gamma Scan Measurements
during Fermi-2 Shutdown
41.9609
41.9608
41.9607
41.9606
41.9605
41.9604
41.9603
41.9602
41.9601
41.96
41.9599
41.9598
41.9597
41.9596
41.9595
41.9594
Latitude
East Courtyard area
Turbine Building lawn area
-83.2586
-83.2584
-83.2582
-83.258
-83.2578
-83.2576
-83.2574
Longitude
Gamma Scan Data
(gross cpm)
3000 to 5000
5000 to 7000
7000 to 9000
9000 to 11000

Summary of Scan Data - Beta

Survey ID: FARBRFTARGV1B1_01

Area: Fuel and Repair Bldg
Level: 1st Floor Roof
Space: Roof
Surface: 1st Floor Roof at power

Survey Date: 10/27/2004 3:51:34 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 sq cm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	638	Gross	2,726	4,773	6,090	542
		Net	545	4,243	6,620	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100cm2)	MDCR (cpm)
Roof Gravel	2,424.00	0.21	925.40	512.40

12/13/2004

Summary of Scan Data - Beta

Survey ID: FARBRFTRGV1ZB1_01

Area: Fuel and Repair Bldg

Level: 1st Floor Roof

Space: Roof

Surface: 1st floor Roof at shutdown

Survey Date: 11/15/2004 3:33:44 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 sq cm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	727	**Gross**	2,485	3,285	4,341	304
		Net	124	1,761	3,920	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm

d prime: 1.90

Surveyor Efficiency: 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100cm2)	MDCR (cpm)
Roof Gravel	2,424.00	0.21	1048.00	512.40

12/13/2004

Summary of Scan Data - Beta

Survey ID: FARBRFTARGV2B1_01

Area: Fuel and Repair Bldg
Level: 2nd Floor Roof
Space: Roof
Surface: 2nd Floor Roof at power

Survey Date: 10/27/2004 2:53:44 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 sq cm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	680	Gross	4,673	6,371	9,137	783
		Net	4,062	7,128	12,123	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100cm2)	MDCR (cpm)
Roof Gravel	2,424.00	0.21	925.40	512.40

12/13/2004

Summary of Scan Data - Beta

Survey ID: FARBRFTRGV2ZB1_01

Area: Fuel and Repair Building

Level: 2nd Floor Roof

Space: Roof

Surface: 2nd Floor Roof at shutdown

Survey Date: 11/16/2004 1:44:27 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 sq cm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	702	**Gross**	2,543	3,257	4,376	275
		Net	244	1,704	3,993	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100cm2)	MDCR (cpm)
Roof Gravel	2,424.00	0.21	1048.00	512.40

12/13/2004

Summary of Scan Data - Beta

Survey ID: FARBRFTARGV3B1_01

Area: Fuel and Repair Bldg
Level: 3rd Floor Roof
Space: Roof
Surface: 3rd Floor Roof at power

Survey Date: 10/27/2004 12:52:51 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 sq cm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	7244	**Gross**	4,281	6,429	9,862	845
		Net	3,353	7,232	13,433	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100cm2)	MDCR (cpm)
Roof Gravel	2,424.00	0.21	925.40	512.40

12/13/2004

Summary of Scan Data - Beta

Survey ID: FARBRFTRGV3ZB1_01

Area: Fuel and Repair Building
Level: 3rd Floor Roof
Space: 3rd Floor Roof at shutdown
Surface: Roof

Survey Date: 11/16/2004 4:35:05 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 sq cm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	5733	**Gross**	1,836	2,964	4,320	392
		Net	-1,202	1,105	3,878	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

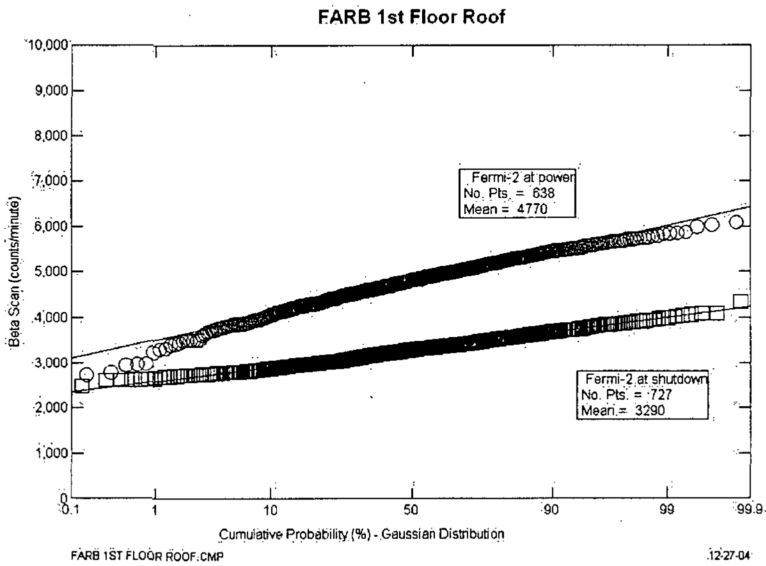
Scan Interval: 2.00 sec

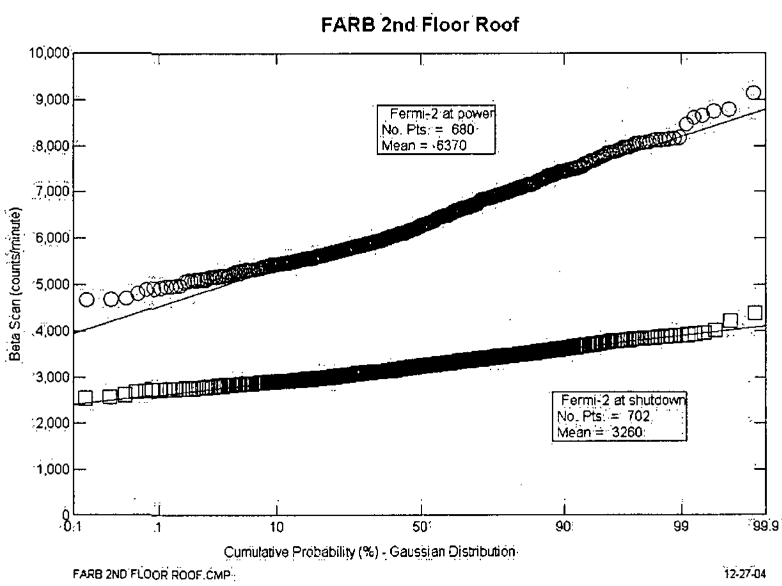
Technician/Surveyor: CHICO

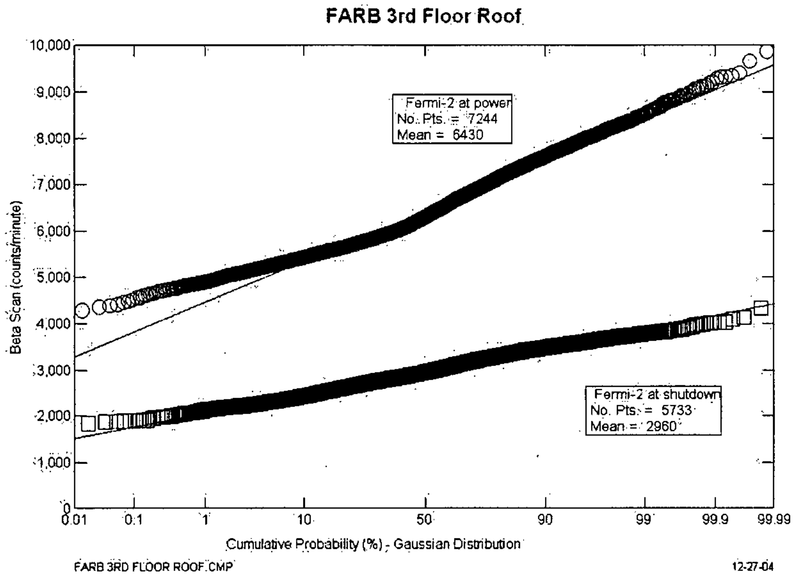
Background Material Summary

Material	Bkgd Level (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100cm2)	MDCR (cpm)
Roof Gravel	2,424.00	0.21	1048.00	512.40

12/13/2004


FARB 1st Floor Roof
Fermi-2 at power
No. Pts. = 638
Mean = 4770
Fermi-2 at shutdown
No. Pts. = 727
Mean = 3290
Beta Scan (counts/minute)
Cumulative Probability (%) - Gaussian Distribution
FARB 1ST FLOOR ROOF.CMP
12-27-04


FARB 2nd Floor Roof
Fermi-2 at power
No. Pts. = 680
Mean = 6370
Fermi-2 at shutdown
No. Pts. = 702
Mean = 3260
Beta Scan (counts/minute)
Cumulative Probability (%) - Gaussian Distribution
FARB 2ND FLOOR ROOF.CMP
12-27-04


FARB 3rd Floor Roof
Fermi-2 at power
No. Pts. = 7244
Mean = 6430
Fermi-2 at shutdown
No. Pts. = 5733
Mean = 2960
Beta Scan (counts/minute)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0.01
0.1
1
10
50
90
99
99.9
99.99
Cumulative Probability (%) - Gaussian Distribution
FARB 3RD FLOOR ROOF.CMP
12-27-04

Summary of Scan Data - Beta

Survey ID: SGBRFTARGVLNB1_01

Area: Steam Generator Bldg

Level: Roof

Space: Steam Generator Bldg Roof at Power

Surface: Floor

Survey Date: 10/25/2004 12:12:50 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	1383	**Gross**	2,769	3,660	4,671	294
		Net	622	2,233	4,057	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Roof Gravel	2,424.00	512.40	0.21	925.40

12/16/2004

Summary of Scan Data - Beta

Survey ID: SGRFTRGVZB1_01

Area: Steam Generator Bldg

Level: Roof

Space: Steam Generator Bldg Roof at shutdown

Surface: Floor

Survey Date: 11/13/2004 12:05:21 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	3063	**Gross**	1,392	1,741	2,194	112
		Net	-2,111	-1,397		

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Roof Gravel	2,424.00	512.40	0.21	1048.00

12/16/2004

Summary of Scan Data - Beta

Survey ID: SGBRF10B1_01

Area: Steam Generator Bldg

Level: Roof

Space: Steam Generator Bldg 10% verification at power

Surface: Floor

Survey Date: 10/26/2004 11:31:01 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	397	**Gross**	3,195	3,686	4,291	192
		Net	1,392	2,279	3,371	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Roof Gravel	2,424.00	512.40	0.21	925.40

12/16/2004

Summary of Scan Data - Beta

Survey ID: SGRFTRGV10ZB1_01

Area: Steam Generator Bldg

Level: Roof

Space: Steam Generator Bldg Roof 10% verification at shutdown

Surface: Floor

Survey Date: 11/15/2004 8:51:51 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	381	**Gross**	1,508	1,756	2,047	106
		Net	-1,873	-1,367		

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

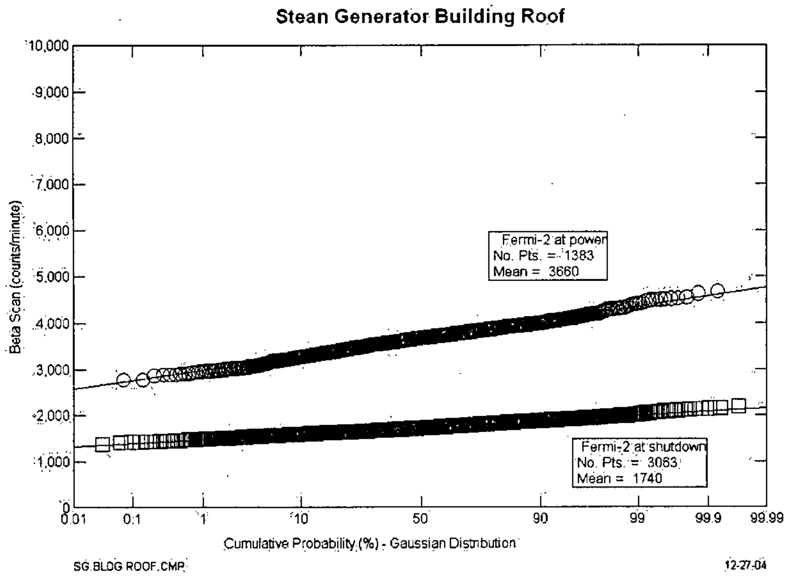
Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Roof Gravel	2,424.00	512.40	0.21	1048.00

12/16/2004


Stean Generator Building Roof
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Beta Scan (counts/minute)
Fermi-2 at power
No. Pts. = 1383
Mean = 3660
Fermi-2 at shutdown
No. Pts. = 3063
Mean = 1740
0.01
0.1
1
10
50
90
99
99.9
99.99
Cumulative Probability (%) - Gaussian Distribution
SG BLDG ROOF.CMP
12-27-04

Summary of Scan Data - Beta

Survey ID: WG1TRWB1_01

Area: Waste Gas Bldg

Level: 1st Floor

Space: West Tank Room at power

Surface: Floor

Survey Date: 10/28/2004 11:54:46 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	1041	**Gross**	1,799	2,160	2,748	147
		Net	-368	284	1,346	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	841.20

12/16/2004

Summary of Scan Data - Beta

Survey ID: WGTKRMWZB1_01

Area: Waste Gas Bldg

Level: 1st Floor

Space: West Tank Room at shutdown

Surface: Floor

Survey Date: 11/13/2004 2:37:17 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	1086	**Gross**	1,631	1,952	2,350	121
		Net	-760	-104	709	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	952.60

12/16/2004

Summary of Scan Data - Beta

Survey ID: WGTKRMW10ZB1_01

Area: Waste Gas Bldg
Level: 1st Floor
Space: West Tank Room 10% verification at shutdown
Surface: Floor

Survey Date: 11/15/2004 8:24:41 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	131	**Gross**	1,591	1,806	2,160	128
		Net	-843	-403	320	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

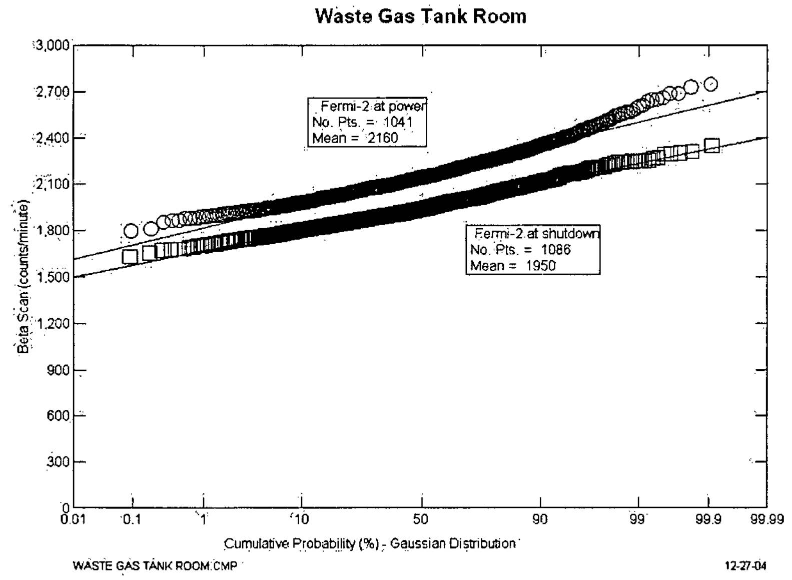
Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	952.60

12/15/2004


Waste Gas Tank Room
Fermi-2 at power
No. Pts. = 1041
Mean = 2160
Fermi-2 at shutdown
No. Pts. = 1086
Mean = 1950
Beta Scan (counts/minute)
3,000
2,700
2,400
2,100
1,800
1,500
1,200
900
600
300
0
0.01
0.1
1
10
50
90
99
99.9
99.99
Cumulative Probability (%) - Gaussian Distribution
WASTE GAS TANK ROOM.CMP
12-27-04

Summary of Scan Data - Beta

Survey ID: NA2RFSWCONB1_01

Area: Sodium Bldg
Level: Roof
Space: Roof at power
Surface: Floor

Survey Date: 10/28/2004 10:25:56 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	1036	**Gross**	2,934	3,874	5,469	465
		Net	1,682	3,378	6,259	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	841.20

12/16/2004

Summary of Scan Data - Beta

Survey ID: NARFCONZB1_01

Area: Sodium Bldg
Level: Roof
Space: Roof at shutdown
Surface: Floor

Survey Date: 11/15/2004 2:27:45 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	1262	Gross	1,837	2,685	3,499	217
		Net	-339	1,395	3,060	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

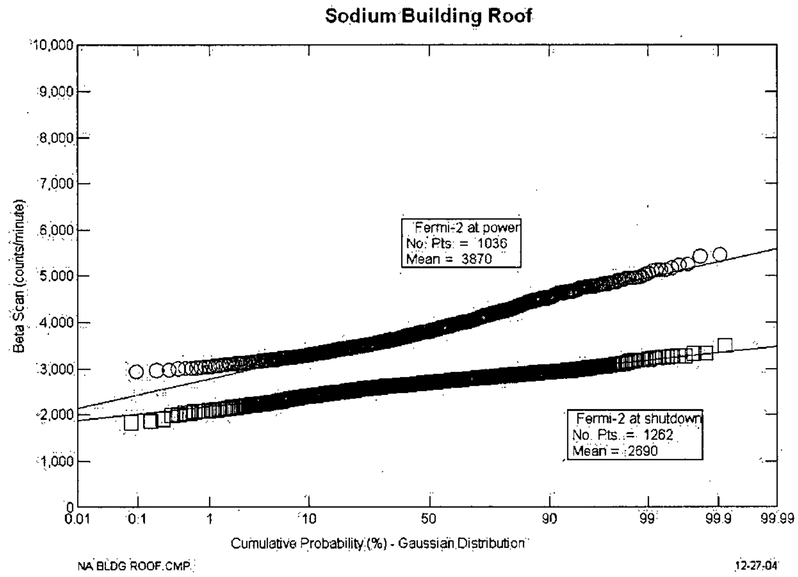
Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	952.60

12/16/2004


Sodium Building Roof
Beta Scan (counts/minute)
Fermi-2 at power
No. Pts. = 1036
Mean = 3870
Fermi-2 at shutdown
No. Pts. = 1262
Mean = 2690
Cumulative Probability (%) - Gaussian Distribution
NA BLDG ROOF.CMP
12-27-04

Summary of Scan Data - Beta

Survey ID: TBRFTARGV1B1_01

Area: Turbine building
Level: Roof
Space: Turbine building roof at power
Surface: Roof

Survey Date: 10/23/2004 2:17:20 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	9,091	**Gross**	1,971.56	2,802.47	3,701.95	227.03
		Net	-817.07	683.50	2,307.89	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm
d prime: 1.90
Surveyor Efficiency: 1.00
Scan Interval: 2.00 sec
Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Roof Gravel	2,424.00	512.40	0.21	925.40

12/23/2004

Summary of Scan Data - Beta

Survey ID: TBRFTRGVZB1_01

Area: Turbine Building

Level: Roof

Space: Turbine Building Roof at shutdown

Surface: Roof

Survey Date: 11/12/2004 2:48:00 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 sq cm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	6206	**Gross**	1,415	1,955	2,555	129
		Net	-2,064	-960	269	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100cm2)	MDCR (cpm)
Roof Gravel	2,424.00	0.21	925.40	512.40

12/14/2004

Summary of Scan Data - Beta

Survey ID: TBRFTRGV10ZB1_01

Area: Turbine Building

Level: Roof

Space: Turbine Building Roof 10% verification at shutdown

Surface: Roof

Survey Date: 11/13/2004 4:06:27 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 sq cm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	628	Gross	1,409	1,867	2,199	121
		Net	-2,076	-1,139		

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR18072

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR14507
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

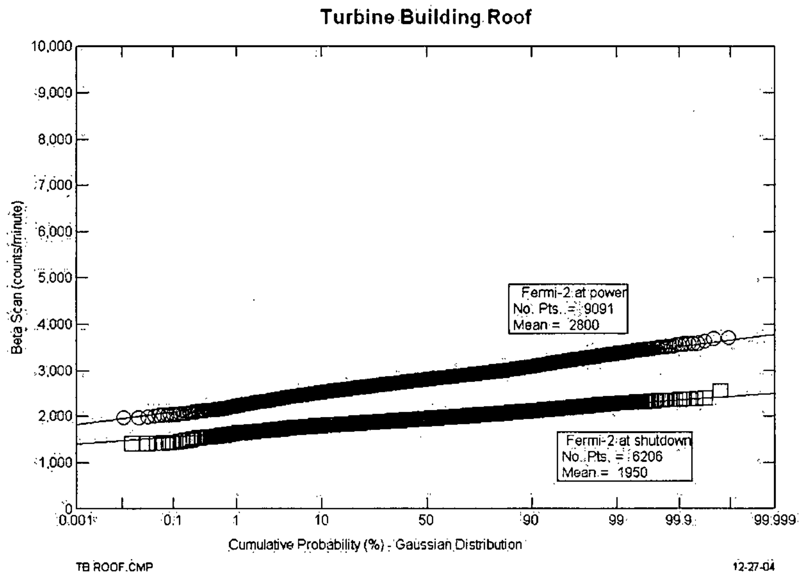
Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100cm2)	MDCR (cpm)
Roof Gravel	2,424.00	0.21	925.40	512.40

12/14/2004


Turbine Building Roof
Beta Scan (counts/minute)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0.001
0.1
1
10
50
90
99
99.9
99.999
Cumulative Probability (%) - Gaussian Distribution
Fermi-2 at power
No. Pts. = 9091
Mean = 2800
Fermi-2 at shutdown
No. Pts. = 6206
Mean = 1950
TB ROOF.CMP
12-27-04

Summary of Scan Data - Gamma

Survey ID: OSCACTYDEG1_01

Area: Inside the RRA

Level: Ground

Space: East Courtyard at power

Surface: Floor

Survey Date: 10/28/2004 2:18:05 PM

Radiation Levels - c/min

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Gravel	459	**Gross**	12,092	23,245	34,107	4,734
		Net	6695	17848	28710	

Instrumentation

Instrument ID: 513G1

Logger Maker: Ludlum
Model: 2350-1
S/N: PR142513

Probe Maker: Ludlum
Model: 44-10
S/N: PR186955

Analysis Parameters

Instrument Efficiency: 1.00 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Scan MDC (cpm)	MDCR (cpm)
Gravel	5,397.00	764.50	764.50

12/15/2004

Summary of Scan Data - Gamma

Survey ID: OSCACTYDEZG1_01

Area: Inside the RRA

Level: Ground

Space: East Courtyard at shutdown

Surface: Floor

Survey Date: 11/17/2004 4:51:21 PM

Radiation Levels - c/min

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Gravel	595	**Gross**	3,262	4,824	7,560	813
		Net	-2,135	-573	2163	

Instrumentation

Instrument ID: 513G1

Logger Maker: Ludlum
Model: 2350-1
S/N: PR142513

Probe Maker: Ludlum
Model: 44-10
S/N: PR186955

Analysis Parameters

Instrument Efficiency: 1.00 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: BO

Background Material Summary

Material	Bkgd Level (cpm)	Scan MDC (cpm)	MDCR (cpm)
Gravel	5,397.00	764.50	764.50

12/15/2004

Summary of Scan Data - Gamma

Survey ID: OSCAMNCTYDZG1_01

Area: Inside the RRA
Level: Ground
Space: Main Courtyard at shutdown
Surface: Floor

Survey Date: 11/17/2004 3:04:39 PM

Radiation Levels - c/min

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Gravel	1421	**Gross**	4,599	5,981	8,848	565
		Net	-798	584	3451	

Instrumentation

Instrument ID: 513G1

Logger Maker: Ludlum
Model: 2350-1
S/N: PR142513

Probe Maker: Ludlum
Model: 44-10
S/N: PR186955

Analysis Parameters

Instrument Efficiency: 1.00 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

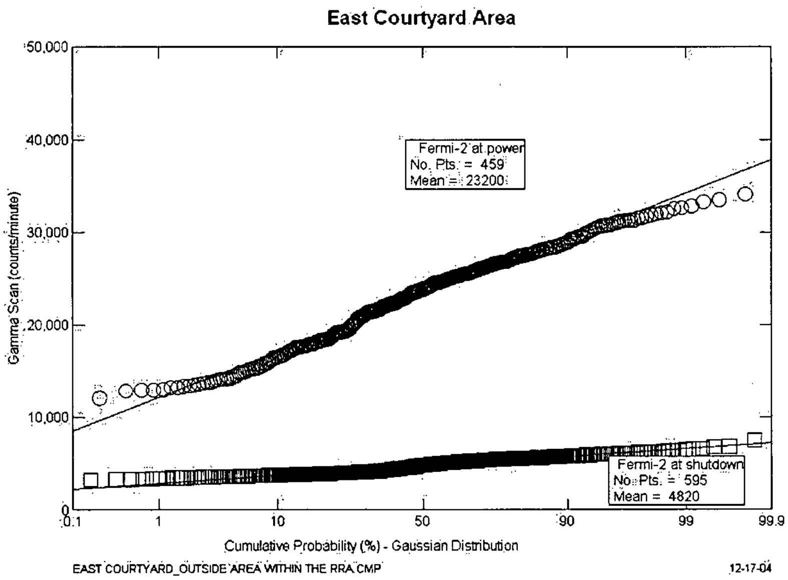
Scan Interval: 2.00 sec

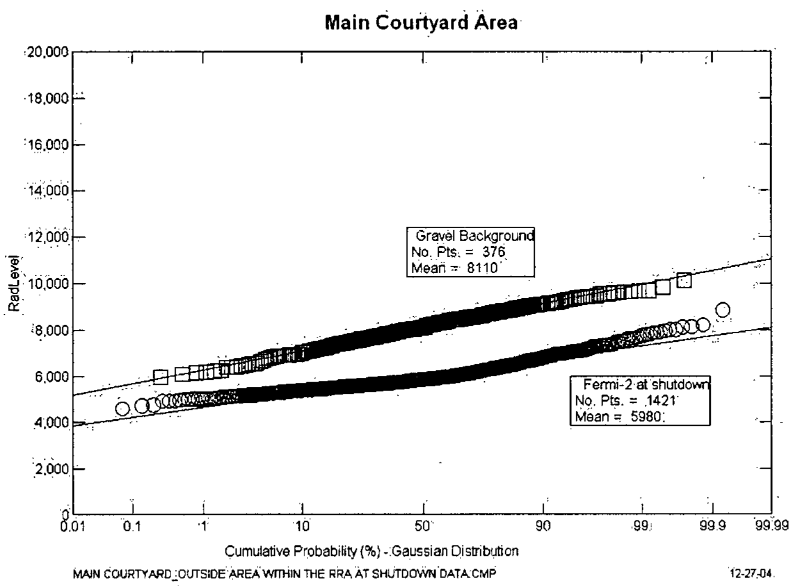
Technician/Surveyor: BO

Background Material Summary

Material	Bkgd Level (cpm)	Scan MDC (cpm)	MDCR (cpm)
Gravel	5,397.00	764.50	764.50

12/15/2004


East Courtyard Area
Gamma Scan (counts/minute)
50,000
40,000
30,000
20,000
10,000
0
Fermi-2 at power
No. Pts. = 459
Mean = 23200
Fermi-2 at shutdown
No. Pts. = 595
Mean = 4820
0.1
1
10
50
90
99
99.9
Cumulative Probability (%) - Gaussian Distribution
EAST COURTYARD_OUTSIDE AREA WITHIN THE RRA.CMP
12-17-04


Main Courtyard Area
RadLevel
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Gravel Background
No. Pts. = 376
Mean = 8110
Fermi-2 at shutdown
No. Pts. = 1421
Mean = 5980
0.01
0.1
1
10
50
90
99
99.9
99.99
Cumulative Probability (%) - Gaussian Distribution
MAIN COURTYARD_OUTSIDE AREA WITHIN THE RRA AT SHUTDOWN DATA.CMP
12-27-04

Summary of Scan Data - Gamma

Survey ID: TBOSGRSSWG1_01

Area: Turbine Bldg

Level: Ground

Space: Lawn at power

Surface: Floor

Survey Date: 10/26/2004 10:06:16 AM

Radiation Levels - c/min

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Grass	1,633	**Gross**	14,464.22	19,667.46	25,206.33	1,796.66
		Net	6,354.22	11,557.46	17,096.33	

Instrumentation

Instrument ID: 513G1

Logger Maker: Ludlum
Model: 2350-1
S/N: PR142513

Probe Maker: Ludlum
Model: 44-10
S/N: PR186955

Analysis Parameters

Instrument Efficiency: 1 cpm/epm

d prime: 1.90

Surveyor Efficiency: 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Scan MDC (cpm)	MDCR (cpm)
Grass	8,110.00	937.20	937.20

12/27/2004

Summary of Scan Data - Gamma

Survey ID: OSTBGRSZG1_01

Area: Turbine Bldg

Level: Ground

Space: Lawn at shutdown

Surface: Floor

Survey Date: 11/13/2004 9:35:35 AM

Radiation Levels - c/min

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Grass	2,673	Gross	4,078.59	6,670.06	9,648.98	944.74
		Net	-4,031.41	-1,439.94	1,538.98	

Instrumentation

Instrument ID: 513G1

Logger Maker: Ludlum
Model: 2350-1
S/N: PR142513

Probe Maker: Ludlum
Model: 44-10
S/N: PR186955

Analysis Parameters

Instrument Efficiency: 1 cpm/epm

d prime: 1.90

Surveyor Efficiency: 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Scan MDC (cpm)	MDCR (cpm)
Grass	8,110.00	937.20	937.20

12/27/2004

Summary of Scan Data - Gamma

Survey ID: OSTBGRS10ZG1_01

Area: Turbine Bldg
Level: Ground
Space: Lawn 10% verification at shutdown
Surface: Floor

Survey Date: 11/15/2004 10:01:00 AM

Radiation Levels - c/min

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Grass	1,017	**Gross**	4,717.74	7,043.41	10,034.77	1,042.80
		Net	-3,392.27	-1,066.59	1,924.77	

Instrumentation

Instrument ID: 513G1

Logger Maker: Ludlum
Model: 2350-1
S/N: PR142513

Probe Maker: Ludlum
Model: 44-10
S/N: PR186955

Analysis Parameters

Instrument Efficiency: 1 cpm/epm
d prime: 1.90
Surveyor Efficiency: 1.00
Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Scan MDC (cpm)	MDCR (cpm)
Grass	8,110.00	937.20	937.20

12/27/2004

Summary of Scan Data - Beta

Survey ID: TBOSTAR10B1_01

Area: Turbine Bldg

Level: Ground

Space: Driveway 10% verification at power

Surface: Floor

Survey Date: 10/28/2004 1:09:42 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Asphalt	581	**Gross**	1,833.75	2,347.46	3,056.25	227.16
		Net	-285.79	641.93	1,921.96	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Asphalt	1,992.00	464.50	0.21	838.90

12/27/2004

Summary of Scan Data - Beta

Survey ID: OSTBTARZB1_01

Area: Turbine Bldg
Level: Ground
Space: Driveway at shutdown
Surface: Floor

Survey Date: 11/12/2004 9:05:53 AM

Radiation Levels
(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Asphalt	857	Gross	882.89	1,249.01	1,617.89	179.56
		Net	-2,268.26	-1,519.50	-765.10	
Sidewalk	190	Gross	1,236.09	1,404.82	1,639.69	86.60
		Net	-2,390.56	-2,045.50	-1,565.16	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm
d prime: 1.90
Surveyor Efficiency: 1.00
Scan Interval: 2.00 sec
Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Asphalt	1,992.00	464.50	0.21	950.00
Sidewalk	2,405.00	510.40	0.21	1044.00

12/27/2004

Summary of Scan Data - Beta

Survey ID: OSTBTAR10ZB1_01

Area: Turbine Bldg

Level: Ground

Space: Driveway 10% verification at shutdown

Surface: Floor

Survey Date: 11/13/2004 3:34:23 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Asphalt	142	**Gross**	996.09	1,270.03	1,570.55	160.17
		Net	-2,036.75	-1,476.53	-861.92	
Sidewalk	142	**Gross**	1,099.92	1,391.96	1,768.13	185.73
		Net	-2,669.04	-2,071.80	-1,302.49	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Asphalt	1,992.00	464.50	0.21	950.00
Sidewalk	2,405.00	510.40	0.21	1044.00

12/27/2004

Summary of Scan Data - Beta

Survey ID: OSTBSTZB1_01

Area: Turbine Bldg

Level: Ground

Space: Turbine Bldg Street at shutdown

Surface: Floor

Survey Date: 11/13/2004 3:24:44 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Asphalt	144	**Gross**	1,557.66	1,823.27	2,079.61	121.39
		Net	-888.29	-345.08	179.17	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm

d prime: 1.90

Surveyor Efficiency: 1.00

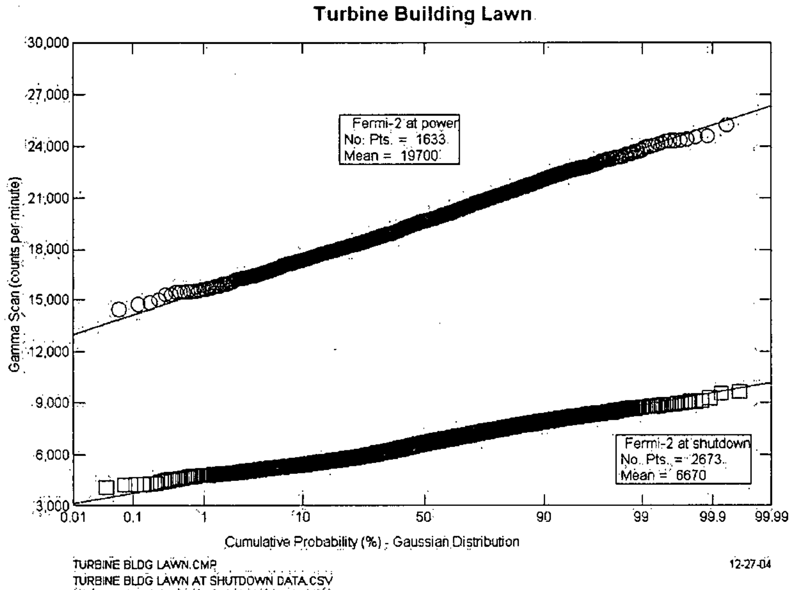
Scan Interval: 2.00 sec

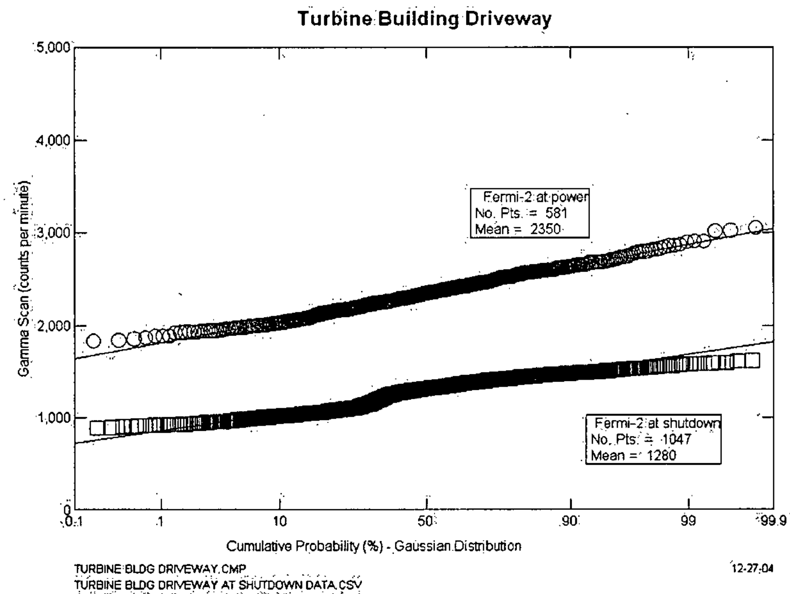
Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Asphalt	1,992.00	464.50	0.21	950.00

12/27/2004


Turbine Building Lawn
Fermi-2 at power
No. Pts. = 1633
Mean = 19700
Fermi-2 at shutdown
No. Pts. = 2673
Mean = 6670
Gamma Scan (counts per minute)
30,000
27,000
24,000
21,000
18,000
15,000
12,000
9,000
6,000
3,000
0.01
0.1
1
10
50
90
99
99.9
99.99
Cumulative Probability (%) - Gaussian Distribution
TURBINE BLDG LAWN.CMP
TURBINE BLDG LAWN AT SHUTDOWN DATA.CSV
12-27-04


Turbine Building Driveway
Fermi-2 at power
No. Pts. = 581
Mean = 2350
Fermi-2 at shutdown
No. Pts. = 1047
Mean = 1280
Gamma Scan (counts per minute)
5,000
4,000
3,000
2,000
1,000
0
0.1
1
10
50
90
99
99.9
Cumulative Probability (%) - Gaussian Distribution
TURBINE BLDG DRIVEWAY.CMP
TURBINE BLDG DRIVEWAY AT SHUTDOWN DATA.CSV
12-27-04

Summary of Scan Data - Beta

Survey ID: TB3FLRCONSB1_01

Area: Turbine Bldg

Level: 3rd Floor

Space: South side of High pressure turbine at power

Surface: Floor

Survey Date: 10/25/2004 9:03:14 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	264	**Gross**	1,704.84	1,962.79	2,362.97	113.92
		Net	-538.45	-72.63	650.08	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	841.20

12/27/2004

Summary of Scan Data - Beta

Survey ID: TB3ECONZB1_01

Area: Turbine Bldg

Level: 3rd Floor

Space: South side of High pressure turbine at shutdown

Surface: Floor

Survey Date: 11/13/2004 10:29:56 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	492	**Gross**	1,227.42	1,571.43	1,987.03	144.81
		Net	-1,586.15	-882.62	-32.66	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm

d prime: 1.90

Surveyor Efficiency: 1.00

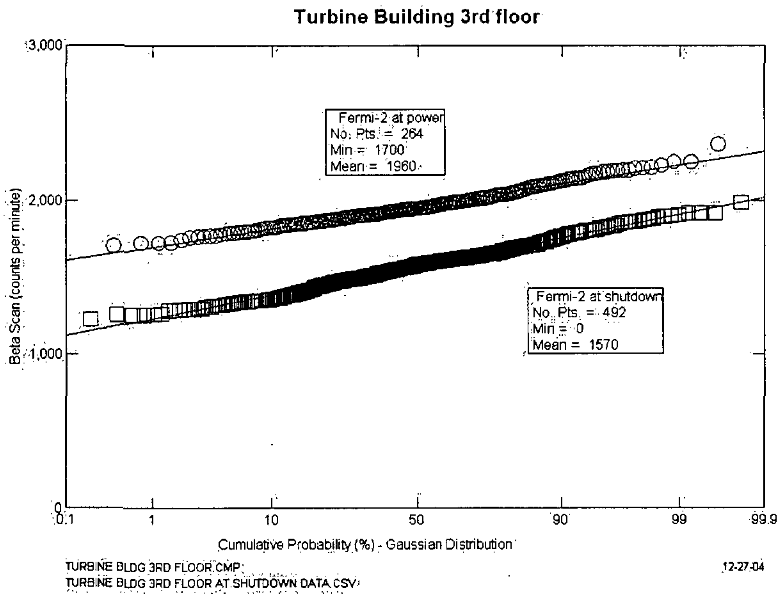
Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	952.60

12/27/2004


Turbine Building 3rd floor
Fermi-2 at power
No. Pts. = 264
Min = 1700
Mean = 1960
Fermi-2 at shutdown
No. Pts. = 492
Min = 0
Mean = 1570
Beta Scan (counts per minute)
3,000
2,000
1,000
0
0.1
1
10
50
90
99
99.9
Cumulative Probability (%) - Gaussian Distribution
TURBINE BLDG 3RD FLOOR.CMP
TURBINE BLDG 3RD FLOOR AT SHUTDOWN DATA.CSV
12-27-04

Summary of Scan Data - Beta

Survey ID: FARB1FPEB1_01

Area: Fuel and Repair Bldg

Level: 1st Floor

Space: East Fuel Pool at power

Surface: Floor

Survey Date: 10/28/2004 8:06:14 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
PaintConcrete	509	**Gross**	1,989.14	2,602.14	5,535.24	334.67
		Net	-545.14	561.90	5,858.85	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm
d prime: 1.90
Surveyor Efficiency: 1.00
Scan Interval: 2.00 sec

Technician/Surveyor: CHIC

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
PaintConcrete	2,291.00	498.10	0.21	899.50

12/27/2004

Summary of Scan Data - Beta

Survey ID: FARBFPEZB1_01

Area: Fuel and Repair Bldg

Level: 1st Floor

Space: East Fuel Pool at shutdown

Surface: Floor

Survey Date: 11/16/2004 9:48:05 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
PaintConcrete	470	**Gross**	2,018.44	2,530.07	4,595.63	244.03
		Net	-557.42	488.92	4,713.24	

Instrumentation

Instrument ID: 729LB1

Instrument Maker:	Ludlum	**Probe Maker:**	Ludlum
Model:	2350-1	**Model:**	43-37-1
S/N:	PR180729	**S/N:**	PR145078
		Area:	771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
PaintConcrete	2,291.00	498.10	0.21	1019.00

12/27/2004

Summary of Scan Data - Beta

Survey ID: FARBFPE10ZB1_01

Area: Fuel and Repair Bldg
Level: 1st Floor
Space: East Fuel Pool 10% verification at shutdown
Surface: Floor

Survey Date: 11/17/2004 11:10:28 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
PaintConcrete	417	**Gross**	2,016.33	2,550.68	4,822.27	308.01
		Net	-561.74	531.08	5,176.75	

Instrumentation

Instrument ID: 729LB1

Instrument Maker:	Ludlum	**Probe Maker:**	Ludlum
Model:	2350-1	**Model:**	43-37-1
S/N:	PR180729	**S/N:**	PR145078
		Area:	771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: BO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
PaintConcrete	2,291.00	498.10	0.21	1019.00

12/27/2004

Summary of Scan Data - Beta

Survey ID: FARB1FPWB1_01

Area: Fuel and Repair Bldg

Level: 1st Floor

Space: West Fuel Pool at power

Surface: Floor

Survey Date: 10/28/2004 7:52:46 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
PaintConcrete	268	**Gross**	1,943.20	2,407.25	2,790.00	138.73
		Net	-628.10	209.94	901.16	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm
d prime: 1.90
Surveyor Efficiency: 1.00
Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
PaintConcrete	2,291.00	498.10	0.21	899.50

12/27/2004

Summary of Scan Data - Beta

Survey ID: FARBFPWZB1_01

Area: Fuel and Repair Bldg

Level: 1st Floor

Space: West Fuel Pool at shutdown

Surface: Floor

Survey Date: 11/16/2004 9:35:40 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
PaintConcrete	272	Gross	1,932.19	2,344.06	3,063.98	161.05
		Net	-733.81	108.51	1,580.85	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm

d prime: 1.90

Surveyor Efficiency: 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
PaintConcrete	2,291.00	498.10	0.21	1019.00

12/27/2004

Summary of Scan Data - Beta

Survey ID: FARBFPW10ZB1_01

Area: Fuel and Repair Bldg

Level: 1st Floor

Space: West Fuel Pool 10% verification at shutdown

Surface: Floor

Survey Date: 11/17/2004 10:42:45 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
PaintConcrete	309	**Gross**	1,961.95	2,371.72	2,848.59	166.53
		Net	-672.94	165.09	1,140.35	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

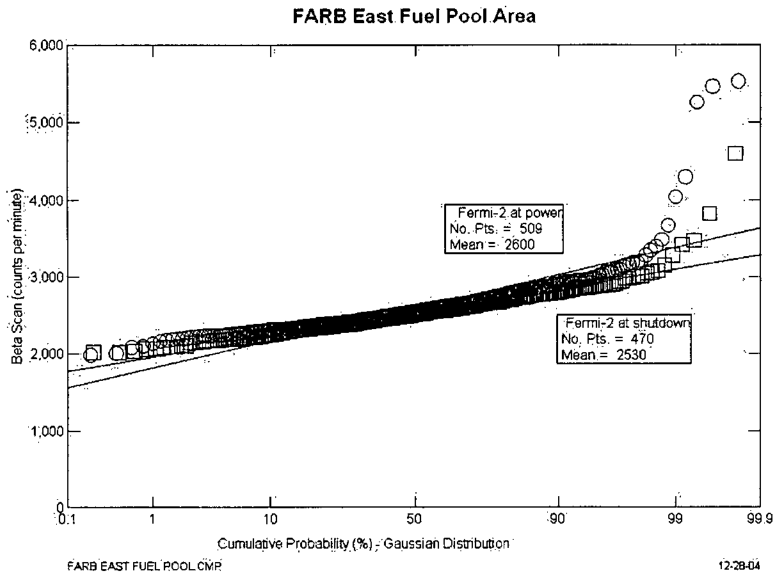
Analysis Parameters

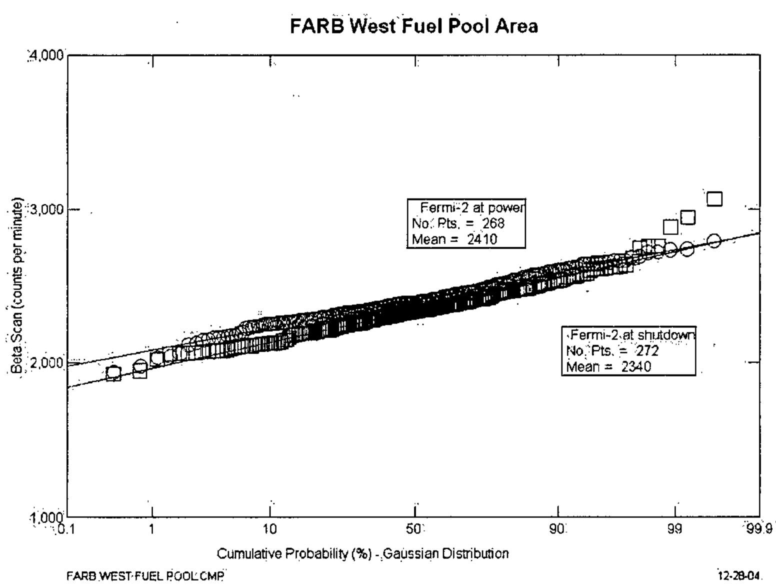
Instrument Efficiency: 0.302 cpm/epm
d prime: 1.90
Surveyor Efficiency: 1.00
Scan Interval: 2.00 sec
Technician/Surveyor: BO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
PaintConcrete	2,291.00	498.10	0.21	1019.00

12/27/2004


FARB East Fuel Pool Area
6,000
5,000
4,000
3,000
2,000
1,000
0
Beta Scan (counts per minute)
Fermi-2 at power
No. Pts. = 509
Mean = 2600
Fermi-2 at shutdown
No. Pts. = 470
Mean = 2530
0.1
1
10
50
90
99
99.9
Cumulative Probability (%) - Gaussian Distribution
FARB EAST FUEL POOL.CMP
12-28-04


FARB West Fuel Pool Area
4,000
3,000
2,000
1,000
Beta Scan (counts per minute)
Fermi-2 at power
No. Pts. = 268
Mean = 2410
Fermi-2 at shutdown
No. Pts. = 272
Mean = 2340
0.1
1
10
50
90
99
99.9
Cumulative Probability (%) - Gaussian Distribution
FARB WEST FUEL POOL.CMP
12-28-04

Summary of Scan Data - Beta

Survey ID: FARB1TKBYB1_01

Area: Fuel and Repair Bldg
Level: 1st Floor
Space: Truckbay at power
Surface: Floor

Survey Date: 10/28/2004 8:56:59 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	731	**Gross**	3,039.84	4,006.22	12,960.00	766.99
		Net	1,872.46	3,617.67	19,787.54	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: BO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	841.20

12/28/2004

Summary of Scan Data - Beta

Survey ID: FARBTKBYZB1_01

Area: Fuel and Repair Bldg
Level: 1st Floor
Space: Truckbay at shutdown

Surface: Floor

Survey Date: 11/16/2004 7:56:20 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	782	**Gross**	1,994.30	2,866.85	14,883.99	1,039.03
		Net	-17.80	1,766.67	26,343.21	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm

d prime: 1.90

Surveyor Efficiency: 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHIC

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	952.60

12/28/2004

Summary of Scan Data - Beta

Survey ID: FARBTKBY10ZB1_01

Area: Fuel and Repair Bldg
Level: 1st Floor
Space: Truckbay 10% verification at shutdown
Surface: Floor

Survey Date: 11/17/2004 10:24:04 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	734	**Gross**	2,127.89	2,909.20	15,783.52	1,223.48
		Net	255.42	1,853.28	28,182.86	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

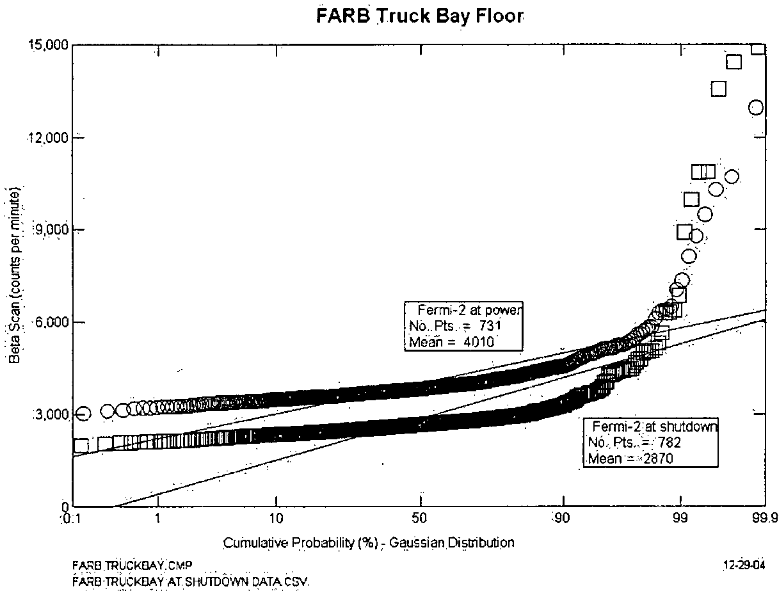
Scan Interval: 2.00 sec

Technician/Surveyor: BO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	952.60

12/28/2004


FARB Truck Bay Floor
Beta Scan (counts per minute)
Cumulative Probability (%) - Gaussian Distribution
Fermi-2 at power
No. Pts. = 731
Mean = 4010
Fermi-2 at shutdown
No. Pts. = 782
Mean = 2870
FARB TRUCKBAY.CMP
FARB TRUCKBAY AT SHUTDOWN DATA.CSV
12-29-04

Summary of Scan Data - Beta

Survey ID: FARB1GACONB1_01

Area: Fuel and Repair Bldg
Level: 1st Floor
Space: Trestleway at power
Surface: Floor

Survey Date: 10/27/2004 4:48:24 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	1,410	**Gross**	2,710.08	3,430.08	6,480.70	353.06
		Net	1,276.93	2,577.20	8,086.41	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.342 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: BO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	841.20

12/28/2004

Summary of Scan Data - Beta

Survey ID: FARBGAZB1_01

Area: Fuel and Repair Bldg

Level: 1st Floor

Space: Trestleway at shutdown

Surface: Floor

Survey Date: 11/16/2004 8:39:50 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	1,413	**Gross**	2,174.06	2,987.65	14,514.61	1,430.11
		Net	349.84	2,013.72	25,587.78	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	952.60

12/28/2004

Summary of Scan Data - Beta

Survey ID: FARBGA10ZB1_01

Area: Fuel and Repair Bldg

Level: 1st Floor

Space: Trestleway 10% verification at shutdown

Surface: Floor

Survey Date: 11/17/2004 10:04:07 AM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	1,258	**Gross**	2,230.78	2,815.59	11,803.36	530.00
		Net	465.84	1,661.85	20,042.94	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm
d prime: 1.90
Surveyor Efficiency: 1.00
Scan Interval: 2.00 sec
Technician/Surveyor: BO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	952.60

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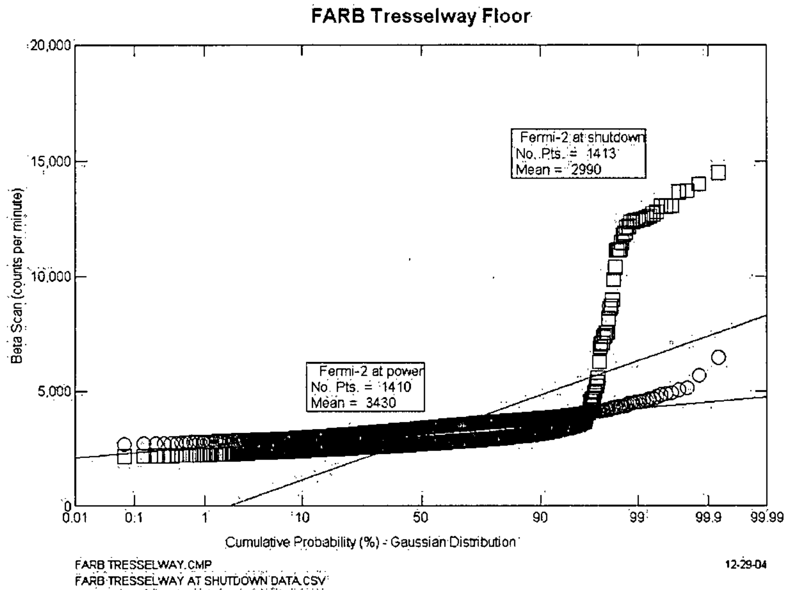
12/28/2004


FARB Tresselway Floor
Beta Scan (counts per minute)
20,000
15,000
10,000
5,000
0
0.01
0.1
1
10
50
90
99
99.9
99.99
Cumulative Probability (%) - Gaussian Distribution
Fermi-2 at shutdown
No. Pts. = 1413
Mean = 2990
Fermi-2 at power
No. Pts. = 1410
Mean = 3430
FARB TRESSELWAY.CMP
FARB TRESSELWAY AT SHUTDOWN DATA.CSV
12-29-04

Summary of Scan Data - Beta

Survey ID: FARBGATSTZB1_01

Area: Fuel and Repair Bldg
Level: 1st Floor
Space: Trestleway at shutdown
Surface: Walls

Survey Date: 11/17/2004 1:17:08 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Transite	253	**Gross**	1,340.39	1,638.92	1,958.44	121.15
		Net	-731.35	-120.83	532.63	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: BO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Transite	1,698.00	428.80	0.21	876.90

12/28/2004

Summary of Scan Data - Beta

Survey ID: FARBWMRMPBZB1_0

Area: Fuel and Repair Bldg

Level: 1st Floor

Space: Warm Room Exterior

Surface: Walls

Survey Date: 11/17/2004 12:58:38 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Painted Block	326	Gross	1,768.13	2,166.06	2,549.77	145.18
		Net	-198.12	615.70	1,400.43	

Instrumentation

Instrument ID: 729LB1

Instrument Maker:	Ludlum	**Probe Maker:**	Ludlum
Model:	2350-1	**Model:**	43-37-1
S/N:	PR180729	**S/N:**	PR145078
		Area:	771 sq cm

Analysis Parameters

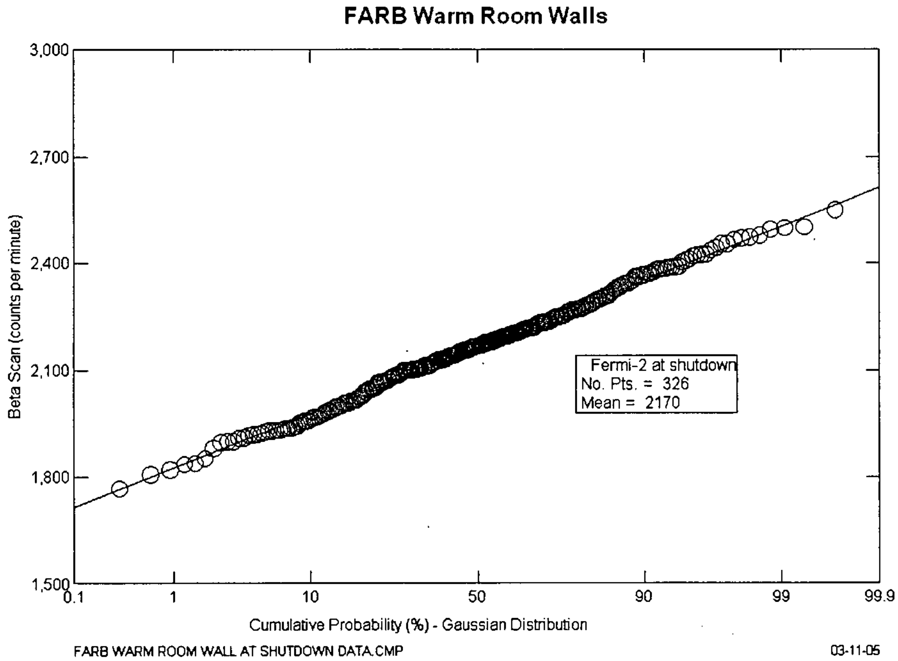
Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: BO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Painted Block	1,865.00	449.40	0.21	919.10


FARB Warm Room Walls
Beta Scan (counts per minute)
3,000
2,700
2,400
2,100
1,800
1,500
0.1
1
10
50
90
99
99.9
Cumulative Probability (%) - Gaussian Distribution
Fermi-2 at shutdown
No. Pts. = 326
Mean = 2170
FARB WARM ROOM WALL AT SHUTDOWN DATA.CMP
03-11-05

Summary of Scan Data - Beta

Survey ID: VNTBLKZB1_01

Area: Fuel and Repair Bldg
Level: 1st Floor
Space: Vent Room at shutdown
Surface: Wall

Survey Date: 11/17/2004 1:35:09 PM

Radiation Levels

(* Gross values in cpm; net activity in dpm/100 cm2)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Cinder Block	262	**Gross**	1,510.78	1,752.41	1,987.03	94.39
		Net	-1,362.50	-868.35	-388.51	

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm
d prime: 1.90
Surveyor Efficiency: 1:00
Scan Interval: 2.00 sec
Technician/Surveyor: BO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Cinder Block	2,177.00	485.60	0.21	993.10

12/28/2004

Summary of Scan Data - Beta

Survey ID: RFBKGDB1_01

Area: St. Clair power station

Level: Roof

Space: Unit 6 roof

Surface: Roof

Survey Date: 11/18/2004 10:25:47 AM

Radiation Levels

(* Gross values in cpm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Roof Gravel	311	**Gross**	2,052	2,424	2,874	152

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100cm2)	MDCR (cpm)
Roof Gravel	2,424.00	0.21	1048.00	512.40

Summary of Scan Data - Beta

Survey ID: CONBKGDB1_01

Area: St Clair Power Station

Level: 3rd Floor

Space: Turbine Bldg

Surface: Floor

Survey Date: 11/18/2004 10:55:40 AM

Radiation Levels

(* Gross values in cpm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Concrete	270	**Gross**	1,715.16	2,003.04	2,397.19	126.64
PaintConcrete	338	**Gross**	1,910.63	2,291.70	2,749.92	143.53

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Concrete	2,003.00	465.80	0.21	952.60
PaintConcrete	2,291.00	498.10	0.21	1019.00

Summary of Scan Data - Beta

Survey ID: BLKBKGDB1_GB_01

Area: St Clair power station

Level: 2nd Floor

Space: Switch Gear Rm

Surface: Wall

Survey Date: 11/18/2004 11:47:50 AM

Radiation Levels

(* Gross values in cpm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Cinder Block	299	**Gross**	1,853.44	2,177.44	2,452.27	121.17

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Cinder Block	2,177.00	485.60	0.21	993.10

Summary of Scan Data - Beta

Survey ID: PBLKBKGDB1_01

Area: St. Clair power station

Level: 3rd Floor

Space: Turbine Bldg Maintainance Shop

Surface: Walls

Survey Date: 11/18/2004 11:32:46 AM

Radiation Levels

(* Gross values in cpm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Painted Block	368	**Gross**	1,568.67	1,865.76	2,153.20	106.02

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Painted Block	1,865.00	449.40	0.21	919.10

Summary of Scan Data - Beta

Survey ID: ASPBKGDB1_01

Area: St. Clair power station

Level: Ground Level

Space: Storage Bldg Driveway

Surface: Floor

Survey Date: 11/18/2004 2:10:48 PM

Radiation Levels

(* Gross values in cpm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Asphalt	283	**Gross**	1,633.83	1,992.45	2,333.67	115.77

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/ep **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Asphalt	1,992.00	464.50	0.21	950.00

Summary of Scan Data - Beta

Survey ID: TSTBKGDB1_01

Area: St. Clair power station
Level: Ground
Space: Coal Transfer Canal
Surface: Walls

Survey Date: 11/18/2004 12:48:22 PM

Radiation Levels

(* Gross values in cpm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Transite	274	Gross	1,396.17	1,698.66	1,933.83	123.08

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Transite	1,698.00	428.80	0.21	876.90

Summary of Scan Data - Gamma

Survey ID: GVLBKGDG1_01

Area: St. Clair Power Station

Level: Ground

Space: Substation

Surface: Floor

Survey Date: 11/18/2004 1:14:31 PM

Radiation Levels - c/min

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Gravel	278	**Gross**	4,133	5,397	8,808	744

Instrumentation

Instrument ID: 513G1

Logger Maker:	Ludlum	**Probe Maker:**	Ludlum
Model:	2350-1	**Model:**	44-10
S/N:	PR142513	**S/N:**	PR186955

Analysis Parameters

Instrument Efficiency: 1.00 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Scan MDC (cpm)	MDCR (cpm)
Gravel	5,397.00	764.50	764.50

Summary of Scan Data - Gamma

Survey ID: GRSBKGDG1_01

Area: St. Clair power station

Level: Ground

Space: Substation Lawn

Surface: Floor

Survey Date: 11/18/2004 1:27:53 PM

Radiation Levels - c/min

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Grass	376	**Gross**	5,973.99	8,110.69	10,128.99	787.40

Instrumentation

Instrument ID: 513G1

Logger Maker: Ludlum
Model: 2350-1
S/N: PR142513

Probe Maker: Ludlum
Model: 44-10
S/N: PR186955

Analysis Parameters

Instrument Efficiency: 1 cpm/epm

d prime: 1.90

Surveyor Efficiency: 1.00

Scan Interval: 2.00

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	Scan MDC (cpm)	MDCR (cpm)
Grass	8,110.00	937.20	937.20

Summary of Scan Data - Beta

Survey ID: SDWKBKGDB1_01

Area: St Clair power station
Level: Ground Level
Space: Outside Admin Bldg sidewalk
Surface: Floor

Survey Date: 11/18/2004 2:28:01 PM

Radiation Levels

(* Gross values in cpm)

Material	Readings		Minimum	Average	Maximum	Standard Deviation
Sidewalk	213	**Gross**	2,078.67	2,405.07	2,768.91	137.04

Instrumentation

Instrument ID: 729LB1

Instrument Maker: Ludlum
Model: 2350-1
S/N: PR180729

Probe Maker: Ludlum
Model: 43-37-1
S/N: PR145078
Area: 771 sq cm

Analysis Parameters

Instrument Efficiency: 0.302 cpm/epm **d prime:** 1.90 **Surveyor Efficiency:** 1.00

Scan Interval: 2.00 sec

Technician/Surveyor: CHICO

Background Material Summary

Material	Bkgd Level (cpm)	MDCR (cpm)	Source Eff (epm/dpm)	Scan MDC (dpm/100 cm2)
Sidewalk	2,405.00	510.40	0.21	1044.00

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3.0 IDENTIFICATION OF REMAINING DECOMMISSIONING ACTIVITIES

3.1 Introduction

In accordance with 10 CFR 50.82 (a)(9)(ii)(B), the License Termination Plan (LTP) must identify the major remaining dismantlement and decontamination activities. This chapter was written following the guidance of NUREG-1700, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans," and Regulatory Guide 1.179, "Standard Format and Content of License Termination Plans for Nuclear Power Reactors," and will discuss those remaining dismantlement activities as of October 31, 2008. Information is presented to demonstrate that these activities will be performed in accordance with 10 CFR 50 and will not be detrimental to the common defense and security or to the health and safety of the public pursuant to 10 CFR 50.82(a) (10). Information that demonstrates that these activities will not have a significant effect on the quality of the environment is provided in LTP Chapter 8, Supplement to the Environmental Report.

The information includes those areas and equipment in need of further remediation, and an estimate of radiological conditions that may be encountered. Included are estimates of associated occupational radiation dose and projected volumes of radioactive waste. Detroit Edison Company's (DECo's) primary goals are to decommission EF1 safely and successfully terminate the EF1 license. DECo will decontaminate and dismantle EF1 in accordance with the SAFSTOR alternative, as described in NUREG-0586, "Final Generic Environmental Impact Statement" (GEIS). Completion of the SAFSTOR option is contingent upon access to one or more low-level waste (LLW) disposal sites. Currently, EF1 has access to the disposal facilities in Clive, Utah.

DECo is currently conducting decontamination and dismantlement (D&D) activities at the EF1 site in accordance with EF1 procedures and approved work packages. Decommissioning activities are being coordinated with the appropriate Federal and State regulatory agencies.

Decommissioning activities at EF1 are conducted in accordance with the EF1 Safety Analysis Report (F1SAR), existing 10 CFR Part 50 license, and the requirements of 10 CFR 50.82(a)(6) and (a)(7). If an activity requires prior Nuclear Regulatory Commission (NRC) approval under 10 CFR 50.59(c)(2) or a change to the EF1 Technical Specifications or license, a submittal will be made to the NRC for review and approval prior to implementation of the activity in question.

Decommissioning activities are conducted in accordance with the Radiation Protection Program, the F1SAR and the Fermi 1 Manual.

The activities described in Section 3.3, Future Decommissioning Activities, include activities up to future release of the site. This section provides an overview and describes the major remaining components of contaminated plant systems and, as appropriate, a description of specific equipment remediation considerations.

Information related to the remaining D&D tasks is also provided. This information includes an estimate of the quantity of radioactive material to be disposed of in accordance with 10 CFR 20.2001, a description of proposed control mechanisms to ensure areas are not re-contaminated, estimates of occupational exposures, and characterization of radiological conditions to be encountered and the types and quantities of radioactive waste. This information supports the assessment of impacts considered in other sections of the LTP and provides sufficient detail to identify inspections or technical resources needed during the remaining dismantlement activities. Many of these dismantlement tasks require coordination with other federal, state or local regulatory agencies or groups.

The dismantlement activities described in Section 3.3 provide the NRC the information to support site release and future license termination pursuant to 10 CFR 50.82(a) (11) (i). Therefore, this section was written in order to clearly indicate each major dismantlement activity that remains to be completed prior to qualifying for license termination. The final state of the EF1 site will be a partially abandoned facility (as defined in Chapter 1 of this LTP) available for reuse. The impact of decommissioning activities performed will be to reduce residual radioactivity to a level that permits release of the property for beneficial reuse by DECo for industrial purposes.

3.2 Completed Decommissioning Activities and Tasks

3.2.1 Fuel and Blanket Subassemblies

Under terms of an initial agreement, the EF1 uranium was to be returned to the AEC in the form of UF_6 meeting diffusion plant purity specifications, if a private commercial company in the U.S. could do the work. If no company were available, the AEC would accept the irradiated materials under the spent fuels chemical processing and conversion provisions of the Atomic Energy Act of 1954, using specified hypothetical plant costs. At the time of decommissioning, no private company was available, so the AEC agreed to accept the material at its Savannah River Project (SRP). Disposal of all blanket subassemblies was accomplished by shipment to the Idaho Chemical Processing Plant (ICPP).

The first shipment of fuel from EF1 was made on February 6, 1973. On May 15, 1973, the last shipment of fuel, which contained fuel segments located at the hot cell facility at Battelle Memorial Institute in Columbus, Ohio at the time of permanent shutdown, arrived at the SRP.

3.2.2 Sodium and NaK Removal

The major volume of secondary sodium was drained into the three 12,000-gallon storage tanks via the service system by normal operating procedures. A complete drain, except about 3600 gallons in the IHX tube bundles, was accomplished by gravity drain supplemented by evacuating the storage tanks and pressurizing the nitrogen cover gas system. In November 1973, the sodium from the IHX tube bundles was drained into the primary sodium system. The secondary sodium service system was drained directly to a barrel fill station. The transfer of secondary sodium to drums began on May 31, 1973, and was completed July 24, 1973. All filled drums were sold and shipped off site.

It was necessary to drain the primary system in steps, beginning May 8, 1973. First, approximately 28,000 gallons of sodium from the primary system and the IHX and pump tanks was transferred to the storage tanks via the overflow pumps. Remaining sodium required removal via special siphon pipes in individual components. The volume of primary sodium was greater than could be stored in the three primary storage tanks. The overflow was placed in drums. Drumming primary sodium was accomplished using the equipment for barreling secondary sodium, with some minor modifications. The primary sodium was sent to Idaho to the Department of Energy (DOE).

Small bore piping was removed and sodium residues were processed in a Reaction Chamber. Large equipment was processed in place to convert the sodium into sodium hydroxide and hydrogen gas. Graphite blocks were removed from the reactor and allowed to "weather" in order to react the residual sodium absorbed into the graphite.

At the beginning of the retirement program, about 2,940 pounds of NaK was stored essentially in four major locations: the primary cold trap cooling loop, the recirculating cover gas vapor trap, the clean gas purification unit, and the fission products detector vapor trap. About 2,350 pounds of the NaK was nonradioactive and was given to an off-site company who provided the shipping containers and transportation costs. Radioactive NaK, approximately 590 pounds, was shipped for burial offsite. NaK systems were processed to react residual NaK residues. The NaK lines were removed or flushed.

3.2.3 FARB

3.2.3.1 Cut-up and Decay Pools

A significant effort was exerted in decontaminating the FARB decay and cut-up pools. After all equipment was removed from the decay pool and cutup pool, the pool walls were scrubbed with a detergent and soapy water. The final wash consisted of a 10% nitric acid solution and a demineralized water rinse. Subsequent to the final cleaning and drying, a 20-mil-thick layer of strippable paint was applied in several coats to all surfaces of pool walls, floor, and tunnel. Approximately 50 gallons of paint were applied using hand rollers with personnel working from a hanging cage.

3.2.3.2 Cold Trap room

The FARB cold trap piping and equipment were removed and sent offsite for disposal.

3.2.4 Sodium Building

The majority of original equipment and piping in the NaK room, valve room and cold-trap room was removed during the initial retirement. Asbestos abatement was performed within the building. Additional equipment was removed during the current decommissioning project. A Reaction Chamber was installed in the cold trap room for processing of sodium as well as the addition of equipment in the NaK room to support the process. The sodium barreling station was removed.

3.2.5 Large Component Removal

The three Steam Generators have been removed along with some of the associated piping. The machinery dome and above floor portions of the primary shield tank, fuel handling and control rod drives mechanisms have been removed as well. Inert gas tanks, waste gas tanks and the fuel transfer tank have been removed.

3.2.6 Health Physics/Chemistry Building

The Health Physics/Chemistry Building has been removed. The slab and the waste discharge line from the Health Physics/Chemistry Building remain within the license termination footprint.

3.2.7 Non-Radiological Decommissioning Activities

Non-radiological decommissioning activities include the removal of the boiler house. Acid and caustic tanks have been removed from the west side of the facility. Asbestos was removed from miscellaneous locations throughout the site. Removal of some non-essential materials and equipment and general cleanup of the site was also performed. The main unit transformer was removed and sold.

3.3 Future Decommissioning Activities

3.3.1 Remaining Component Removal

The Reactor Vessel and large component removal project is currently in progress and is expected to be completed in the first quarter of 2010. The reaction chamber and associated piping will be removed from the Sodium Building cold trap room. The liquid waste tanks and associated equipment are slated for removal in 2009. Primary sodium storage tanks will be removed after the processing liquid stored in them has been dispositioned. Other components will be removed prior to building decontamination (e.g. auxiliary fuel storage facility, steam cleaning equipment).

3.3.2 Decontamination of Structures and Systems

3.3.2.1 Reactor Building

Some decontamination is expected once equipment is removed. Cleaning, up to and including paint removal, will be done as necessary to meet the derived concentration guideline level (DCGL).

3.3.2.2 FARB

The liners from the decay and cut-up pools will be removed. Some remediation is expected in the transfer tank room as well as the steam cleaning chamber. The waste line that runs from the old Health Physics/Chemistry Building to the FARB will be excavated and removed. The Hot Sump liner will be removed and decontamination will be performed as required. No decommissioning activities are currently planned for the tressleway.

3.3.2.3 Sodium Building Cold Trap Room

Once the reaction chamber and associated piping are removed, some remediation is expected and will be performed as necessary, to meet the DCGL.

3.3.2.4 Embedded Pipe Systems

Embedded pipe systems are located in several of the impacted buildings. Most embedded system piping is associated with floor drains. Embedded piping will be removed as necessary to meet DCGLs. If portions of the embedded piping cannot be removed, the piping will be evaluated (by survey) to determine final disposition.

3.3.2.5 Groundwater Sump Systems

Groundwater sump piping that will remain is believed to be below DCGL levels. Surveys have been performed on components contained within these systems (i.e. sump pumps).

3.3.3 Control Mechanisms to Ensure No Recontamination

Due to the scope of remaining structures and systems to be decontaminated and the need for some FSS activities to be performed in parallel with dismantlement activities, a systematic approach to controlling areas is established. Upon commencement of the FSS for survey areas where there is a potential for re-contamination, isolation and control measures will be implemented as described in Section 5.2.4.4 of this LTP.

3.4 Occupational Exposure

Figure 3-1 provides EF1 cumulative site dose and estimates for the decommissioning project. These estimates were developed to provide site management ALARA goals. The goals are verified by summation of actual site dose, as determined by appropriate dosimetry. Exposure estimates are a compilation of radiation work permit estimates for the period. The total nuclear worker exposure during decommissioning is currently estimated to be less than 50 person-rem. This estimate is significantly below the 1,215 person-rem estimate of the GEIS for immediate dismantlement and below the ten-year SAFSTOR estimate 664 person-rem. The spike in exposure for 2009 reflects projected exposure for the removal of the reactor vessel and large components.

Figure 3-1: EF1 Cumulative Site Dose

Year	Exposure (person-rem)
1998 – 1999*	0.163
1999 – 2000*	0.397
2000 – 2001*	0.508
2001 – 2002*	0.068
2002 – 2003*	0
2003 – 2004*	0.251
2004 – 2005*	0.525
2005 – 2006*	0.148
2006 – 2007*	0.331
2007 – 2008*	0.980
2008**	0.353
2009***	45.030
2010***	1.000
2011***	0.200

* Annual reports run from July 1 to June 30 of the following year
** Exposure from July 2008 to December 31, 2008
***Estimated exposures for these years

3.4.1 Public Exposure

Continued application of EF1's current and future Radiation Protection and Radiological Effluent Programs assures public protection in accordance with 10 CFR Part 20 and 10 CFR Part 50, Appendix I. Sections 8.4.4 and 8.4.5 of this LTP conclude that the public exposure as a result of decommissioning activities is bounded by the evaluation in the GEIS, which includes the impact is small.

3.4.2 Estimate of Quantity of Radioactive Material to be Shipped for Disposal

EF1 has shipped for radioactive disposal approximately 1,508 cubic meters (53,250 cubic feet) from 1999 through December 31, 2007. The estimate of remaining waste is 1,416 cubic meters (50000 cubic feet), most of which is dealing with the reactor vessel and large component removal. This waste is expected to be classified as Class A waste and disposed of at Energy Solution's Clive Utah disposal site. This volume of waste is bounded by NUREG-0586, (GEIS) volume for the reference pressurized water reactor of 18,343 cubic meters (647,700 cubic feet).

3.4.3 Solid Waste Activity and Volume

EF1's Annual Report, submitted in accordance with 10 CFR 50.36(a), includes a report on solid waste activity and volumes. This report is submitted by August 31st of each year. The Fermi 1 reporting year is July 1st to June 30th. A summary of solid waste disposal for 1997 through 2007 is provided in Table 3-1. Future updates may be obtained from EF1 via inspection or future annual reports.

Table 3-1: Solid Waste Effluent Release Report Summary

Year	Volume (ft^3)	Total Curies	Nuclides
1999	37520	0.024	Co-60, Ni-63, Sr-90, Cs-137
2000	1162	0.001	Co-60, Ni-63, Sr-90, Cs-137
2001	3534	0.002	Co-60, Ni-63, Sr-90, Cs-137
2002	2324	0.009	Co-60, Ni-63, Sr-90, Cs-137
2003	1163	0.0002	Co-60, Ni-63, Sr-90, Cs-137
2004	No Shipments	N/A	N/A
2005	1169	0.008	Co-60, Ni-63, Sr-90, Cs-137
2006	2769	0.09	Co-60, Ni-63, Sr-90, Cs-137
2007	3611	0.02	Co-60, Ni-63, Sr-90, Cs-137

3.4.4 Liquid Waste Activity and Volume

There were no radioactive liquid releases during the period from 1997 to present.

3.4.5 Gaseous Waste Activity and Volume

EF1 submits the Annual Report, which includes data on gaseous waste. The set of data provided in Table 3-2 provides a compilation of this information. A summary of the gaseous waste effluent release reports for July 1999 through June 2008 is provided below. Future updates may be obtained from EF1 via inspection. Radioactive gaseous releases are expected to cease after 2010.

Table 3-2: Gaseous Waste Effluent Releases

Year	Fission & Activation (Ci)	Iodine (Ci)	Particulates (Ci)	Tritium (Ci)	TEDE mRem
1999	N/A	N/A	N/A	1.64E-09	8.07E-13*
2000	N/A	N/A	N/A	8.56E-09	4.21E-12*
2001	N/A	N/A	N/A	7.09E-07	3.49E-10*
2002	N/A	N/A	N/A	4.55E-10	2.24E-13*
2003	N/A	N/A	N/A	0.035	1.74E-05
2004	N/A	N/A	N/A	0.013	5.96E-06
2005	N/A	N/A	N/A	0.012	5.78E-06
2006	N/A	N/A	N/A	0.03	1.70E-05
2007	N/A	N/A	N/A	0.004	2.75E-06
2008	N/A	N/A	0.0006	0.0018	8.82E-04

*TEDE reflects a revised calculation, previously reported values used an over conservative formula

3.5 Site Description after License Release

Currently, no permanent buildings or structures on site are scheduled for demolition.

Various buildings may be used for office space or maintenance activities. At some future date, DECo may decide to refurbish or demolish any of the buildings or structures onsite. The Fermi 1 footprint remains within the Fermi 2 Owner Controlled Area (OCA) following license termination. The Fermi 2 Updated Final Safety Analysis Report; Section 1, identifies Fermi 1 as being within the Fermi 2 OCA.

3.6 Coordination with Outside Entities

The decommissioning and termination of EF1's 10 CFR Part 50 license involves, among others, the US NRC, the US Department of Transportation, the State of Michigan

(MIOSHA, MI/Department of Environmental Quality State Historical Preservation Office), Frenchtown Township, Monroe County and the local fire district.

Chapter 8 of this LTP, "Supplement to the Environmental Report" discusses some of the related requirements.

3.7 References

3.7.1 U.S. Nuclear Regulatory Commission NUREG-1700, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans" (April 2000)

3.7.2 U.S. Nuclear Regulatory Commission Regulatory Guide 1.179, "Standard Format and Content of License Termination Plans for Nuclear Power Reactors" (January 1999)

3.7.3 U.S. Nuclear Regulatory Commission NUREG-0586, "Final Generic Environmental Impact Statement (GEIS) on Decommissioning of Nuclear Facilities" (October 2002), Supplement 1

3.7.4 EF1 Safety Analysis Report, Revision 4, November, 2006

3.7.5 EF1 Annual Reports, 1999 to 2008

3.7.6 EF1, Technical Specifications, Amendment 20

3.7.7 Fermi 2 Updated Final Safety Analysis Report

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4.0 SITE REMEDIATION PLANS

4.1 Remediation Actions and ALARA Evaluations

This chapter of the LTP describes various remediation actions that may be used during the decommissioning of Fermi 1 as well as the Radiation Protection Program requirements for the remediation.

4.2 Remediation Actions

Remediation actions are performed throughout the decommissioning process. The remediation action taken is dependent on the material contaminated. The principal materials that may be subjected to remediation are hardened structural surfaces and soils.

4.2.1 Structures

Following the removal of designated equipment and components, structures will be surveyed as necessary, contaminated materials will be remediated or removed and disposed of as radioactive waste. Contaminated structural surfaces will be remediated to levels that will meet the established radiological criteria provided in Chapter 6 of this LTP. Remediation techniques that may be used for the structural surfaces include: washing, wiping, pressure washing, vacuuming, scabbling, chipping, and sponge or abrasive blasting. Washing, wiping, abrasive blasting, vacuuming and pressure washing techniques may be used for both metal and concrete surfaces. Scabbling and chipping are mechanical surface removal methods intended for concrete surfaces. Activated concrete removal, if required, may include using machines with hydraulic-assisted, remote-operated, articulating tools. These machines have the ability to exchange scabbling, shear, chisel and other tool heads.

4.2.1.1 Scabbling and Shaving

The principal remediation methods expected to be used for removing contaminants from concrete surfaces are scabbling and shaving. Scabbling is a surface removal process that uses pneumatically operated air pistons with tungsten-carbide tips that fracture the concrete surface to a nominal depth of 0.25 inches at a rate of about 20 ft^2 per hour. The scabbling pistons (feet) are contained in a close-capture enclosure that is connected by hoses to a sealed vacuum and collector system. Shaving uses a series of diamond cutting wheels on a spindle, and performs at similar rates to scabbling. The wheels are also contained in a close-capture enclosure similar to scabbling equipment. The fractured media and dusts from both methods are deposited into a sealed removable container. The exhaust air passes through both roughing and absolute HEPA (high efficiency particulate air filter) filtration devices. Dust and debris generated through these remediation processes is collected and controlled during the operation.

4.2.1.2 Needle Guns

A second method of scabbling is accomplished using needle guns. The needle gun is a pneumatic air-operated tool containing a series of tungsten-carbide or hardened steel rods enclosed in a housing. The rods are connected to an air-driven piston to abrade and fracture the media surface. The media removal depth is a function of the residence time of the rods over the surface. Typically, one to two millimeters are removed per pass. Generated debris collection, transport and dust control are accomplished in the same manner as other scabbling methods. Use of needle guns for removal and chipping of media is usually reserved for areas not accessible to normal scabbling operations. These include, but are not limited to inside corners, cracks, joints and crevices. Needle gunning techniques can also be applied to painted and oxidized surfaces.

4.2.1.3 Chipping

Chipping includes the use of pneumatically operated chisels and similar tools coupled to vacuum-assisted collection devices. Chipping activities are usually reserved for cracks and crevices. This action is also a form of scabbling.

4.2.1.4 Sponge and Abrasive Blasting

Sponge and abrasive blasting are similar techniques that use media or materials coated with abrasive compounds such as silica sands, garnet, aluminum oxide, and walnut hulls. Sponge blasting is less aggressive, incorporating a foam media that, upon impact and compression, absorbs contaminants. The medium is collected by vacuum and the contaminants are washed from the medium so the medium may be reused. Abrasive blasting is more aggressive than sponge blasting but less aggressive than scabbling. Both operations use intermediate air pressures. Sponge and abrasive blasting are intended for the removal of surface films and paints.

4.2.1.5 Pressure Washing

Pressure washing uses a nozzle of intermediate water pressure to direct a jet of pressurized water that removes superficial materials from the suspect surface. A header may be used to minimize over-spray. A wet vacuum system is used to suction the potentially contaminated water into containers for filtration or processing. It is expected that pressure washing will be used sparingly at Fermi 1 due to the constraints on the processing of waste water.

4.2.1.6 Washing and Wiping

Washing and wiping techniques are actions that are normally performed during the course of remediation activities and will not always be evaluated as a separate ALARA action. When washing and wiping techniques are used as the sole means to reduce residual contamination below DCGL levels, ALARA evaluations are performed. Washing and wiping techniques used as housekeeping or good practice measures will not be evaluated. Examples of washing and wiping activities for which ALARA evaluations would be performed include:

- Decontamination of stairs and rails,
- Decontamination of structural materials, metals or media for which decontamination reagents may be required, or
- Structure areas that do not provide sufficient access for utilization of other decontamination equipment such as pressure washing.

4.2.1.7 Grit Blasting

Most contaminated piping will be removed and disposed of as radioactive waste. Any remaining contaminated piping buried or embedded in concrete may be remediated using methods such as grit blasting. Grit blasting uses grit media such as garnet or sand under intermediate air pressure directed through a nozzle that is pulled through the closed piping at a fixed rate. The grit blasting action removes the interior surface layer of the piping. A HEPA vacuum system maintains the sections being cleaned under negative pressure and collects the media for reuse or disposal. The final system pass is performed with clean grit to remove any residual contamination.

4.2.1.8 Removal of Activated/Concrete

Characterization surveys of concrete have not shown signs of activation. If at a later date activated concrete is found, the subject material will be evaluated and remediated as necessary.

4.2.1.9 Additional Remedial Actions

Mechanical abrasive equipment, such as hones, may be used to remove contamination from the surfaces of embedded piping. Chemical removal means may be used, as appropriate, for the removal of certain contaminants.

4.2.2 Soil

Soil contamination above the site specific DCGL that is removed will be disposed of as radioactive waste. Operational constraints and dust control will be addressed in site excavation and soil control procedures. In addition, work package instructions for remediation of soil may include additional constraints and mitigation or control methods. The site characterization process established the location and extent of soil contamination. As needed, additional investigations will be performed to ensure that any changing soil contamination profile during the remediation actions is adequately identified and addressed. It should also be noted that soil remediation volume estimates in the LTP may vary from section to section, as appropriate, depending on their use, e.g., decommissioning cost estimates, ALARA evaluations, or dose assessment. Section 5, "Final Status Survey Plan" of this LTP discusses soil sampling and survey methods. Soil remediation equipment will include, but not be limited to, shovels, back hoe and track hoe excavators. As practical, when the remediation depth approaches the soil interface region between unacceptable and acceptable contamination, a squared edge excavator bucket design or similar technique may be used. This simple methodology minimizes the mixing of contaminated soils with acceptable lower soil layers as would occur with a toothed excavator bucket. Remediation of soils will include the use of established Excavation Safety and Environmental Control procedures. Additionally, work package instructions will augment the above guidance and procedural requirements to ensure adequate erosion, sediment, and air emission controls during soil remediation.

4.3 Remediation Activities Impact on the Radiation Protection Program

The Radiation Protection Program approved for decommissioning is similar to the program in place during power operation. During power operations, contaminated structures, systems and components were decontaminated in order to perform maintenance or repair actions. The techniques used during operations are the same or similar to the techniques used during decommissioning to reduce personnel exposure to radiation and contamination and to prevent the spread of contamination from established contaminated areas. Decommissioning does not present any new challenge to the Radiation Protection Program above those encountered during normal plant operation, except that certain local temporary effluent systems have been and/or will be installed to capture airborne effluents. The original ventilation system in the Radiologically Restricted Area (RRA) was disabled and partly removed during decommissioning performed in the 1970s. The temporary systems have been proceduralized.

Decommissioning planning allows radiation protection personnel to focus on each area of the site and plan each activity well before execution of the remediation technique. Low levels of surface contamination are to be remediated by washing and wiping. These techniques have been used thus far, successfully, in the decommissioning process. Wiping with a detergent has been the method of choice for large area decontamination.

Wiping with detergent soaked or oil-impregnated media has been used on small items, overhead spaces and small hand tools to remove surface contaminants. These same techniques will be applied to remediate lightly contaminated structural surfaces during remediation actions. Intermediate levels of contamination and contamination on the internal surfaces of piping or components may be subjected to pressure washing, hydrolazing or grit blasting, as required. The basement has been decontaminated by hand washing/wiping with a large degree of success. Only small areas are expected to require other techniques. Small tools, hoses and cables have been hand wiped to remove surface contamination. These methods will be used to reduce contamination on moderately contaminated exterior surfaces as well as internal surfaces of pipes during decommissioning. Scabbling or other surface removal techniques will reduce high levels of contamination, including on contaminated concrete. Diamond wire cutting will be used to section the reactor vessel and thermal or mechanical cutting will be used to segment the contaminated piping/components in the basement. Mechanical and thermal cutting were used at Fermi 1 during previous decommissioning operations. The current Radiation Protection Program provides adequate controls for these actions. The decommissioning organization is experienced in and capable of applying these remediation techniques on contaminated systems, structures or components during decommissioning. The existing Radiation Protection Program is adequate to safely control the radiological aspects of remediation work. The activities expected during decommissioning would be no different than those encountered during a commercial plant's operations or earlier in the decommissioning project; therefore no changes to the program have been deemed necessary to ensure the health and safety of the workers and the public.

4.4 ALARA Evaluation

In order to terminate the NRC license, the licensee must demonstrate that the dose criteria in 10CFR20 Subpart E have been met, and should demonstrate whether it is feasible to further reduce the levels of residual activity to below those necessary to meet the dose criteria (i.e., to levels that are As Low As Reasonably Achievable – ALARA). For the Fermi 1 (EF1) decommissioning, the ALARA cleanup levels are established at one of two levels, a pre-defined generic ALARA screening or a survey unit-specific ALARA evaluation. In either case, an ALARA action level (AL) is applied.

The AL corresponds to a residual activity concentration at which the averted radiation dose converted into dollars is equal to the costs of remediation. An ALARA analysis ensures that the efforts to remove residual contamination are commensurate with the risk that exists leaving the contamination in place. "Reasonably achievable" is judged by considering the state of technology and the economics of improvements in relation to all of the benefits from these improvements. However, a comprehensive consideration of risks and benefits will include risks from non-radiological hazards. An action taken to reduce radiation risks should not result in a significantly larger risk from the other hazards.

NUREG-1757, "Consolidated NMSS Decommissioning Guidance" recognizes that remediation of soils beyond the Derived Concentration Guideline Levels (DCGLs) is not likely to be cost-beneficial due to the high costs of waste disposal. For EF1, if remediation of soils beyond the DCGL is determined not to be cost-beneficial, then residual activity in soils that meet the DCGL will be considered ALARA. Similarly, if residual radioactivity on remaining structures is below a pre-determined generic ALARA screening level, then the levels associated with the structure will be considered ALARA.

The methodology and equations used are consistent with those provided in Volume 2 of NUREG-1757. Copies of ALARA evaluations will be included in the FSS Report for each survey area.

4.5 Unit Cost Estimates

In order to effectively perform ALARA evaluations and remediation actions, unit cost values are required. These values are used to perform the NUREG-1757, Volume 2 cost-benefit analysis.

4.5.1 Calculation of Total Cost

When performing a fairly simple evaluation, the costs generally include the monetary costs of: (1) the remediation action being evaluated, (2) transportation and disposal of the waste generated by the action, (3) workplace accidents that occur because of the remediation action, (4) traffic fatalities resulting from transporting the waste generated by the action, (5) doses received by workers performing the remediation action, and (6) doses to the public from excavation, transport, and disposal of the waste. Other costs that are appropriate for the specific case may also be included. Values of some standard parameters are contained in Table 4-1.

The total cost, ($Cost_T$) which is balanced against the benefits; has several components and may be evaluated according to Equation N-3 of NUREG-1757, Vol. 2 Appendix N below:

$$Cost_T = Cost_R + Cost_{WD} + Cost_{ACC} + Cost_{TF} + Cost_{WDose} + Cost_{PDose} + Cost_{other}$$

Where:

$Cost_R$ = monetary cost of the remediation action (including mobilization costs);

$Cost_{WD}$ = monetary cost for transport and disposal of the waste generated by the action;

$Cost_{ACC}$ = monetary cost of worker accidents during the remediation action;

$Cost_{TF}$ = monetary cost of traffic fatalities during transportation of the waste;

$Cost_{WDose}$ = monetary cost of dose received by workers performing the remediation action and transporting waste to the disposal facility;

$Cost_{PDose}$ = monetary cost of dose to the public from excavation, transport and disposal of the waste, and;

$Cost_{other}$ = other costs as appropriate for the particular situation.

4.5.1.1 Remedial Action Costs

Calculations of the incremental remedial action costs include the standard manpower and mechanical costs. Lower concentrations may change sampling/survey requirements. Increased survey costs can be considered in the remedial action (e.g., confined spaces, difficult to access areas, ceilings and walls above 6 feet) and will raise standard remediation costs due to the increase in man hours, but note that these are the incremental costs of surveying below the dose limit.

4.5.1.2 Transport and Disposal of the Waste

The cost of waste transport and disposal ($Cost_{WD}$) may be evaluated according to Equation N-4 of NUREG-1757, Vol. 2 Appendix N below:

$$Cost_{WD} = V_A \times Cost_V$$

Where:

V_A = volume of waste produced, remediated in units of m^3; and

$Cost_V$ = cost of waste disposal per unit volume, including transportation cost, in units of $\$/m^3$.

4.5.1.3 Non-radiological Risks

The cost of non-radiological workplace accidents ($Cost_{ACC}$) may be evaluated using Equation N-5 of NUREG-1757, Vol. 2 Appendix N below:

$$Cost_{ACC} = \$3,000,000 \times F_W \times T_A$$

Where:

$3,000,000 = monetary value of a fatality equivalent to $2000/Person-Rem (see pages 11–12 of "Reassessment of NRC's Dollar per Person-Rem Conversion Factor Policy," NUREG–1530, December 1995);

F_W = workplace fatality rate in fatalities/hour worked; and

T_A = worker time required for remediation in units of worker-hours.

4.5.1.4 Transportation Risks

The cost of traffic fatalities incurred during the transportation of waste ($Cost_{TF}$) may be evaluated using Equation N-6 of NUREG-1757, Vol. 2 Appendix N below:

$$Cost_{TF} = \$3{,}000{,}000 \times \left(\frac{V_A}{V_{SHIP}}\right) \times F_T \times D_T$$

Where:

V_A = volume of waste produced in units of m^3;

F_T = fatality rate per truck-kilometer traveled in units of fatalities/truck-km;

D_T = distance traveled in km; and

V_{SHIP} = volume of a truck shipment in m^3.

4.5.1.5 Worker Dose Estimates

The cost of the remediation worker dose ($Cost_{WDose}$) may be evaluated using Equation N-7 of NUREG-1757, Vol. 2 Appendix N below:

$$Cost_{WDose} = \$2000 \times D_R \times T$$

Where:

D_R = total effective dose equivalent (TEDE) rate to remediation workers in units of rem/hr; and

T = time worked (site labor) to remediate the area in units of person-hour.

4.5.1.6 Loss of Economic Use of Property

A cost in the "other" category could include the fair market rental value or economic use for the site during the time the additional remediation work is being performed. These costs are usually associated with locations such as laboratories, hospital rooms, and industrial sites, etc and with regard to EF1, rental costs do not apply. The possible other cost that could arise is if Detroit Edison decides to build Fermi 3 and construction is delayed due to additional decontamination of Fermi 1.

4.5.1.7 Parameters

For performing these calculations, acceptable values for some of the parameters are shown in the Table 4-1 below:

Table 4-1: Parameter Values for Use in ALARA Analysis

Parameter	**Value**	**Reference and comments**
Workplace accident fatality rate, F_W	4.2 x 10^{-8}/hr	NUREG–1496, "Final Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities," and NUREG–1496, July 1997, Volume 2, Appendix B, Table A.1
Transportation fatality rate, F_T	Trucks: 3.8 x 10^{-8}/km	NUREG–1496, Volume 2, Appendix B, Table A.1
Dollars/person-rem	$2000	NUREG/BR–0058
Monetary discount rate, r	0.07/y for the first 100 years and 0.03/y thereafter, or 0.07 for buildings and 0.03 for soil	NUREG/BR–0058
Number of years of exposure, N	Buildings: 70 years Soil: 1000 year	NUREG–1496, Volume 2, Appendix B, Table A.1
Population density, P_D	Building: 0.001 person/m^2 Land: 0.0001 person/m^2	EF1 Site-Specific Sensitivity Analysis
Excavation, monitoring, packaging, and handling soil	Soil: 6 person-hours/m^3 of soil	Derived from Site-Specific Information
Waste shipments volume, V_{SHIP}	Truck: 13.6 m^3/shipment	NUREG–1496, Volume 2, Appendix B, Table A.1

4.5.2 Calculation of Benefits

In the simplest form of the analysis, the only benefit estimated from a reduction in the level of residual radioactivity is the monetary value of the collective averted dose to future occupants of the site. For buildings, the collective averted dose from residual radioactivity should be based on some form of building occupancy scenario. For land, the averted dose may generally be based on the resident farmer scenario. In general, the ALARA analysis should use the same critical group scenario that is used for the compliance calculation.

The benefit from collective averted dose (B_{AD}) is calculated by determining the present worth of the future collective averted dose and multiplying it by a factor to convert the dose to monetary value using Equation N-1 of NUREG-1757, Vol. 2 Appendix N:

$$B_{AD} = \$2000 \times PW(AD_{collective})$$

Where:

B_{AD}	=	benefit from an averted dose for a remediation action, in current U.S. dollars
\$2000	=	value in dollars of a person-rem averted (see NUREG/BR–0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," Revision 4, 2004)
$PW(AD_{collective})$	=	present worth of a future collective averted dose

An acceptable value for a collective dose is \$2000 per person-rem averted, discounted for a dose averted in the future. See Section 4.3.3 of "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," NUREG/BR–0058, Revision 4, 2004. For doses averted within the first 100 years, a discount rate of 7 percent should be used. For doses averted beyond 100 years, a 3 percent discount rate should be used.

The present worth of the future collective averted dose can be estimated from Equation N-2 of NUREG-1757, Appendix N for relatively simple situations:

$$PW(AD_{collective}) = P_D \times A \times 0.025 \times F \times \frac{Conc}{DCGL_W} \times \frac{1 - e^{-(r+\lambda)N}}{r + \lambda}$$

Where:

P_D	=	population density for the critical group scenario in people/m^2;
A	=	area being evaluated in square meters (m^2)
0.025	=	annual dose to an average member of the critical group from residual radioactivity at the Derived Concentration Guideline Level ($DCGL_W$) concentration in rem/y;
F	=	effectiveness, or fraction of the residual radioactivity removed by the remediation action;

Conc	=	average concentration of residual radioactivity in the area being evaluated in units of activity per unit area for buildings or activity per unit volume for soils;
$DCGL_W$	=	derived concentration guideline equivalent to the average concentration of residual radioactivity that would give a dose of 0.25 mSv/y (25 mrem/y) to the average member of the critical group, in the same units as "*Conc*";
r	=	monetary discount rate in units per year;
λ	=	radiological decay constant for the radionuclide in units per year; and
N	=	number of years over which the collective dose will be calculated.

The present worth of the benefit calculated by Equation N-2, above, assumes that the peak dose occurs in the first year. This is almost always true for the building occupancy scenario, but not always true for the residential scenario where the peak dose can occur in later years. When the peak dose occurs in later years, Equation N-2 would overestimate the benefit. A more exact calculation may be used, that avoids this overestimation of the benefit of remediation by calculating the dose during each year of the evaluation period and then calculating the present worth of each year's dose.

The $DCGL_W$ used should be the same as the $DCGL_W$ used to show compliance with the 25 mrem/y dose limit. The population density, P_D, should be based on the dose scenario used to demonstrate compliance with the dose limit. Thus, for buildings, the estimate P_D for the building occupancy scenario should be used. For soil, P_D should be based on the resident farmer scenario. The factor at the far right of the equation, which includes the exponential terms, accounts for both the present worth of the monetary value and radiological decay.

If more than one radionuclide is present, the total benefit from a collective averted dose, B_{AD} is the sum of the collective averted dose for each radionuclide. When multiple radionuclides have a fixed concentration, residual radioactivity below the dose criteria is normally demonstrated by measuring one radionuclide and comparing its concentration to a $DCGL_W$ that has been calculated to account for the dose from the other radionuclides. In this case, the adjusted $DCGL_W$ may be used with the concentration of the radionuclide being measured. The other case is where the ratio of the radionuclide concentrations is not fixed and varies from location to location within a survey unit; this benefit is the sum of the collective averted dose from each.

4.5.3 Residual Radioactivity Levels that are ALARA

The residual radioactivity level that is ALARA is the concentration *(Conc)* at which the benefit from removal equals the cost of removal. If the total cost $(Cost_T)$ is set equal to the present worth of the collective dose averted in

Equation 2, the ratio of the concentration *(Conc)* to the $DCGL_W$ can be determined by using Equation N-8 of NUREG-1757, Vol. 2 Appendix N below:

$$\frac{Conc}{DCGL_W} = \frac{Cost_T}{\$2000 \times P_D \times 0.025 \times F \times A} \times \frac{r+\lambda}{1-e^{-(r+\lambda)N}}$$

All the items in Equation N-8 are as previously defined.

Since P_D, N, λ and r are constants that have generic values for all locations on the site for each scenario, EF1 only needs to determine the total cost, $Cost_T$, and the effectiveness, *F,* for a specific remediation action for a specific area. If the concentration at a location exceeds *Conc*, it may be cost effective to remediate the location by a method whose total cost is $Cost_T$. Note that the concentration, *Conc,* which is ALARA, can be higher or lower (more or less stringent) than the $DCGL_W$, although the $DCGL_W$ must be met in order to meet the criteria for license termination.

4.6 Radionuclides Considered for ALARA Calculations

As discussed in LTP Chapter 6, Section 6.4.1, the site-specific suite of radionuclides identified for use at Fermi 1 contains 24 radionuclides. Only one of these radionuclides has been identified above minimum detectable concentration (MDC) levels in soil samples and structural surface samples. For purposes of the ALARA calculations, only Cs-137 is used along with its associated DCGL value.

4.7 References

4.7.1 U.S. Nuclear Regulatory Commission NUREG/CR-5512, Volume 3, "Residual Radioactive Contamination from Decommissioning – Parameter Analysis, Draft Report for Comment," October 1999

4.7.2 U.S. Nuclear Regulatory Commission, NUREG-1496, Volume 2, "Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities," July 1997

4.7.3 U.S. Nuclear Regulatory Commission, NUREG-1757, Volume 2, Final Report, "Consolidated NMSS Decommissioning Guidance - Characterization, Survey, and Determination of Radiological Criteria," September 2003

4.7.4 U.S. Nuclear Regulatory Commission, NUREG/CR-5884, Volume 2, "Revised Analyses of Decommissioning for the Reference Pressurized Water Reactor Power Station," November, 1995

4.7.5 U.S. Nuclear Regulatory Commission, NUREG/CR-5884, Volume 1, "Revised Analyses of Decommissioning for the Reference Pressurized Water Reactor Power Station," November, 1995

4.7.6 "License Termination Plan," submitted by Maine Yankee Atomic Power Company, Revision 3, October 15, 2002

4.7.7 U.S. Nuclear Regulatory Commission, NUREG-1530, "Reassessment of NRC's Dollar per Person-Rem Conversion Factor Policy," December 1995

4.7.8 U.S. Nuclear Regulatory Commission, NUREG–1496, Volume 1, Final Report, "Final Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities," July 1997

4.7.9 U.S. Nuclear Regulatory Commission, NUREG/BR–0058, Revision 4, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," September 2004

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5.0 FINAL STATUS SURVEY PLAN

5.1 Introduction to the Final Status Survey Plan

The Fermi 1 (EF1) Final Status Survey (FSS) Plan has been prepared using the applicable regulatory and industry guidance. This plan will be used to develop work instructions to perform the FSS of the EF1 site.

5.1.1 Purpose

The FSS Plan describes the final survey process used to demonstrate that the EF1 facility and site comply with radiological criteria for unrestricted use specified in 10 CFR 20.1402, i.e., annual dose limit of 25 millirem as well as ensure dose will be As Low As Reasonably Achievable (ALARA) for all dose pathways. Nuclear Regulatory Commission (NRC) regulations applicable to radiation surveys are found in 10 CFR 50.82(a)(9)(ii)(D), 10CFR 50.82(11)(ii) and 10 CFR 20.1501(a) and (b).

5.1.2 Scope

Detroit Edison Company (DECo) intends to release the EF1 site land and structures now covered under the 10 CFR Part 50 license. The EF1 license will be terminated with the buildings remaining. Fermi 1 is located on the same site as Fermi 2, within the same owner controlled area and outside the Fermi 2 protected area. This FSS Plan addresses only structures and land areas that are identified as contaminated or potentially contaminated resulting from activities associated with EF1 plant operation or EF1 decommissioning activities. Figure 5-1 depicts a cutaway of the EF1 site.

5.1.3 Final Status Survey Preparation and Implementation Overview

The FSS Plan contained in this chapter will be used as the basis for developing FSS procedures and applying existing procedures to the FSS process. Section 5.1.4 contains a list of regulatory documents used in preparing the FSS Plan. Figure 5-2 provides an overview of the FSS process. Quality Assurance requirements are outlined in Section 5.8 and apply to activities associated with decommissioning and FSS. A FSS Package will be produced for each survey unit; the survey package is a collection of documentation detailing survey design, survey implementation and data evaluation for the FSS. The sections below describe specific elements of the organization, preparation and implementation of the EF1 FSS. All processes associated with final status surveys will be conducted in accordance with approved site procedures.

5.1.3.1 FSS Organization

The general FSS organization will consist of the Fermi 1 Health Physicist, the License Termination Manager, FSS Engineer and technicians. Since the License Termination organization has not been fully implemented at the time of LTP development, it is expected that specific job titles may vary over the period of project execution. These titles are used within this document to describe various functional areas of responsibility. Refer to Section 5.8.1.1 which outlines the basic responsibilities and functions of the FSS organization.

5.1.3.2 Survey Preparation

Survey preparation is the first step in the final status survey process and occurs after any necessary remediation has been completed. In areas where remediation is required, a remediation survey or equivalent evaluation will be performed to confirm that remediation was successful prior to initiating FSS activities. Remediation surveys, turnover surveys, or equivalent evaluation, for areas not requiring remediation, may be performed using the same process and controls as FSS so that data from these surveys may be used as part of the FSS data. In order for survey data to be used for FSS, it will be designed and collected in compliance with approved procedures and in accordance with Sections 5.3 through 5.5. Additionally the area will be controlled in accordance and implemented via approved procedures. Any surveys performed prior to the approval of the LTP are understood to have been performed "at risk". Survey design and the data collected will be carefully evaluated to ensure the intent of the LTP and associated procedures were met before using the data. Following turnover/remediation surveys (if required) or post-remediation evaluation, the FSS is performed. Areas to be surveyed are isolated and/or controlled to ensure that radioactive material is not reintroduced into the area from ongoing activities nearby and to maintain the "as left" condition of the area. Section 5.2 addresses specific survey preparation requirements and considerations. All tools and equipment that would impede the survey must be removed, the area must be free of obstructions to the survey, and the area is in a condition that will allow FSS activities.

NOTE: Areas outside of the Controlled Area may contain tools and equipment provided those items remaining (prior to FSS) contain no radioactive material, were not utilized during the remediation process, the safety of survey personnel is not jeopardized and do not impede the performance of the Final Status Survey.

Routine access, material storage, and worker transit through the area are not allowed, unless authorized by the License Termination Manager, or designee. An inspection of the area is conducted by FSS personnel to ensure that work is complete and the area is ready for final status survey. Approved procedures provide isolation and control measures until the area is released for unrestricted use.

5.1.3.3 Survey Design

The survey design process establishes the methods and performance criteria used to conduct the survey. Survey design assumptions are documented in Survey Packages in accordance with approved procedures. The site land, structures, and systems (embedded and buried piping/conduit are the principal potentially contaminated systems that will remain after decommissioning) are organized into survey areas and classified by contamination potential as Class 1, Class 2, Class 3, or non-impacted in accordance with Section 5.2.2. See Chapter 2 for illustrative representations of the EF1 survey areas. Survey unit size is based on the assumptions in the dose assessment models in accordance with the guidance provided in NUREG-1757, Volume 2, "Consolidated NMSS Decommissioning Guidance - Characterization, Survey, and Determination of Radiological Criteria, Final Report". The percent coverage for scan surveys is determined in accordance with Section 5.3.2. The number and location of structure surface measurements (and structure volumetric samples, if required) and soil samples are established in accordance with Sections 5.3.3 and 5.3.5. Investigation levels are also established in accordance with Section 5.3.6. A survey map is prepared for each survey unit and a reference grid is superimposed on the map to allow use of an (x, y) coordinate system. Random numbers between 0 and 1 are generated, which are then multiplied by the maximum x and y axis values of the sample grid. This provides coordinates for each random sample location, or a random start location for a systematic grid, as appropriate. Grid points may be automatically designated on the map, with grid locations, if generated, using Visual Sample Plan (VSP) software. The measurement/sample locations are plotted on the map. Each measurement/sample location is assigned a unique identification code, which identifies the measurement/sample by survey area, survey unit, and sequential number. The appropriate instruments and detectors, instrument operating modes and survey methods used to collect and analyze data are also specified. Replicate measurements are performed as part of the quality process established to identify, assess, and control errors and uncertainty associated with sampling, survey, or analytical activities. This quality control process, described in Section 5.8.1, provides assurance that the survey data meets the accuracy and reliability requirements necessary to support the decision to release or not release a survey unit. Written survey instructions that incorporate the requirements set forth in the survey design and direction are provided, as applicable to survey design, for selection of instruments, count times, instrument modes, survey methods, required documentation, investigation set points, investigative actions, background requirements and other appropriate instructions. In conjunction with the survey instructions, survey data forms may be prepared to assist in survey documentation as well as utilizing the data-logging capabilities of the instruments. The survey design is reviewed and quality verification steps applied to ensure that appropriate instruments, survey methods and sample locations have been properly identified. A two-tiered review process will be used with a review by a peer Engineer and a review and approval by the License Termination Manager, or designee.

5.1.3.4 Survey Data Collection

After preparation of a survey package, the FSS data are collected. Trained and qualified personnel will perform the necessary measurements using calibrated instruments in accordance with approved procedures and instructions contained in the survey package. Section 5.5 addresses FSS data collection requirements. Survey areas and/or locations are identified by gridding, markings, or flags as appropriate. A FSS Supervisor, or qualified designee, performs a pre-survey briefing with the survey technicians during which the survey instructions are reviewed and additional survey unit considerations are discussed (e.g., safety). The technicians gather instruments and equipment as indicated and perform surveys in accordance with the appropriate procedures and survey package specifications. Technicians are responsible for documenting survey results and maintaining custody of samples and instrumentation. At the completion of surveys, technicians return instruments and prepare samples for analysis. Survey instruments provided to the technicians are prepared in accordance with approved site procedures and the survey instructions. Instrument calibration, except for onsite lab instrumentation, is performed by an off-site vendor and performance checks are conducted in accordance with applicable site procedures. Data are reviewed to flag any measurements that exceed investigation criteria so that appropriate investigation surveys and remediation can be planned and performed as necessary.

If a survey unit has been selected to receive a Quality Control (QC) survey (replicate surveys, etc.), a QC survey package is developed and implemented. QC measurement results are compared to the original measurement results. If QC results do not reach the same conclusion as the original survey, an investigation is then performed. Section 5.8 provides additional detail regarding QC survey requirements.

5.1.3.5 Data-Assessment

Survey data assessment is performed to verify that the data are sufficient to demonstrate that the survey unit meets the unrestricted use criterion. Statistical analyses are performed on the data and compared to predetermined investigation levels (see Section 5.3.6). Depending on the results of the data assessment and any required investigation, the survey unit may either be released or require further remediation, reclassification, and/or resurvey. Assumptions and requirements in the survey package are reviewed for applicability and completeness; additional data needs are identified during this review. Specific data assessment requirements are contained in Section 5.6. A review is performed of survey data and sample counting reports to verify completeness, legibility and compliance with survey design and associated instructions. As directed by FSS supervision, the following types of activities may be performed:

- Convert data to reporting units,
- Calculate mean, median and range of the data set,
- Review the data for values that vary more than three standard deviations from the data mean,
- Calculate the standard deviation of the data set,
- Calculate Minimum Detectable Concentration (MDC) for each survey type performed,
  and
- Create posting, frequency and quartile plots for visual interpretation of data.

Computer programs may be utilized for these activities provided that they have been verified and validated. FSS personnel include data quality verifications in their evaluations of statistical calculations. Integrity and usefulness of the data set and the need for further data or investigation are also included in the evaluations. The License Termination Manager will review the data for statistical evaluation. The results of the data evaluation are documented and filed in the survey package.

5.1.3.6 Final Status Survey Package Completion

Survey results are documented by survey unit in corresponding survey packages. The data are reviewed, analyzed, and processed and the results documented in the FSS Package. This documentation file provides a record of the information necessary to support the decision to release the survey units for unrestricted use. The FSS Reports will be prepared to provide the necessary data and analyses from FSS packages for submittal to the NRC. Section 5.7 addresses reporting of survey results and conclusions.

5.1.4 Regulatory Requirements and Industry Guidance

This FSS Plan has been developed using the guidance contained in the following documents:

- NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),"

- NUREG-1505, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys,"
- NUREG-1507, "Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions,"
- NUREG-1700, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans," [Reference 5-5]"',
- NUREG-1757, Vol. 2, "Consolidated NMSS Decommissioning Guidance Characterization, Survey, and Determination of Radiological Criteria, Final Report,"

and

- Regulatory Guide 1.179, "Standard Format and Content of License Termination Plans for Nuclear Power Reactors," (January 1999)

Other documents used in the preparation of this plan are listed in the References section (see Section 5.9). DECo anticipates the NRC may choose to conduct confirmatory measurements during EF1 FSS activities. The NRC may take confirmatory measurements to make a determination the FSS and associated documentation demonstrate that the site is suitable for release in accordance with the criteria established in 10 CFR Part 20 subpart E.

5.2 Development of Survey Plan

5.2.1 Radiological Status

The following sections provide a summary of site characterization and dose modeling results applicable to development of the EF1 FSS Plan.

5.2.1.1 Identification of Radiological Contaminants

A site-specific suite of radionuclides potentially present at EF1 has been developed. This suite contains 25 radionuclides that are potentially present in EF1 environs, structures and systems/components. Development of this site-specific suite of radionuclides is described in the LTP Chapter 6, Compliance with the Radiological Criteria for License Termination, Section 6.4. DECo has conducted radiological characterization of the site property to identify and document residual contamination resulting from nuclear plant operation. The effort included reviews of historical information as well as physical measurements of onsite soils, structures, and systems during scoping and characterization surveys. The LTP Chapter 2, Site Characterization, contains a detailed discussion of this effort.

5.2.1.2 Dose Modeling Summary

Dose models allow the translation of residual radioactivity levels into potential radiation doses to the public. For the EF1 site, dose models have been developed based on the guidance found in NUREG/CR-5512, Volumes 1, 2, and 3. The conceptual model reflects the anticipated site conditions at the time of unrestricted release. The dose modeling approach for the EF1 site is consistent with the information for site-specific modeling provided in Appendix I of NUREG-1757, including source term abstraction and scenarios, pathways, and critical groups.

There are three defining factors for a dose model: 1) the scenario, 2) the critical group and 3) the exposure pathways. The scenarios described in NUREG/CR-5512 Volume 1, address the major exposure pathways of direct exposure to penetrating radiation and inhalation and ingestion of radioactive materials. The scenarios also identify the critical group, which is defined as the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity within the assumptions of a particular scenario. The design for scenarios and the site-specific modeling provide reasonable and conservative estimates of the potential doses associated with residual radioactivity.

The dose models supporting the building surface and soil Derived Concentration Guideline Levels (DCGLs) were developed using the approach outlined above. The scenarios described in NUREG/CR-5512 Volume 1, were selected for the EF1 site to estimate potential radiation doses from radioactive material in buildings (building occupancy scenario) and soil (resident farmer scenario).

Table 5-1 provides a list of significant radionuclides that may be present in onsite soils and on structural surfaces along with their corresponding single nuclide DCGL values derived in LTP Chapter 6.

Table 5-1 DCGLs by Radionuclide and Medium Type

Radionuclide	Building Surface* (dpm/100cm^2)	Soil* (pCi/g)
Ag-108m	1.8E+04	7.8E+00
Am-241	5.0E+03	1.3E+02
C-14	1.0E+07	4.5E+02
Cm-242	3.1E+05	7.7E+03
Cm-243	7.2E+03	7.8E+01
Co-60	1.1E+04	5.1E+00
Cs-134	1.7E+04	8.3E+00
Cs-137	3.9E+04	1.7E+01
Eu-152	2.2E+04	1.1E+01
Eu-154	2.0E+04	1.1E+01
Eu-155	3.6E+05	4.0E+02
Fe-55	4.1E+07	3.4E+04
H-3	2.9E+08	3.1E+04
Na-22	1.3E+04	6.2E+00
Nb-94	1.5E+04	1.2E+02
Ni-59	6.0E+05	1.1E+04
Ni-63	3.6E+07	4.0E+03
Pu-238	5.7E+03	1.6E+02
Pu-239	5.0E+03	1.4E+02
Pu-240	5.0E+03	1.4E+02
Pu241	2.7E+05	5.2E+03
Sb-125	5.9E+04	3.4E+01
Sr-90	1.4E+05	1.2E+01
Tc-99	1.4E+07	1.2E+02

* DCGL values correspond to an annual dose of 25 mrem.

5.2.1.3 Surrogate Ratio DCGLs

As a general rule, surrogate ratio DCGLs are developed and applied to land areas and materials with volumetric residual radioactivity where fairly constant radionuclide concentration ratios can be demonstrated to exist. They are derived using pre-remediation site characterization data collected prior to the FSS. The established ratio among the radionuclide concentrations allows the concentration of every radionuclide to be expressed in terms of any one of them. Likewise, a surrogate ratio DCGL allows the DCGLs specific to Hard-to-Detect (HTD) radionuclides in a mixture to be expressed in terms of a single radionuclide that is more readily measurable. The measured radionuclide is called the surrogate radionuclide. Cs-137 is expected to be the surrogate radionuclide for EF1. A sufficient number of measurements, representative of the area of interest, are taken to establish a consistent ratio of radionuclide concentrations. The number of measurements needed to determine the ratio is based on the chemical, physical and radiological characteristics of the radionuclides and the site. Measurements from different media types will not be mixed to derive the ratio. The surrogate ratio is acceptable if the mean values for individual samples for a given media are within two standard deviations of the overall mean value for the media. Once an appropriate surrogate ratio is determined, the DCGL of the measured radionuclide is modified to account for the represented radionuclide according to the following Equation 5-1 (MARSSIM Equation 4-1):

$$DCGL_{SR} = DCGL_{Sur} \times \frac{DCGL_{Rep}}{[(C_{Rep}/C_{Sur})(DCGL_{Sur})] + DCGL_{Rep}}$$

Equation 5-1

where:

$DCGL_{SR}$ = modified DCGL for surrogate ratio,

$DCGL_{Sur}$ = DCGL for surrogate radionuclide,

$DCGL_{Rep}$ = DCGL for represented radionuclide,

C_{Rep} = Concentration of represented radionuclide, and

C_{Sur} = Concentration of surrogate radionuclide.

When a surrogate ratio is established using data collected prior to remediation, post-remediation or FSS measurements will be reviewed to ensure that the established ratios are still appropriate. The surrogate ratio DCGL will be evaluated using the EF1 DQOs and modified, if necessary. Professional judgment is used to determine consistency.

5.2.1.4 Gross Activity DCGLs

As a rule, gross activity DCGLs are developed and applied to structures and plant systems with surface residual radioactivity where multiple radionuclides are present at concentrations that exceed 10 percent of their respective DCGLs. The gross activity DCGL is determined in a manner similar to surrogate DCGLs taking into account nuclide detectability to enable field measurement of gross activity, rather than the determination of individual radionuclide activity, for comparison to the radionuclide specific DCGL. The gross activity DCGL, or $DCGL_{GA}$, for surfaces with multiple radionuclides is calculated using the following Equation 5-2 (MARSSIM, Equation 4-4):

$$DCGL_{GA} = \frac{1}{\frac{f_1}{DCGL_1} + \frac{f_2}{DCGL_2} + \cdots \frac{f_n}{DCGL_n}}$$

Equation 5-2

where:

f_n= fraction of the total activity contributed by radionuclide n, and

$DCGL_n$ = DCGL for radionuclide n.

Different radionuclides or radionuclide combinations may exist on different portions of the site and require the calculation of one or more site-specific gross activity DCGLs. Gross activity DCGLs are calculated using the relative nuclide fractions determined from samples of building surface or plant system material, as appropriate, prior to remediation. For areas where the radionuclide distribution has not been determined, the most conservative distribution resulting in the lowest DCGL of those specified areas will be used. The distributions are based on the radionuclides identified in samples collected from the specific areas prior to FSS. If new radionuclide distribution data are obtained and determined to be more appropriate for use, the $DCGL_{GA}$ may be re-evaluated and altered during the course of the FSS, however the single nuclide DCGLs will not be revised without NRC approval.

5.2.2 Classification of Areas

Prior to beginning the final status survey, a characterization of the radiological status and historical review of the site was performed. Additional data may be collected and evaluated throughout the decommissioning. The methods and results from site characterization are described in Chapter 2 of this LTP. Based on the characterization results, the structures and open land areas were classified following the guidance in Appendix A, of NUREG-1757, Volume 2 and Section 4.4 of NUREG 1575. Area classification ensures that the number of measurements and the scan coverage is commensurate with the potential for residual contamination to exceed the unrestricted use criteria.

Initial classification of site areas is based on historical information and site scoping and characterization data. Data from operational surveys performed in support of decommissioning, routine surveillance or any other applicable survey data may be used to change the initial classification of an area up to the time of commencement of the final status survey as long as the classification reflects the levels of residual radioactivity that existed prior to remediation. Once the FSS of a given survey unit begins, the basis for any reclassification will be documented, requiring a redesign of the survey unit package and the initiation of a new survey using the redesigned survey unit package. If during the conduct of a FSS, sufficient evidence is accumulated to warrant an investigation and reclassification of the survey unit, the FSS may be terminated without completing the survey unit package.

5.2.2.1 Non-Impacted Areas

Non-impacted areas have no reasonable potential for residual contamination because there was no demonstrable impact from site operations. These areas are not required to be surveyed beyond what has already been completed as a part of the Historical Site Assessment (HSA) as described in the LTP Chapter 2, or scoping/site characterization surveys performed to confirm the area's non-impacted classification. The EF1 ancillary systems have been classified as non-impacted.

5.2.2.2 Impacted Areas

Impacted areas may contain residual radioactivity from licensed activities. Based on the levels of residual radioactivity present, impacted areas are further divided into Class 1, Class 2 or Class 3 designations. The definitions provided below are from NUREG-1757, Volume 2, Page A2.

- Class 1 Areas: Class 1 areas are impacted areas that are expected to have concentrations of residual radioactivity that exceed the $DCGL_W$[1],
- Class 2 Areas: Class 2 areas are impacted areas that are not likely to have concentrations of residual radioactivity that exceed the $DCGL_W$, and
- Class 3 Areas: Class 3 areas are impacted areas that have a low probability of containing residual radioactivity.

If the available information is not sufficient to designate an area as a particular class, the area will either be classified as Class 1 or be further characterized. Areas that are considered to be on the borderline between classes will receive the more restrictive classification.

[1]The *W* in $DCGL_W$ refers to the Wilcoxon Rank Sum test per MARSSIM (NUREG-1575, page 2-3) and generally represents the uniform level of residual contamination that results in the dose limit, regardless of the statistical test used. EF1 intends to use the Sign Test for most survey areas and will still use the term $DCGL_W$ to denote contamination limits, see Section 5.6.1.3.

5.2.2.3 Initial Classification of Structural Surfaces and Land Areas

Based on more than 1332 measurements made during the site characterization and the information evaluated as part of the HSA, all land areas and structural surfaces, to remain after decommissioning were assigned an initial classification. Characterization was performed and reported by initial survey area designation. The area designations developed for the characterization process were used, for the most part, to delineate and classify areas for final status survey. This allows characterization data to be efficiently used for final survey area classification and for estimating the sigma value for sample size determination. For operational efficiency, each of the final survey areas listed in Table 5-2 may be subdivided into multiple survey units. The classification of all subdivided survey units will be the same as indicated in Table 5-2, unless reclassified in accordance with this LTP. No individual survey unit will have more than one classification. Areas, such as the Reactor Building Basement and Sodium Building cold trap room will require further characterization once the large components are removed from these areas to support FSS package development. These areas are classified as Class 1 areas and will remain Class 1 areas. Chapter 2 provides the data for the information contained within Table 5-2.

Table 5-2 Survey Area Summary

Survey Area Designator	Name/Building	Total Area Footprint (Square Meters)	Classification	σ	Mean
OOL	Open Land Area	7478	Class 3	0.13 pCi/g	0.16 pCi/g
SGB	Steam Generator Building	1527	Class 3	222 dpm/100cm^2	1472 dpm/100cm^2
CTB	Control Building	2075	Class 3	184 dpm/100cm^2	1164 dpm/100cm^2
TBN	Turbine Building	6235	Class 3 and Class 2	218 dpm/100cm^2	1522 dpm/100cm^2
OFB	Office Building	1170	Class 3	299 dpm/100cm^2	1101 dpm/100cm^2
NOL	Open Land Area (Controlled Area)	2392	Class 2	0.08 pCi/g	0.06 pCi/g
RXB	Reactor Building	757	Class 1, Class 2 and Class 3	770 dpm/100cm^2 89 dpm/100cm^2 363 dpm/100cm^2	1150 dpm/100cm^2 820 dpm/100cm^2 928 dpm/100cm^2
FRB	Fuel and Repair Building	2746	Class 1 and Class 2	1078 dpm/100cm^2 905 dpm/100cm^2	2157 dpm/100cm^2 1999 dpm/100cm^2
TRW	Trestle way	545	Class 1 and Class 2	532 dpm/100cm^2	1816 dpm/100cm^2
NAB	Sodium Building	1116	Class 1 and Class 2	*340 dpm/100cm^2	*1576 dpm/100cm^2
VNB	Ventilation Building	175	Class 1 and Class 2	203 dpm/100cm^2	1366 dpm/100cm^2
NAT	Sodium Tunnel	50	Class 2	1320 dpm/100cm^2	3030 dpm/100cm^2
ESG	East Sodium Gallery (including FPD Bldg)	98	Class 2	179 dpm/100cm^2	1161 dpm/100cm^2
WSG	West Sodium Gallery	67	Class 2	102 dpm/100cm^2	1146 dpm/100cm^2
WGB	Waste Gas Building	303	Class 2	185 dpm/100cm^2	1385 dpm/100cm^2
IGB	Inert Gas Building	466	Class 2	220 dpm/100cm^2	1324 dpm/100cm^2

* Characterization of the cold trap room will be performed once equipment has been removed. This area is classified as a Class 1 area and will remain a Class 1 area.

5.2.2.4 Changes in Classification

Initial classification of site areas is based on historical information, scoping surveys and site characterization data. Data from operational surveys performed in support of decommissioning, routine surveillance and any other applicable survey data may be used to change the initial classification of an area up to the time of commencement of the FSS as long as the classification reflects the levels of residual radioactivity that existed prior to remediation. Units within initial survey areas may be upgraded in classification due to future requirements for lay down and storage areas during demolition activities or incorrect initial classification. If during FSS, sufficient evidence is accumulated to warrant an investigation and reclassification of the survey unit in accordance with Section 5.3.6, the survey may be terminated without completing the current survey unit package.

5.2.3 Establishing Survey Units

The survey units contained within the survey areas are divisions that have similar characteristics and contamination levels. Survey units are assigned only one classification. The site is surveyed and evaluated on a survey unit basis. The site is released on a survey area basis (i.e. through survey area FSS reports).

5.2.3.1 Survey Unit Size

Survey unit sizes will be selected based on area classification, survey execution logistics, and applicable regulatory guidance documents. Typical survey unit sizes for structural surfaces and open land area soil are listed below in Table 5-3. Survey unit sizes are consistent with NUREG-1575. Class 1 and 2 areas provided in Table 5-2 may be further subdivided into smaller areas to meet the guidelines present in Table 5-3. If survey unit areas larger than the sizes in Table 5-3 are used, a technical evaluation will be presented in the FSS Package for the specific survey unit justifying the survey unit size. Due to the relatively small size of EF1 there will be occasions where the survey unit will be smaller than the suggested size for the classification (e.g. the West Sodium Gallery) in which case the number of data points may be unnecessarily large for the survey unit. It would be appropriate to survey these areas using the MARSSIM protocol and would not require notification to the NRC; however if any alternative survey design (i.e. design based on judgment) is desired, prior approval by the NRC is required.

Table 5-3 Suggested Survey Unit Sizes

Class	Structural Surfaces*	Open Land Area Soil
1	100 m^2	2000 m^2
2	100 m^2 to 1000 m^2	2000 m^2 to 10,000 m^2
3	No limit	No limit

* Based on floor area

5.2.3.2 Reference Coordinate System for Open Land Areas (Reference Grid)

A reference coordinate system is used for impacted areas to facilitate the identification of sample points within the survey unit. The reference coordinate system is basically an X-Y plot of the site area referenced to a fixed structure(s) on the site (e.g. the corner of a building). Once the reference points are established, sample points will be determined by measurement from these reference points.

5.2.4 Access Control Measures

5.2.4.1 Turnover

Due to the scope of decommissioning activities, it is anticipated that some surveys will be performed in parallel with dismantlement activities. This will require a systematic approach to turnover of areas be established. Prior to acceptance of a survey unit for FSS, the following conditions must be satisfied in accordance with applicable procedures. These include:

a) Decommissioning activities having the potential to contaminate a survey unit shall be complete or measures taken to eliminate such potential.

b) Tools and equipment that would impede the FSS of the survey must be removed, and housekeeping and cleanup shall be complete.

c) Decontamination activities in the area shall be complete.

d) Access control or other measures to prevent recontamination must be implemented.

e) Turnover or remediation surveys may be performed and documented to the same standards as final status surveys so that data can be used for the FSS.

5.2.4.2 Walkdown

The principal objective of the walkdown is to assess the physical scope of the survey unit. The walkdown ensures that the area has been left in the necessary configuration for FSS or that any further work has been identified. The walkdown provides detailed physical information for survey design. Details such as structural interferences or areas requiring special survey techniques can be determined. Specific requirements will be identified for accessing the survey area and obtaining support functions necessary to conduct final status surveys, such as interference removal, dewatering, etc. Industrial safety and environmental concerns will also be identified during this walkdown.

5.2.4.3 Transfer of Control

Once a walkdown has been performed and the turnover requirements have been met, access control to the area is transferred from the EF1 RP Department to the License Termination group. Access control and isolation methods are described in the subsection below.

5.2.4.4 Isolation and Control Measures

Since all decommissioning activities will not be completed prior to the start of the FSS, measures will be implemented to protect survey units from contamination during and subsequent to the FSS. Decommissioning activities creating a potential for the spread of contamination will be completed within each survey unit prior to the FSS. Additionally, decommissioning activities that create a potential for the spread of contamination to adjacent areas will be evaluated and controlled. Upon commencement of the FSS for survey units where there is a potential for re-contamination, implementation of a combination of the following control measures will be required as needed for appropriate area control:

- Personnel training,
- Installation of barriers to control access to surveyed areas,
- Installation of barriers to prevent the migration of contamination from adjacent or overhead areas from water runoff, etc.,
- Installation of postings requiring contamination monitoring prior to surveyed area access,
- Locking entrances to surveyed areas of the facility,
- Installation of tamper-evident devices at entrance points, or
- Periodic surveillance/inspection to monitor and verify adequacy of isolation and control measures.
- Installation of postings restricting the introduction of radioactive materials into the area.

Periodic surveillances/inspections will not be required for open land areas that are not normally occupied and are unlikely to be impacted by decommissioning activities. If the periodic surveillance/inspection indicates that the adequacy of isolation and control measures has been compromised with the potential for recontamination of the area, post-FSS radiation survey locations will be selectively determined for survey, based on technical or site-specific knowledge and current conditions present in or near the survey area. The selected locations will be surveyed using the same instruments and techniques used for the FSS and the results will be compared with those obtained during the FSS to determine whether the area had been re-contaminated. The primary function of these surveys is to detect the potential migration of contaminants from decommissioning activities taking place in adjacent areas.

5.3 Survey Design and Data Quality Objectives

This section describes the methods and data required to determine the number and location of measurements or samples in each survey unit and the coverage fraction for scan surveys. The design activities described in this section will be documented in a survey package for each survey unit. Survey design considers the following:

- Type I and II Errors,
- Scan Survey Coverage,
- Sample Size Determination,
- Instrumentation and Required MDCs,
- Sample Location, and
- DCGL and $DCGL_{EMC}$. ($DCGL_{EMC}$ is defined in Section 5.3.6.3)

5.3.1 Data Quality Objectives (DQOs)

The appropriate design for a given survey area is developed using the DQO process as outlined in MARSSIM, Appendix D. These seven steps are:

1) State the problem,
2) Identify the decision,
3) Identify inputs to the decision,
4) Define the study boundaries,
5) Develop a decision rule,
6) Specify limits on decision errors, and
7) Optimize the design for obtaining data.

The DQO process will be used for designing and conducting all final status surveys at EF1. Each survey package will contain the appropriate information, statistical parameters and contingencies to support the DQO process.

5.3.2 Scan Survey Coverage

The area covered by scan measurement is based on the survey unit classification as described in NUREG-1757 and as shown in Table 5-4 below. 100% accessible area scan of Class 1 survey units will be required. The emphasis will be placed on scanning the higher risk areas of Class 2 survey units such as soils, floors and lower walls. Scanning percentage of Class 3 survey units will be performed on likely areas of contamination based on the judgment of the FSS engineer.

Table 5-4 Scanning Requirements

	Class 1	Class2	Class 3
Scan Coverage	100%	10 – 100%*	Judgmental (1 – 10%)

* For Class 2 Survey Units, the amount of scan coverage will be proportional to the potential for finding areas of elevated activity or areas close to the release criterion in accordance with MARSSIM Section 5.5.3. Accordingly, EF1 will use historical information and the results of individual measurements collected during characterization to correlate this activity potential to scan coverage levels.

5.3.3 Sample Size Determination

NUREG-1757, Volume 2, Appendix A describes the process for determining the number of survey measurements necessary to ensure a data set sufficient for statistical analysis. Sample size is based on the relative shift, the Type I and II errors, standard deviation, and the specific statistical test used to evaluate the data.

5.3.3.1 Determining Which Statistical Test Will Be Used

Appropriate tests will be used for the statistical evaluation of survey data. Tests such as the Sign test and Wilcoxon Rank Sum (WRS) test will be implemented using unity rules, surrogate methodologies, or combinations of unity rules and surrogate methodologies, as applicable, as described in MARSSIM and NUREG-1505 chapters 11 and 12. If the contaminant is not in the background or constitutes a small fraction of the DCGL, such as the case for much of EF1, the Sign test will be used. If background is a significant fraction of the DCGL, the WRS test will be used.

5.3.3.2 Establishing Decision Errors

The probability of making decision errors is controlled by hypothesis testing. The survey results will be used to select between one condition of the environment (the null hypothesis) or an alternate condition (the alternative hypothesis). These hypotheses, chosen for MARSSIM Scenario A, are defined as follows:

Null Hypothesis (H_0): The survey unit does not meet the release criteria.
Alternate Hypothesis (H_a): The survey unit does meet the release criteria.

EF1 will use the Null Hypothesis concept in the design of all Final Status Surveys.

A Type I decision error would result in the release of a survey unit containing average residual radioactivity above the release criteria. The Type I decision error occurs when the Null Hypothesis is rejected when it is true. The probability of making this error is designated as "α". A Type II decision error would result in the failure to release a survey unit when the average residual radioactivity is below the release criteria. This occurs when the Null Hypothesis is accepted when it is not true. The probability of making this error is designated as "β". Appendix E of NUREG-1757, Volume 2 recommends using a Type I error probability (α) of 0.05 and states that any value for the Type II error probability (β) is acceptable. Following the NUREG-1757, Volume 2 guidance, α will be set at 0.05. A β of 0.05 will be selected initially, based on site specific considerations. The β may be modified, as necessary, after weighing the resulting change in the number of required survey measurements against the risk of unnecessarily investigating and/or remediating survey units that are truly below the release criteria.

5.3.3.3 Relative Shift

The relative shift (Δ / σ) is calculated. Delta (Δ) is equal to the $DCGL_W$ minus the Lower Boundary of the Gray Region (LBGR). Calculation of sigma (σ) is discussed in Section 5.3.3.3.2 and initial values are provided in Table 5-2. The sigma values used for the relative shift calculation may be recalculated based on the most current data obtained from post-remediation or post-demolition surveys or from background reference areas, as appropriate. The LBGR is initially set at 0.5 times the $DCGL_W$, but may be adjusted to obtain an optimal value, normally between 1 and 3 for the relative shift.

5.3.3.3.1 Lower Boundary of the Gray Region

The LBGR is the point at which the Type II (β) error applies. The default value of the LBGR is set initially at 0.5 times the DCGL. If the relative shift is greater than 3, then the number of data points, N, listed for the relative shift values of 3 from Table 5-5 or Table 5-3 in MARSSIM will normally be used as the minimum sample size. If the minimum sample size results in a sample density less than the required minimum density (see Section 5.3.3) the sample size will be increased accordingly.

5.3.3.3.2 Standard Deviation (Sigma)

Sigma values (estimate of the standard deviation of the measured values in a survey unit and/or reference area) were initially calculated from characterization data. These sigma values can be used in FSS design or more current post-remediation sigma values can be used. The use of the sigma values from the characterization data will be conservative for the sample size determination since the post-remediation sigma values are expected to be smaller. The sigma values for survey areas listed in Table 5-2 which contain survey areas with two different classifications (upper walls and ceiling being a Class lower than lower walls and floor of the same room), will be evaluated to ensure that the sigma conservatively represents the contaminant distribution of each associated survey unit; otherwise a specific sigma value will be developed.

5.3.3.3.3 Wilcoxon Rank Sum (WRS) Test Sample Size

The number of data points, N, to be obtained from each reference area or survey unit are determined using Table 5-3 in MARSSIM. This table includes the recommended 20% adjustment to ensure an adequate sample size.

5.3.3.3.4 Sign Test Sample Size

The number of data points is determined from Table 5-5 in MARSSIM for application of the Sign Test. This table includes the recommended 20% adjustment to ensure an adequate sample size.

5.3.3.3.5 Elevated Measurement Comparison Sample Size Adjustment

If the scan MDC is greater than the $DCGL_W$, the sample size will be calculated using Equation 5-3 (NUREG-1757 Equation A-8) provided below. If N_{EMC} exceeds the statistically determined sample size *(N)*, N_{EMC} will replace *N*.

$$N_{EMC} = \frac{A}{A_{EMC}}$$

Equation 5-3

where:

N_{EMC} = the elevated measurement comparison sample size,
A = the survey unit area, and
A_{EMC} = the area corresponding to the area factor calculated using the MDC concentration.

5.3.4 Background Reference Area

Background reference area measurements are required when the WRS test is used, and background subtraction may be used with the Sign Test, under certain conditions such as those described in Chapter 12 of NUREG-1505. Reference area measurements, if needed, will be collected using the methods and procedures required for Class 3 final survey units. For soil, reference areas will have a soil type as similar to the soil type in the survey unit as possible. When there is a reasonable choice of possible soil reference areas with similar soil types, consideration will be given to selecting reference areas that are most similar in terms of other physical, chemical, geological, and biological characteristics. For structure survey units that contain a variety of materials with markedly different backgrounds, a reference area will be selected containing similar materials. If one material is predominant, or if there is not a large variation in background among materials, a background from a reference area containing a single material is appropriate when it is demonstrated that the selected reference area will not result in underestimating the residual radioactivity in the survey unit.

It is understood that background reference areas should have physical characteristics (including soil type and rock formation) similar to the site and shall not contain areas contaminated by site activities. Off-site areas (outside the Fermi 2 Owner Controlled Area) should be chosen to serve as background reference areas.

Should significant variations in background reference areas be encountered, appropriate evaluations will be performed to define the background concentration. As noted in NUREG-1757, Appendix A, Section A.3.4, the Kruskal-Wallis test can be conducted in such circumstances to determine that there are no significant differences in the mean background concentrations among potential reference areas. EF1 will consider this and other statistical guidance in the evaluation of apparent significant variations in background reference areas.

If material background subtraction is performed, the sigma value used will account for the variability of the material background.

5.3.4.1 Ambient Radiation Levels

EF1 resides on the same site as the operating Fermi 2 unit. Consequently, EF1 experiences ambient radiation levels due mainly to the influence from Fermi 2, predominantly from the ^{16}N sky shine component. Ambient levels vary depending upon the location in EF1 to the proximity of Fermi 2. A study was performed in 2004 and the results can be found in Section 2.3.1 of this LTP. Based on the 2004 survey and the characterization survey performed, Survey Areas OOL-01 and NOL-01 were affected the most. The ambient levels associated with Fermi 2 are not associated with any structures, materials, soils, groundwater and other media present at the EF1 site (NRC 2000); therefore the ambient levels are not residual reactivity associated with the EF1 site. Since these levels of radiation are a result of Fermi 2 operation and not that of EF1 licensed radioactive material, a methodology must be employed to account for this influence during beta and gamma measurements.

For gamma measurements, there are two options available:

1. Shield the source of the ambient radiation by placing shielding material between Fermi 2 and the area being surveyed. This method would be useful for small areas of concern, such as investigations, but would be inefficient for large areas.

2. Schedule the scanning of the affected areas when Fermi 2 is shutdown.

EF1 will, whenever possible, schedule the gamma scanning of outside affected areas when Fermi 2 is shutdown. If scheduling during shutdown is not possible, shielding will be utilized to decrease the ambient effects on gamma scanning.

For beta measurements the following will apply:

When ambient levels warrant an ambient correction, a minimum of five ambient measurements will be taken in each affected room. These measurements will be taken at different locations throughout the room. The beta sensitive probe will be positioned at approximately waist high and at a minimum of 3 feet from any surface. The probe will be shielded to sufficiently attenuate the expected beta particles present on the building surface (i.e., approximately 300 mg/cm^2) resulting in the determination of the Fermi 2 gamma influence on the beta measurements. The mean of these ambient readings will then be subtracted from the direct measurement readings for that room.

5.3.5 Reference Grid and Sample Location

Sample location is a function of the number of measurements required, the survey unit classification, and the contaminant variability.

5.3.5.1 Reference Grid

The reference grid is primarily used for reference purposes and is illustrated on sample maps. Physical marking of the reference grid lines in the survey unit will be performed only when necessary. For the sample grid in Class 1 and 2 survey units, a randomly selected sample start point will be identified. Beginning at the random starting coordinate, a row of points is identified, parallel to the X axis, at intervals of L. A second row of points is then developed, parallel to the first row, at a distance of 0.866 x L from the first row. The sample and reference grids are illustrated on sample maps and may be physically marked in the field. For Class 3 survey units, all sample locations are randomly selected, based on the reference grid point(s). Global Positioning System (GPS) instruments may be used in open land areas to determine reference or sample grid locations within the survey area. Locations within a survey area may also be tied to a site USGS survey benchmark. Digital cameras may be employed to provide a record of survey locations within the survey unit and will be used extensively at EF1. When used, these photographic records will be linked to landmark and directional information to ensure reproducibility. For most of the grid development at EF1, benchmarks will be developed from permanent site structures (e.g. the corner of a building) and will be utilized to determine the location of samples/measurements.

5.3.5.2 Measurement Locations

Measurement locations within the survey unit are clearly identified and documented for purposes of reproducibility. Actual measurement locations are identified by tags, labels, flags, stakes, paint marks, geopositioning units or photographic records. An identification code matches a survey location to a particular survey unit.

Sample points for Class 1 and Class 2 survey units are positioned in a systematic pattern or grid throughout the survey unit by first randomly selecting a start point coordinate. A random number generator is used to determine the start point of the grid pattern. The grid spacing, L, is a function of the area of the survey unit as shown in Equation 5-4 (MARSSIM Equation 5-5) below for a triangular grid:

$$L = \sqrt{\frac{A}{0.866\, n_{EA}}}$$

Equation 5-4

Where:
A = Area of the survey unit
n_{EA} = Calculated number of survey locations

Beginning at the random starting coordinate, a row of points is identified, parallel to the X axis, at intervals of L. A second row of points is then developed, parallel to the first row, at a distance of 0.866 x L from the first row.

Software may be used to generate grid patterns and sample/measurement locations (i.e. Visual Sample Plan {VSP}).

Random measurement patterns are used for Class 3 survey units. Sample location coordinates (*x* and *y*) are randomly picked using a random number generator or VSP.

Measurement locations selected using either a random selection process or a randomly-started systematic pattern that do not fall within the survey unit or that cannot be surveyed due to site conditions are replaced with other measurement locations as determined by the License Termination Manager, FSS Engineer, or designee.

5.3.6 Investigation Levels and Elevated Areas Test

During survey unit measurements, levels of radioactivity may be identified that warrant investigation. Depending on the results of the investigation, the survey unit may require no action, remediation, and/or reclassification and resurvey. Investigation process and investigation levels are described below.

5.3.6.1 Investigation Process

During the survey process, locations with potential residual activity exceeding investigation levels are documented and marked for further investigation. The elevated survey measurement is verified by resurvey. For Class 1 areas, size and average activity level in the elevated area is acceptable if it complies with the area factors and other criteria that may apply to evaluation of the DCGL for elevated measurements $DCGL_{EMC}$. As discussed in Section 5.3.6.3 below, the $DCGL_{EMC}$ is applicable only for Class 1 areas. If any location within a Class 2 area exceeds the DCGL, scanning coverage in the vicinity is increased in order to determine the extent and level of the elevated reading(s) and the area is evaluated for reclassification. If the elevated reading occurs in a Class 3 area, the scanning coverage is increased and the area is evaluated for reclassification and resurvey under the criteria of the new classification. All survey unit investigations will be conducted in accordance with the applicable FSS Data Quality Objectives (DQOs).

Investigations should address:

(1) The assumptions made in the survey unit classification;
(2) The most likely or known cause of the contamination; and
(3) The effects of summing multiple areas with elevated activity within the survey unit.

Depending on the results of the investigation, a portion of the survey unit may be reclassified or combined with an adjacent area with similar characteristics if there is sufficient justification. Either action would result in resurvey of the (new) area(s). The results of the investigation process are documented in the survey package. See also Section 5.6 for additional discussion regarding potential reclassification of the survey unit.

5.3.6.2 Investigation Levels

Technicians will respond to all instrument indications of elevated activity while surveying. Upon receiving an indication, the technician will stop and resurvey the last square meter of area surveyed to verify the increase. Technicians are cautioned, in training, about the importance of the verification survey and are given specific direction in the procedure as to survey extent and scan speed. If the indication is verified, the technician will mark the area with a flag or other appropriate means. Each area marked will be addressed in an investigation survey instruction prepared for the survey unit. The instruction will specify the required actions, such as a re-scan of the area, direct measurements, and collection of a soil sample (for land surveys). Each investigation will be evaluated and reported in the survey area report. Investigation levels are shown in Table 5-5.

Table 5-5 Investigation Levels

Classification	Scan Investigation Levels	Direct Investigation Levels
Class 1	> $DCGL_{EMC}$	>$DCGL_{EMC}$ or >$DCGL_W$ and > a statistical parameter-based value
Class 2	>$DCGL_W$ or >MDC_{SCAN} if MDC_{SCAN} is greater than $DCGL_W$	>$DCGL_W$
Class 3	Detectable over Background	>0.5 $DCGL_W$

In Class 1 areas the size and average activity level in the elevated area is determined to demonstrate compliance with the area factors. If any location in a Class 2 area exceeds the DCGL, scanning coverage in the vicinity is increased in order to determine the extent and level of the elevated reading(s). If the elevated reading occurs in a Class 3 area, the scanning coverage is increased and reclassification of the area should be considered.

5.3.6.3 Elevated Measurement Comparison (EMC)

5.3.6.3.1 Open Land Areas and Structural Surfaces

The elevated measurement comparison is applied to Class 1 survey units when one or more verified scan or static measurement exceeds the investigation level. As stated in MARSSIM, the EMC is intended to flag potential failures in the remediation process and should not be considered the primary means to identify whether or not a survey unit meets the release criterion. The EMC provides assurance that unusually large measurements receive the proper attention and that any area having the potential for significant dose contribution is identified. Locations identified by scan methodology or soil sample analyses measurements with levels of residual radioactivity which exceed the $DCGL_{EMC}$ are subject to additional surveys to determine compliance with the elevated measurement criteria. The size of the area containing the elevated residual radioactivity and the average level of residual activity within the area are determined. The average level of activity is compared to the $DCGL_W$ based on the actual area of elevated activity. An *a priori* $DCGL_{EMC}$ for the area between direct measurements (the likely size of an elevated area) is established during the survey design and is calculated as follows:

$$DCGL_{EMC} = Area\ Factor \times DCGL_W$$

Equation 5-5

The area factor is the multiple of the $DCGL_W$ that is permitted in the area of elevated residual radioactivity without remediation. The area factor is related to the size of the area over which the elevated activity is distributed. The actual area is generally bordered by levels of residual radioactivity below the $DCGL_W$ and its size is determined during the investigation process. Area factor calculations are described in LTP Section 6.6 and summarized in Tables 5-6 and 5-7. (As shown in Tables 5-6 and 5-7, Co-60 and Cs-137 are the limiting detectable isotopes with the limiting area factors considering that direct exposure is the primary dose concern for structures and soil. Therefore, these area factors will typically be used to evaluate elevated measurements in soil or on surfaces). The actual area of elevated activity is determined by investigation surveys and the area factor is adjusted for the actual area of elevated activity. The product of the adjusted area factor and the $DCGL_W$ determines the *a posteriori* $DCGL_{EMC}$. Additional measurements are made to determine the average activity of the elevated area, if necessary. If the $DCGL_{EMC}$ is exceeded, the area is remediated and resurveyed. The results of the elevated area investigations in a given survey unit that are below the $DCGL_{EMC}$ limit are evaluated using Equation 5-6 below. If more than one elevated area is identified in a given survey unit, the unity rule with Equation 5-6 is used to determine compliance. If the formula value is less than unity, no further elevated area testing is required and the EMC test is satisfied.

Table 5-6 Soil Area Factors

Area (m^2)	AF value: Ag-108m	Am-241	C-14	Cm-242	Cm-243	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Eu-155	Fe-55	H-3
1	1.1E+01	3.9E+01	1.8E+04	5.1E+01	1.4E+01	1.2E+01	1.2E+01	1.2E+01	1.1E+01	1.1E+01	8.4E+00	1.6E+03	2.9E+02
2	6.2E+00	2.9E+01	8.1E+03	4.4E+01	8.4E+00	6.6E+00	6.6E+00	6.9E+00	6.4E+00	6.4E+00	5.1E+01	8.6E+02	1.3E+02
5	3.3E+00	1.9E+01	2.6E+03	3.4E+01	4.7E+00	3.5E+00	3.6E+00	3.7E+00	3.4E+00	3.5E+00	2.8E+00	3.5E+02	5.8E+01
10	2.2E+00	1.4E+01	1.1E+03	2.7E+01	3.1E+00	2.3E+00	2.4E+00	2.5E+00	2.3E+00	2.3E+00	1.9E+00	1.7E+02	3.8E+01
25	1.6E+00	1.0E+01	3.2E+02	1.8E+01	2.3E+00	1.7E+00	1.7E+00	1.8E+00	1.6E+00	1.6E+00	1.4E+00	7.1E+01	2.3E+01
50	1.3E+00	7.5E+00	1.2E+02	1.2E+01	1.9E+00	1.4E+00	1.4E+00	1.5E+00	1.3E+00	1.3E+00	1.2E+00	3.6E+01	1.6E+01
100	1.2E+00	5.4E+00	4.5E+01	7.6E+00	1.7E+00	1.2E+00	1.3E+00	1.3E+00	1.2E+00	1.2E+00	1.1E+00	1.8E+01	9.9E+00
250	1.1E+00	3.1E+00	1.2E+01	3.6E+00	1.5E+00	1.1E+00	1.1E+00	1.2E+00	1.1E+00	1.1E+00	1.1E+00	7.1E+00	4.4E+00
500	1.0E+00	1.8E+00	4.4E+00	1.9E+00	1.2E+00	1.1E+00	1.1E+00	1.1E+00	1.0E+00	1.0E+00	1.0E+00	3.6E+00	2.3E+00
1000	1.0E+00	1.0E+00	1.6E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.8E+00	1.2E+00
2000	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Area (m^2)	AF value: Mn-54	Na-22	Nb-94	Ni-59	Ni-63	Pu-238	Pu-239	Pu-240	Pu-241	Sb-125	Sr-90	Tc-99	
1	1.1E+01	1.1E+01	1.1E+01	1.4E+03	1.4E+03	6.4E+01	6.5E+01	6.5E+01	4.2E+01	1.1E+01	7.5E+02	1.0E+03	
2	6.4E+00	6.4E+00	6.3E+00	7.1E+02	7.1E+02	5.7E+01	5.7E+01	5.8E+01	3.1E+01	6.2E+00	3.9E+02	5.0E+02	
5	3.5E+00	3.5E+00	3.4E+00	2.8E+02	2.8E+02	4.5E+01	4.5E+01	4.5E+01	1.4E+01	3.3E+00	1.7E+02	2.0E+02	
10	2.3E+00	2.3E+00	2.2E+00	1.4E+02	1.4E+02	3.5E+01	3.5E+01	3.5E+01	1.5E+01	2.2E+00	8.8E+01	1.0E+02	
25	1.6E+00	1.6E+00	1.6E+00	5.7E+01	5.7E+01	2.2E+01	2.2E+01	2.2E+01	1.1E+01	1.6E+00	3.8E+01	4.1E+01	
50	1.3E+00	1.4E+00	1.3E+00	2.8E+01	2.8E+01	1.4E+01	1.4E+01	1.4E+01	8.0E+00	1.3E+00	2.0E+01	2.0E+01	
100	1.2E+00	1.2E+00	1.2E+00	1.4E+01	1.4E+01	8.3E+00	8.3E+00	8.4E+00	5.7E+00	1.2E+00	1.0E+01	1.0E+01	
250	1.1E+00	1.1E+00	1.1E+00	5.7E+00	5.7E+00	3.8E+00	3.8E+00	3.8E+00	3.2E+00	1.1E+00	4.2E+00	4.1E+00	
500	1.0E+00	1.0E+00	1.0E+00	2.8E+00	2.8E+00	2.0E+00	2.0E+01	2.0E+00	1.8E+00	1.0E+00	2.1E+00	2.0E+00	
1000	1.0E+00	1.0E+00	1.0E+00	1.4E+00	1.4E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+01	1.0E+00	1.1E+00	1.0E+00	
2000	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	

Table 5-7 Building Surfaces Area Factors

Area	AF Value:											
(m^2)	Ag-108m	Am-241	C-14	Cm-242	Cm-243	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Eu-155	Fe-55	H-3
1	1.3E+01	8.1E+01	8.1E+01	9.9E+01	5.1E+01	1.3E+01	1.3E+01	1.3E+01	1.3E+01	1.3E+01	1.3E+01	1.0E+02	1.0E+02
2	7.1E+00	4.1E+01	4.1E+01	5.0E+01	2.7E+01	7.1E+00	7.1E+00	7.2E+00	7.1E+00	7.1E+00	7.4E+00	5.0E+01	5.0E+01
3	5.2E+00	2.8E+01	2.8E+01	3.3E+01	1.9E+01	5.2E+00	5.3E+00	5.3E+00	5.2E+00	5.2E+00	5.4E+00	3.3E+01	3.3E+01
4	4.2E+00	2.1E+01	2.1E+01	2.5E+01	1.5E+01	4.3E+00	4.3E+00	4.3E+00	4.3E+00	4.3E+00	4.4E+00	2.5E+01	2.5E+01
5	3.7E+00	1.7E+01	1.7E+01	2.0E+01	1.2E+01	3.7E+00	3.7E+00	3.7E+00	3.7E+00	3.7E+00	3.8E+00	2.0E+01	2.0E+01
6	3.3E+00	1.5E+01	1.5E+01	1.7E+01	1.1E+01	3.3E+00	3.3E+00	3.3E+00	3.3E+00	3.3E+00	3.4E+00	1.7E+01	1.7E+01
8	2.8E+00	1.1E+01	1.1E+01	1.2E+01	8.4E+00	2.8E+00	2.8E+00	2.8E+00	2.8E+00	2.8E+00	2.9E+00	1.3E+01	1.2E+01
10	2.4E+00	9.0E+00	9.0E+00	9.9E+00	7.0E+00	2.4E+00	2.5E+00	2.5E+00	2.5E+00	2.4E+00	2.5E+00	1.0E+01	1.0E+01
15	2.0E+00	6.2E+00	6.1E+00	6.6E+00	5.0E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00	2.1E+00	6.7E+00	6.7E+00
25	1.6E+00	3.8E+00	3.8E+00	4.0E+00	3.3E+00	1.6E+00	1.6E+00	1.6E+00	1.6E+00	1.6E+00	1.6E+00	4.0E+00	4.0E+00
50	1.2E+00	2.0E+00	2.0E+00	2.0E+00	1.8E+00	1.2E+00	1.2E+00	1.2E+00	1.2E+00	1.2E+00	1.3E+00	2.0E+00	2.0E+00
100	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00
Area	AF Value:												
(m^2)	Mn-54	Na-22	Nb-94	Ni-59	Ni-63	Pu-238	Pu-239	Pu-240	Pu-241	Sb-125	Sr-90	Tc-99	
1	1.3E+01	1.3E+01	1.3E+01	1.0E+02	1.0E+02	9.8E+01	9.9E+01	9.8E+01	9.9E+01	1.3E+01	5.5E+01	4.8E+01	
2	7.1E+00	7.1E+00	7.1E+00	5.0E+01	5.0E+01	4.9E+01	5.0E+01	4.9E+01	4.9E+01	7.1E+00	2.9E+01	2.6E+01	
3	5.2E+00	5.2E+00	5.2E+00	3.3E+01	3.3E+01	3.3E+01	3.3E+01	3.3E+01	3.3E+01	5.2E+00	2.0E+01	1.8E+01	
4	4.3E+00	4.3E+00	4.3E+00	2.5E+01	2.5E+01	2.5E+01	2.5E+01	2.5E+01	2.5E+01	4.3E+00	1.6E+01	1.4E+01	
5	3.7E+00	3.7E+00	3.7E+00	2.0E+01	2.0E+01	2.0E+01	2.0E+01	2.0E+01	2.0E+01	3.7E+00	1.3E+01	1.2E+01	
6	3.3E+00	3.3E+00	3.4E+00	1.7E+01	1.7E+01	1.7E+01	1.7E+01	1.7E+01	1.7E+01	3.3E+00	1.1E+01	1.0E+01	
8	2.8E+00	2.8E+00	2.8E+00	1.2E+01	1.3E+01	1.2E+01	1.2E+01	1.2E+01	1.2E+01	2.8E+00	8.8E+00	8.0E+00	
10	2.4E+00	2.4E+00	2.4E+00	1.0E+01	1.0E+01	9.9E+00	1.0E+01	9.9E+00	1.0E+01	2.4E+00	7.3E+00	6.7E+00	
15	2.0E+00	2.0E+00	2.0E+00	6.7E+00	6.7E+00	6.6E+00	6.7E+00	6.6E+00	6.6E+00	2.0E+00	5.2E+00	4.9E+00	
25	1.6E+00	1.6E+00	1.6E+00	4.0E+00	4.0E+00	4.0E+00	4.0E+00	4.0E+00	4.0E+00	1.6E+00	3.4E+00	3.2E+00	
50	1.2E+00	1.2E+00	1.2E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00	1.2E+00	1.9E+00	1.8E+00	
100	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	

Equation 5-6 applies to a single radionuclide contaminant. When multiple radionuclides are present, the calculation in Equation 5-6 is made with a unitized DCGL.

$$\frac{\delta}{DCGL_W} + \frac{(Conc_{AVE} - \delta)}{(Area\ Factor)(DCGL_W)} < 1$$

Equation 5-6

where:

δ = Estimate of average concentration of residual radioactivity and

$Conc_{AVE}$= average concentration in elevated area.

If more than one elevated area exists in the survey unit, a separate term will be included for each in Equation 5-6 (refer to Section 5.6.2.2).

5.3.6.3.2 Embedded Piping

Embedded piping will be surveyed to building surface DCGLs. If an embedded pipe is found to be contaminated above the DCGL and cannot be remediated then the dose contribution to the survey unit will be determined and the DCGLs for the remainder of the survey unit will be scaled to account for that dose contribution.

5.3.6.4 Remediation and Reclassification

As shown in Table 5-8, Class 1 areas of elevated residual activity above the $DCGL_{EMC}$ are remediated to reduce the residual radioactivity to acceptable levels. Based on survey data, it may be necessary to remediate an entire survey unit or only a portion of it. If an individual survey measurement (scan or direct measurement) in a Class 2 survey unit exceeds the $DCGL_W$, the survey unit or a portion of it may be reclassified to a Class 1 survey unit and the survey redesigned and re-performed accordingly. If an individual survey measurement in a Class 3 survey unit exceeds 0.5 $DCGL_W$, the survey unit, or portion of a survey unit, will be evaluated, and if necessary, reclassified to a Class 2 survey unit and the survey redesigned and re-performed accordingly.

Table 5-8 Investigative Actions for Individual Survey Units

Area Classification	Action if Investigation Results Exceed: $DCGL_{EMC}$	$DCGL_W$	$0.5\ DCGL_W$
Class 1	Remediate and resurvey as necessary	Acceptable*	N/A
Class 2	Remediate, reclassify portions as necessary and investigate**	Reclassify portions as necessary and investigate**	N/A
Class 3	Remediate, reclassify portions as necessary and investigate**	Reclassify portions as necessary, increase scan coverage and investigate**	Reclassify portions as necessary and resurvey, increase scan coverage

*For individual measurements above DCGL, the Sign Test will be conducted on the survey unit and an EMC evaluation performed.
**Requires an investigation of the initial classification process and a survey unit evaluation of sufficient intensity to satisfy the requirements of new classification status.

5.3.6.5 Resurvey

Following an investigation, if a survey unit is reclassified to a more restrictive classification or if remediation activities were performed, a resurvey is performed in accordance with approved procedures. If a Class 2 area had contamination greater than the $DCGL_W$, the area should be reclassified to a Class 1 area. If the average value of Class 2 direct survey measurements was less than the $DCGL_W$, the scan MDC was sensitive enough to detect the $DCGL_{EMC}$ and there were no areas greater than the $DCGL_{EMC}$, the survey redesign may be limited to obtaining a 100% scan without having to re-perform the static measurements or soil sample analyses. This condition assumes that the sample density meets the requirements for a Class 1 area.

5.4 Survey Methods and Instrumentation

5.4.1 Survey Measurement Methods

Survey measurements and sample collection are performed by personnel trained and qualified in accordance with the applicable EF1 procedures. The techniques for performing survey measurements or collecting samples are specified in approved EF1 procedures. FSS measurements include surface scans, direct surface measurements and gamma spectroscopy of volumetric materials. Advanced Survey Technologies (e.g. *ISOCS*), not specifically described in this LTP may also be used for final status surveys. If so, EF1 will give the NRC thirty days notice to provide an opportunity to review the associated basis document that will be provided on the Advanced Survey Technology(s). On-site lab facilities are used for gamma spectroscopy, liquid scintillation and gas proportional counting in accordance with applicable procedures. Off-site facilities are used, as necessary. No matter which facilities are used, analytical methods will be administratively established to detect levels of radioactivity at 10% to 50% of the DCGL value.

5.4.2. Structures

Structures will receive scan surveys, direct measurements and, when necessary, volumetric sampling.

5.4.2.1 Scan Surveys

Scanning is performed in order to locate small elevated areas of residual activity above the investigation level. Structures are scanned for beta-gamma radiation with appropriate instruments such as those listed in Table 5-9. The measurements will typically be performed at a distance of 1 cm or less from the surface and at a nominal scan speed of 5 cm/sec for hand-held instruments. Adjustments to scan speed and distance may be made in accordance with approved technical guidance.

5.4.2.2 Direct Measurements

Direct measurements are performed to detect surface activity levels. Direct measurements are conducted by placing the detector on or very near the surface to be counted and acquiring data over a predetermined count time. A count time of one minute is typically used for EF1 surface measurements and generally provides detection levels well below the DCGL (the count time may be varied provided the required detection level is achieved).

5.4.2.3 Concrete with Activated Radionuclides

Because of the extremely short operation of EF1, and the configuration of a Liquid Metal Fast Breeder Reactor, it is not expected that there will be activated concrete at EF1. Volumetric sampling of the concrete structures will be performed to verify that assumption. If concrete activation is discovered, volumetric DCGLs may be developed and the EF1 LTP will be revised to reflect these new DCGLs.

5.4.2.4 Volumetric Concrete Measurements

Volumetric sampling of contaminated concrete, as opposed to direct measurements may be necessary if the efficiency or uncertainty of the gross beta measurements is too high.
In this case the surface layer is removed from the known area, by using a commercial stripping agent or by physically abrading the surface. The removed coating material is analyzed for activity content and the level converted to appropriate units (i.e., dpm/100 cm^2) for comparison with

surface activity DCGLs. Direct measurements can then be performed on the underlying surface after removal of the coating.

The thickness of the layer of building surface to be removed as a sample should be consistent with the development of the EF1 site model and the DCGLs (i.e. <10mm in depth).

5.4.2.5 Soils

Soil will receive scan surveys at the coverage level described in Table 5-4 and volumetric samples will be taken at designated locations. Surface soil samples will normally be taken at a depth of 0 to 15 cm. Samples will be collected and prepared in accordance with approved procedures.

5.4.2.5.1 Scans

Open land areas are scanned for gamma emitting nuclides. The gamma emitters are used as surrogates for the HTD radionuclides. Sodium iodide detectors are typically used for scanning. For detectors such as the SPA-3, the detector is held within 2.5 to 5 centimeters off the ground surface and is moved at a speed of 0.5 m/sec, traversing each square meter 3 times. The area covered by scan measurements is based on the survey unit classification as described in Section 5.3.2.

5.4.2.5.2 Volumetric Samples

Soil materials are analyzed by gamma spectroscopy. Soil samples of approximately 1,500 grams are normally collected from the surface layer (top 15 cm). Sample preparation includes removing extraneous material, homogenizing, and drying the soil for gamma isotopic analysis. Separate containers are used for each sample and each container is moved through the analysis process following site procedures. Samples are split when required by the applicable quality control procedures. If a survey area has already been excavated and remediated to the soil DCGL, this area will be treated as surface soil, and the FSS will be performed on the excavated area. Soil samples will be collected to depths at which there is high confidence that deeper samples will not result in higher concentrations. Alternatively, a sodium-iodide detector of sufficient sensitivity to detect DCGL concentrations may be utilized to identify the presence or absence of subsurface contamination, and the extent of such contamination. If the detector identifies the presence of contamination at a significant fraction of the DCGL, confirmatory investigation and analyses of soil samples of the suspect areas will be performed. All subsurface sampling will be performed in accordance with the guidance in Section G.2.1 of NUREG-1757, Volume 2. The sample size for subsurface samples will be determined using the same methods described for surface soil. Per NUREG-1757, Volume 2, scanning is not applicable to subsurface areas; however, EF1 Final Status Surveys will employ scanning techniques commensurate with the survey unit classification. Scanning subsurface soils, where accessible, as an excavated surface, will demonstrate compliance with site release criteria.

5.4.3 Specific Survey Area Considerations

5.4.3.1 Pavement-Covered Areas

Survey of paved areas will be required along the roadways providing ingress and egress to EF1 (e.g. FARB, west yard entrance, turbine building entrance, etc.). The survey design of paved areas will be based on soil survey unit sizes since they are outdoor areas where the exposure scenario is most similar to direct radiation from surface soil. The applicable DCGL will be the soil DCGL. Scan and static gamma and beta-gamma surveys are determined by the survey unit design. Samples will be obtained of not only the asphalt, but of the soil present under the asphalt. Paved areas may be separate survey units or they may be incorporated into surveys of adjacent open land areas of like classification.

5.4.3.2 Stored Bulk Materials

Excavated soil may be reused onsite. Prior to reuse, excavated soil will be characterized to determine its suitability. Any surface scanning or volumetric analyses will be directly compared with DCGL values. Controls will be instituted to prevent mixing of soils from more restrictive survey area classifications (e.g., Class 2 material could be used in either Class 1 or 2 areas and Class 1 material could only be used in Class 1 areas). Soils satisfying the criteria for unrestricted release may be stockpiled for use as EF1 onsite backfill material.

The one area that would need to be separately evaluated is if the decision is made to leave sand, steel shot or other materials within or outside of existing structures. There are no plans to dispose of concrete building rubble onsite as part of Fermi 1 decommissioning, since the buildings will remain standing. However, there are materials such as sand and steel shot that were sealed behind walls or in penetrations during plant operations. Some needed to be removed to gain access to areas for equipment removal. Sand will need to be removed because the walls it is behind are being removed, and to support final status survey of building surfaces.

If the removed material meets the criteria for free release, it may be stored inside or outside Fermi 1 structures outside the Radiologically Restricted Area (RRA). Samples analyzed of such materials through January 2009 have met the free release criteria. For example, sand that has been free released may be stored in bags in Fermi 1 following license termination. The environmental impact of storing sand bags filled with sand released from Fermi 1 during decommissioning, is no different than storing sand bags for potential use elsewhere in case of flooding, and so is minimal.

Any plans to leave the removed material onsite if it contains detectable activity would need to be separately evaluated and addressed in a revision to the LTP.

5.4.3.3 Embedded Piping and Buried Piping

Separate FSS survey plans will be developed for embedded/buried piping which will include survey unit DQOs. These FSS plans will include:

- radionuclides of interest and chosen surrogate,
- levels and distribution of contamination,
- internal surface condition of the piping,
- internal residues and sediments and their radiation attenuation properties,
- removable and fixed surface contamination,
- instrument sensitivity and related scan and fixed minimum detectable concentrations,
- piping geometry and presence of internally inaccessible areas/sections,
- instrument calibration

Residual radioactivity on internal surfaces, such as floor drains, embedded piping, and buried piping may be inaccessible or difficult to measure directly using field survey detectors and established techniques. Where no remediation has occurred, inaccessible or difficult to measure internal surfaces are assumed to have the same level of residual radioactivity as that found on accessible internal surfaces. No special measurement methods are applied. Where remediation has occurred in the accessible portions of the piping, representative samples of the inaccessible internal surfaces are obtained, an assessment of pre-remediation survey data is performed, or other appropriate measures are taken (e.g., calibrated detectors extended into piping runs in a controlled manner) such that a reasonable approximation of the residual radioactivity on the inaccessible internal surfaces can be made. Accessible internal surfaces are surveyed the same as other structural surfaces. Scale and sediment samples will be obtained, if appropriate as well as smears and wipes to assist in the identification of the total radionuclide deposits within the piping. The activity of the internal surfaces will be compared to the building surface DCGLs which is a conservative measure. The contribution to the building surface DCGL for the survey unit will be calculated and the remainder of the building surface DCGLs will be scaled to account for the contribution. If the amount of activity observed on the internal surfaces is so great as to fail a survey unit, and the cost of remediation or removal is deemed "prohibitively expensive", specialized embedded piping DCGLs and grouting measures will be developed in a technical based document and a revision will be made to this LTP.

5.4.3.4 Cracks, Crevices, Wall-Floor Interfaces and Small Holes

Surface contamination on irregular structure surfaces (e.g., cracks, crevices, and holes) is difficult to survey directly. Where no remediation has occurred and residual activity has not been detected above background, these surface blemishes may be assumed to have the same level of residual activity as that found on adjacent surfaces. The accessible surfaces are surveyed in the same manner as other structural surfaces and no special corrections or adjustments are required. In situations where remediation has taken place or where residual activity has been detected above background, a representative sample of the contamination within the crack or crevice may be obtained or an adjustment for instrument efficiency may be made. If an instrument efficiency adjustment cannot be justified based on the depth of contamination or other geometry factors, volumetric samples will be collected. As an alternative method, radionuclide specific analysis, coupled with application of the unity rule may be used. Volumetric samples analyzed by gamma spectroscopy will detect the presence of radioactivity below the surface. Such sampling is typically performed following removal of paint and other surface coatings during remediation. After analysis, the data may be converted to equivalent surface activity. The accessible surfaces on irregular structure surfaces are surveyed in the same manner as other structure surfaces except that they are included in areas receiving judgmental scans when scanning is performed over less than 100% of the area.

5.4.3.5 Paint Covered Surfaces

Painted surfaces will be evaluated prior to the start of the FSS for that survey unit. In the event of suspected activity beneath painted surfaces, the coating will be removed prior to performing the survey. No special consideration will be given to wall or ceiling areas painted before plant startup and which have not been subjected to repeated exposure to materials that would have penetrated the painted surface.

5.4.3.6 EF1 Building Liners

Many of the interior surfaces of the rooms at EF1 are lined with steel. Before surveying an area, the steel liner will be inspected for integrity. If there are no breaches in the liner, and it is not expected that contamination exists behind the liner based on the historical site assessment; the room will be surveyed by direct survey of the liner. If there is indication of a breach in the liner, the affected portion of the liner will be removed or "peeled" back to expose a portion of the surface behind the liner and that portion of the surface will be surveyed as well. If contamination is expected behind the liner (the area contained contaminated liquid) as is the case of the decay and cut-up pools and the hot sump, the liner will be removed from the area prior to the survey. FSS survey packages will include WI-EF1RP-001 "Work Instruction to provide guidance on addressing steel room liners with regard to the Final Status Survey of a Survey Unit" providing direction to the evaluation of the room liners.

5.4.4 Instrumentation

Radiation detection and measurement instrumentation for the FSS is selected to provide both reliable operation and adequate sensitivity to detect the radionuclides identified at the site at levels sufficiently below the DCGL. Detector selection is based on detection sensitivity, operating characteristics and expected performance in the field. The instrumentation will, to the extent practicable, use data logging. Commercially available portable and laboratory instruments and detectors are typically used to perform the three basic survey measurements: 1) surface scanning; 2) direct surface contamination measurements; and 3) spectroscopy of soil and other bulk materials, such as concrete.

EF1 FSS procedures control the issuance and use of instrumentation. Records supporting the instrumentation program are maintained in accordance with EF1 procedures.

5.4.4.1 Instrument Selection

Radiation detection and measurement instrumentation is selected based on the type and quantity of the radiation to be measured. The instruments used for direct measurements are capable of detecting the radiation of concern below the applicable DCGL. MDCs of less than 50% of the DCGL allow detection of residual activity in Class 3 survey units at an investigation level of 0.5 times the DCGL. Instruments used for scan measurements in Class 1 areas are required to be capable of detecting radioactive material at the $DCGL_{EMC}$. Instrumentation currently proposed for use in the EF1 FSS is listed in Table 5-9. Instrument MDCs are discussed in Section 5.4.3.4 and nominal MDC values are also listed in Table 5-10. Other measurement instruments or techniques may be utilized. The acceptability of any alternate technologies for use in the FSS Program will be justified in a technical basis evaluation document. Technical basis evaluations for Advanced Survey Technologies will be provided for NRC review thirty days prior to use. An instrument technical analysis will include the following:

- Description of the conditions under which the method would be used;
- Description of the measurement method, instrumentation and criteria;
- Justification that the technique would provide the required sensitivity for the given survey unit classification in accordance with Table 5-10; and
- Demonstration that the instrument provides sufficient sensitivity for measurement below the release criteria with Type I error equivalent to 5% or less.

Table 5-9 Typical FSS Instrumentation

Measurement Type	Detector Type	Effective detector Area and Window density	Instrument and model	Detector model
Alpha Scan	Gas-flow proportional	126 cm^2 0.8 mg/cm^3 Aluminized Mylar	Ludlum 2350-1	Ludlum 43-68
Beta-gamma static and scan	Gas-flow proportional	126 cm^2 0.8 mg/cm^3 Aluminized Mylar	Ludlum 2350-1	Ludlum 43-68
Beta-gamma scan	Gas-flow proportional	584 cm^2 0.8 mg/cm^3 Aluminized Mylar	Ludlum 2350-1	Ludlum 43-37
Gamma scan	Scintillation	2" diameter x 2" length NaI	Ludlum 2350-1	Eberline SPA-3
Soil, structure surface and bulk material	High purity germanium	N/A	Canberra and off-site Lab	N/A

Table 5-10 Typical FSS Detection Sensitivities

Instruments and Detectors	Radiation	Background Count Time (minutes)	Background (cpm)	Instrument Efficiency	Count Time (minutes)	Static MDC (dpm/100cm^2)	Scan MDC (dpm/100cm^2)
Model 43-68	Alpha	1	2	0.087	1	26	N/A
Model 43-68	Beta-Gamma	1	243	0.2172	1	695	4251
Model 43-37	Beta-Gamma	1	607	0.1926	1	204	1882
Model SPA-3	Gamma	1	8000	0.62	0.04	N/A	See Table 5-13 for E_i
HPGe	Gamma	Up to 60	N/A	0.40 relative	10-60	0.05 pCi/g volumetric	N/A
Tennelec Low Bkg. Counter	Alpha Beta	10 10	0.1 1.0	0.35 0.48	1-10	11 16	N/A N/A

5.4.4.2 Calibration and Maintenance

Instruments and detectors are calibrated by an off-site vendor for the radiation types and energies of interest at the site. The calibration sources for beta survey instruments are Tc-99/SrY-90 because the average beta energies approximates the beta energy of the radionuclides found on surfaces at EF1. The alpha calibration source is Pu-239 that has an appropriate alpha energy for plant-specific alpha emitting nuclides. Gamma scintillation detectors are calibrated using Cs-137. Radioactive sources used for calibration are traceable to the National Institute of Standards and Technology (NIST). When characterized HPGe detectors are used, suitable NIST-traceable sources are used for onsite calibration, and the software is set up appropriately for the desired geometry.

5.4.4.3 Response Checks

Instrumentation response checks are conducted to assure proper instrument response and operation. An acceptable response for field instrumentation is an instrument reading within ±20% of the established check source value as documented on a control chart. Response checks are performed daily before instrument use and again at the end of use. Check sources contain the same type of radiation of that being measured in the field and are held in fixed geometry jigs for reproducibility. If an instrument fails a response check, it is tagged "Out of Service" and is removed from service until the problem is corrected in accordance with applicable EF1 procedures. Measurements made between the last acceptable check and the failed check will be evaluated to determine if they should remain in the data set.

5.4.4.4 Minimum Detectable Concentration (MDC)

The MDC is determined for the instruments and techniques used for final status surveys (Table 5-9). The MDC is the concentration of radioactivity that an instrument can be expected to detect 95% of the time.

5.4.4.4.1 Static MDC for Structure Surfaces

For static (direct) surface measurements, with conventional detectors, such as those listed in Table 5-9, the MDC is calculated by Equation 5-7 as follows:

$$MDC_{static} = \frac{3 + 4.65\sqrt{B}}{(K)(t)}$$

Equation 5-7

where:

3 = poisson probability sum for α and β squared and corrected to 3 (Brodsky 1992)
MDC_{static} = minimum detectable concentration for direct counting (dpm/100 cm^2),

B = number of background counts during the count interval t,

t = count interval (for paired observations of sample and blank, usually 1 minute), and

K = calibration constant (counts/min per dpm/100 cm^2)

The value of K includes correction factors for efficiency (e_i and e_s). The value of e_s is dependent on the material type. Corrections for radionuclide absorption have been made.

5.4.4.4.2 Structural Surface Beta-Gamma Scan MDCs

Following the guidance of Sections 6.7 and 6.8 of NUREG-1507, MDCs for surface scans of structural surfaces for beta and gamma emitters will be computed by Equation 5-8 below. For determining scan MDCs, a rate of 95% of correct detections is required and a rate of 60% of false positives is determined to be acceptable: therefore, a sensitivity index value of 1.38 was selected from Table 6.1 of NUREG-1507 and Equation 5-7 becomes:

$$MDC_{structural\ surface\ scan}(dpm/100cm^2) = \frac{1.38\sqrt{B}}{\sqrt{p}\ e_i\ e_s\ \left(\frac{A}{100}\right) t}$$

Equation 5-8

where:

B = number of background counts during the count interval t,
p = surveyor efficiency,
e_i = instrument efficiency for the emitted radiation (cpm per dpm),
e_s = source efficiency (intensity) in emissions per disintegration,
A = sensitive area of the detector (cm2), and
t = time interval of the observation while the probe passes over the source (minutes).

The numerator in Equation 5-8 represents the minimum detectable count rate that the observer would "see" at the performance level represented by the sensitivity index. The surveyor efficiency (p) will be taken to be 0.5, as recommended by Section 6.7.1 of NUREG-1507. The factor of 100 corrects for probe areas that are not 100 cm^2. In the case of a scan measurement, the counting interval is the time the probe is actually over the source of radioactivity. This time depends on scan speed, the size of the source, and the fraction of the detector's sensitive area that passes over the source; with the latter depending on the direction of probe travel. The source efficiency term (e_s) in Equation 5-8 may be adjusted to account for effects such as self absorption, as appropriate.

5.4.4.4.3 Total Efficiency (e_t) and Source Efficiency (e_s) for Concrete Contamination

The source term inventory on contaminated concrete appears to be primarily located within the top few millimeters of the concrete surface. The practical application of choosing the proper instrument efficiency may be determined by averaging the surface variation (peaks and valleys narrower than the length of the detector) and adding 0.5 inches, the spacing that should be maintained between the detector and the highest peaks of the surface. Selection of the source to detector distance is based on Table 5-11 that best reflects the predetermined geometry.

Table 5-11 Source to Detector Distance Effects on Instrument Efficiencies for α/β Emitters

Source to Detector Distance (cm)	Instrument Efficiency e_i	
	Tc-99 Distributed	Th-230 Distributed
Contact	(1)(2π eff)	(1) (2π eff)
1.27 (0.5 in.)	(0.803) (2π eff)	(0.761) (2π eff)
2.54 (1 in.)	(0.701) (2π eff)	(0.579) (2π eff)
5.08 (2 in.)	(0.503) (2π eff)	(0.099) (2π eff)

Source efficiency (e_s), reflects the physical characteristics of the surface and any surface coatings. The source efficiency is the ratio between the number of particles emerging from surface and the total of particles released within the source. The source efficiency accounts for attenuation and backscatter. Source efficiency (e_s), is nominally 0.5 (no self-absorption/attenuation, no backscatter) backscatter increases the value, self-absorption decreases the value. Source efficiencies may either be derived empirically or simply selected from the guidance contained in ISO 7503-1. ISO 7503-1 takes a conservative approach by recommending the use of factors to correct for alpha and beta self-absorption/attenuation when determining surface activity. However, this approach may prove to be too conservative for radionuclides with max beta energies that are marginally lower than 0.400 MeV, such as Co-60 with a β_{max} of 0.3 14 MeV. In this situation, it may be more appropriate to determine the source efficiency by considering the energies of other beta emitting radionuclides. Using this approach it is possible to determine weighted average source efficiency. For example, a source efficiency of 0.375 may be calculated based on a 50/50 mix of Co-60 and Cs-137. The source efficiencies for Co-60 and Cs-137 are 0.25 and 0.5 respectively, since the radionuclide fraction for Co-60 and Cs-137 is 50% for each, the weighted average source efficiency for the mix may be calculated in the following manner:

$(.25)(.50) + (.50)(.50) = 0.375$

Equation 5-9

Table 5-12 Source Efficiencies as Listed in ISO 7503-1

	>.400 Mev$_{max}$	**< .400 Mev$_{max}$**
Beta Emitters	$e_s = 0.50$	$e_s = 0.25$
Alpha Emitters	$e_s = 0.25$	$e_s = 0.25$

The total efficiency for any given condition can now be calculated from the product of the instrument efficiency e_i and the source efficiency e_s.

$$e_{total} = (e_i)\,(e_s)$$

Equation 5-10

5.4.4.4.4 Structural Surface Alpha Scan MDCs

In cases where alpha scan surveys are required, MDCs must be quantified differently than those for beta-gamma surveys because the background count rate from a typical alpha survey instrument is nearly zero (1 to 3 counts per minute typically). Since the time that an area of alpha activity is under the probe varies and the background count rates of alpha survey instruments is so low, it is not practical to determine a fixed MDC for scanning. Instead, it is more useful to determine the probability of detecting an area of contamination at a predetermined DCGL for given scan rates.

For alpha survey instrumentation with a background around one to three counts per minute, a single count will give a surveyor sufficient cause to stop and investigate further. Thus, the probability of detecting given levels of alpha emitting radionuclides can be calculated by use of Poisson summation statistics. Doing so (see MARSSIM Section 6.7.22 and Appendix J for details) one finds that the probability of detecting an area of alpha activity of 300 dpm/100 cm^2 at a scan rate of 3 cm per second (roughly 1 inch per second) is 90% if the probe dimension in the direction of the scan is 10 cm. If the probe dimension in the scan direction is halved to 5 cm, the detection probability is still 70%. Choosing appropriate values for surveyor efficiency, instrument and surface efficiencies will yield MDCs for alpha surveys for structure surfaces. If for some reason lower MDCs are desired, then scan speeds may be adjusted, within practicable limits, via the methods of 6.7.2.2 and Appendix J of MARSSIM.

5.4.4.4.5 Open Land Area Gamma Scan MDCs

In addition to the MDCR and detector characteristics, the scan MDC (in pCi/g) for land areas is based on extent of the elevated area, depth of the elevated area, and the radionuclide (i.e., energy and yield of gamma emissions). If one assumes constant parameters for each of the above variables, with the exception of the specific radionuclide in question, the scan MDC may be reduced to a function of the radionuclide alone. The evaluation of open land areas requires a detection methodology of sufficient sensitivity for the identification of small areas of potentially elevated activity. Scan measurements are performed by passing a 2" x 2" NaI (TI) gamma scintillation detector in gross count rate mode across the land surface under investigation. The centerline of the detector is maintained at a source-to-detector distance of approximately 6 cm and moved from side to side in a 1-meter wide pattern at a rate of 0.5 m/sec. This serpentine scan pattern is designed to cross each survey cell (one square meter) a minimum of three times in approximately ten seconds with a maximum separation of less than 150 cm between one pass. The audible signal is monitored for detectable increases in count rate. An observed count rate increase results in further investigation to verify findings and define the level and extent of residual radioactivity. This method represents the Stage1 and Stage 2 surface scanning process for land areas defined in NUREG-1507 and is the basis for calculation of the scanning detection sensitivity (scan MDC). The sensitivity is only slightly affected by the relative amounts of Cs-137 and Co-60 in the soil giving typical scan MDC values in the range of 5 to 6 pCi/g for instrument backgrounds of 8,000 to 10,000 cpm. Alternate methods of sufficient sensitivity for the identification of small areas of elevated radioactivity may be used where appropriate.

An *a-priori* determination of scanning sensitivity is performed to ensure that the measurement system is able to detect concentrations of radioactivity at levels below the regulatory release limit. Expressed in terms of Scan MDC, this sensitivity is the lowest concentration of radioactivity for a given background that the measurement system is able to detect at specified performance level and surveyor efficiency.

The scan MDC value (in pCi/g) for open land area surface scanning with a desired performance level of 95% correct detections and 60% false positive rate, the sensitivity index has a value of 1.38 resulting in a minimum detectable count rate (MDCR) of:

$$MDCR = 1.38\sqrt{b_i} \times \left(\frac{60sec}{1min}\right)$$

Equation 5-11

where:

b_i = background counts in the observation interval.

Introducing the human factor performance element of surveyor efficiency, the surveyor minimum detectable count rate becomes:

$$MDCR_{surveyor} = \frac{MDCR}{\sqrt{p}}$$

Equation 5-12

where:

$MDCR_{surveyor}$ = Minimum detectable surveyor count rate (cpm), and
p = Surveyor efficiency = *0.5*.

A corresponding minimum detectable exposure rate can be determined for a specified detector and radionuclide by dividing the $MDCR_{surveyor}$ value by the detector manufacturer's count rate to exposure rate ratio (cpm per µR/h) to give a minimum detectable exposure rate in units of µR/h. The minimum detectable exposure rate is then used to determine the minimum detectable radionuclide concentration (i.e., the Scan MDC) by modeling a specified small area of elevated activity using MicroShield™ to yield a conversion factor (E_i) of cpm per pCi/g. The minimum detectable exposure rate is then divided by the MicroShield™ conversion factor to give a Scan MDC in units of pCi/g. Table 5-13 provides the E_i for EF1 predominant gamma emitting radionuclides as determined by EF1 TBD NSEF-08-022 "Instrument Efficiency

Determination for Use in Minimum Detectable Concentration Calculations."

Table 5-13 Efficiency for Photon Emitting Isotopes

Isotope	E_i (cpm/pCi/g)
Na-22	625
Co-60	379
Nb-94	415
Ag-108m	633
Sb-125	192
Cs-134	499
Cs-137	191
Eu-152	342

5.4.4.4.6 HPGe Spectrometer Analysis

The onsite chemistry laboratory maintains gamma isotopic spectrometers that are calibrated to various sample geometries, including one-liter Marinelli geometry for soil analysis. These systems are calibrated using a NIST-traceable mixed gamma source. The detectors are manufactured by Canberra Industries.

Laboratory counting system count times are set to meet a maximum MDC of 10% of the DCGL for EF1 radionuclides.

5.4.4.4.7 Pipe Survey Instrumentation

Accessible portions of the remaining embedded piping will be surveyed to ensure residual remaining activity is less than the DCGL. Pipe survey instruments proposed for use at EF1 are scintillation detectors and GM arrays. Pipe survey instruments proposed for use will have a level of sensitivity adequate to detect residual activity below the building surface DCGLs.

5.5 Data Collection and Processing

This section describes data collection, review, validation and record keeping requirements for final status surveys.

5.5.1 Sample Handling and Record Keeping

Sample collection and handling requirements are provided for each sample from the point of collection through obtaining the final results to ensure the validity of the sample data. FSS instructions, data and drawings shall be controlled as described in approved EF1 procedures or instructions. The results of the FSS will be retained as radiological records in accordance with EF1 procedures, but not less than the duration of the possession only license upon which time the records will be turned over to Fermi 2.

5.5.2 Data Management

Survey data are collected from several sources during the data life cycle and are evaluated for validity throughout the survey process. QC replicate measurements are not used as final status survey data. (See Section 5.8.1.4.1 for design and use of QC measurements). Measurements performed during turnover and investigation surveys can be used as final status survey data if they were performed according to the same requirements as the final status survey data. These requirements are:

- Survey data shall reflect the as-left survey unit condition; i.e., no further remediation required,
- The application of isolation measures to the survey unit to prevent recontamination and to maintain final configuration are in effect; and
- The data collection and design were in accordance with FSS methods and procedures, e.g., scan MDC, investigation levels, survey data point number and location, statistical tests, and EMC tests.

Measurement results stored as final status survey data constitute the final survey of record and are included in the data set for each survey unit used for determining compliance with the site release criteria. Measurements are recorded in units appropriate for comparison to the applicable DCGL. Numerical values, even negative numbers, are recorded. Measurement records include, at a minimum, the surveyor's name, the location of the measurement, the instrument used, measurement results, the date and time of the measurement, any surveyor comments, and records of applicable reviews.

5.5.3 Data Verification and Validation

The final status survey data are reviewed prior to data assessment to ensure that they are complete, fully documented and technically acceptable. The review criteria for data acceptability will include at a minimum, the following items:

a) The instrumentation MDC for fixed or volumetric measurements was below the $DCGL_W$ or if not, it was below the $DCGL_{EMC}$ for Class 1, below the $DCGL_W$ for Class 2 and below 0.5 $DCGL_W$ for Class 3 survey units,

b) The instrument calibration was current and traceable to NIST standards,

c) The field instruments were source checked with satisfactory results before and after use each day data were collected or data was evaluated accordance with Section 5.4.3.3.

d) The MDCs and assumptions used to develop them were appropriate for the instruments and techniques used to perform the survey,

e) The survey methods used to collect data were appropriate for the types of radiation involved and for the media being surveyed,

f) "Special methods" for data collection were properly applied to the survey unit under review. These special methods are either described in this LTP section or will be the subject of an NRC notice of opportunity for review,

g) The sample was controlled from the point of sample collection to the point of obtaining results,

h) The data set is comprised of qualified measurement results collected in accordance with the survey design and which accurately reflects the radiological status of the facility, and

i) The data have been properly recorded.

If the data review criteria are not met, the discrepancy will be evaluated and the decision to accept or reject the data will be documented in accordance with approved procedures. The EF1 Corrective Action Program (CAP) will be used to document and resolve discrepancies as applicable.

5.5.4 Graphical Data Review

Survey data will be graphed to identify patterns, relationships or possible anomalies which might not be apparent using other methods of review. A posting plot and a frequency plot will be made. Other special graphical representations of the data set will be made as the need dictates. The License Termination Manager will review all data for acceptance.

5.5.4.1 Posting Plots

Posting plots will be used to identify spatial variability in the data. The posting plot consists of the survey unit map with the numerical data shown at the location from which it was obtained. Posting plots can reveal patches of elevated radioactivity or local areas in which the DCGL is exceeded. Posting plots can be generated for background reference areas to point out spatial trends that might adversely affect the use of the data. Anomalies in the background data may be the result of residual, undetected activity, or may just reflect background variability.

5.5.4.2 Frequency Plots

Frequency plots will be used to examine the general shape of the data distribution. Frequency plots are basically bar charts showing data points within a given range of values. Frequency plots reveal such things as skewness and bimodality (having two peaks). Skewness may be the result of a few areas of elevated activity or may be the result of very little activity present in the survey unit such as a log-normal data distribution. Multiple peaks (bi-modal, tri-modal, etc.) in the data may indicate the presence of isolated areas of residual radioactivity or background variability due to soil types or differing materials of construction. Variability may also indicate the need to more carefully match background reference areas to survey units or to subdivide the survey unit by material or soil type.

5.6 Data Assessment and Compliance

An assessment is performed on the final status survey data to ensure that they are adequate to support the determination to release the survey unit. Simple assessment methods such as comparing the survey data to the DCGL or comparing the mean value to the DCGL are first performed. The statistical tests are then applied, as necessary, to the final data set and conclusions are made as to whether the survey unit meets the site release criterion.

5.6.1 Data Assessment Including Statistical Analysis

The results of the survey measurements are evaluated to determine whether the survey unit meets the release criterion. In some cases, the determination can be made without performing complex, statistical analyses.

5.6.1.1 Interpretation of Sample Measurement Results

An assessment of the measurement results is used to quickly determine whether the survey unit passes or fails the release criterion or whether one of the statistical analyses must be performed. The evaluation matrices are presented in Tables 5-14 and 5-15.

Table 5-14 Interpretation of Sample Measurements When the WRS Test is Used

Measurement Results	Conclusion
Difference between maximum survey unit concentration and minimum reference area concentration is less than $DCGL_W$	Survey unit meets release criterion
Difference of survey unit average concentration and reference average concentrations greater than $DCGL_W$	Survey unit fails
Difference between any survey unit concentration and any reference area concentration is greater than $DCGL_W$. A difference of survey unit average concentration and reference area average concentration is less than $DCGL_W$	Conduct WRS test and elevated measurements test

Table 5-15 Interpretation of Sample Measurements When the Sign Test is Used

Measurement Results	Conclusion
All concentrations less than $DCGL_W$	Survey unit meets release criterion
Average concentration greater than $DCGL_W$	Survey unit fails
Any concentration greater than $DCGL_W$ and average concentration less than $DCGL_W$	Conduct Sign Test and elevated measurements test

When required, one of four non-parametric statistical tests will be performed on the survey data:

1) WRS Test
2) Sign Test
3) WRS Test Unity Rule
4) Sign Test Unity Rule

In addition, survey data are evaluated against the EMC criteria as previously described in Section 5.3.6.3 and as required by NUREG-1757, Volume 2. The statistical test is based on the null hypothesis (H_0) that the residual radioactivity in the survey unit exceeds the DCGL. There must be sufficient survey data at or below the DCGL to reject the null hypothesis and conclude the survey unit meets the site release criterion for dose. Statistical analyses are performed using a specially designed software package or, if necessary, using hand calculations.

5.6.1.2 Wilcoxon Rank Sum Test

The WRS test, or WRS Unity Rule (NUREG-1505, Chapter 11), may be used when the radionuclide of concern is present in the background or measurements are used that are not radionuclide-specific. In addition, this test is valid only when "less than" measurement results do not exceed 40 percent of the data set.

The WRS test is applied as follows:

1) The background reference area measurements are adjusted by adding the $DCGL_W$ to each background reference area measurement, X_i; i.e., $Z_i = X_i + DCGL$.

2) The number of adjusted background reference area measurements, m, and the number of survey unit measurements, n, are summed to obtain N, (N = m + n).

3) The measurements are pooled and ranked in order of increasing size from 1 to N. If several measurements have the same value, they are assigned the average rank of that group of measurements.

4) The ranks of the adjusted background reference area measurements are summed to obtain W_r.

5) The value of W_r, is compared with the critical value in Table I.4 of MARSSIM. If W_r, is greater than the critical value, the survey unit meets the site release dose criterion. If W_r, is less than or equal to the critical value, the survey unit fails to meet the criterion.

5.6.1.3 Sign Test

The Sign test and Sign test Unity Rule are one-sample statistical tests used for situations in which the radionuclide of concern is not present in background, or is present at acceptable low fractions compared to the $DCGL_W$. If present in background, the gross measurement is assumed to be entirely from plant activities. This option is used when it can be reasonably expected that including the background concentration will not affect the outcome of the Sign test. The advantage of using the Sign test is that a background reference area is not necessary. The Sign test is conducted as follows:

1) The survey unit measurements, X_i, i = 1, 2, 3,...N; where N = the number of measurements, are listed.

2) X_i is subtracted from the $DCGL_W$ to obtain the difference $D_i = DCGL_W - X_i$, where i = 1, 2, 3,..., N.

3) Differences where the value is exactly zero are discarded and N is reduced by the number of such zero measurements.

4) The number of positive differences is counted. The result is the test statistic S+.

Note: A positive difference corresponds to a measurement below the $DCGL_W$ and contributes evidence that the survey unit meets the site release criterion.

5) The value of S+ is compared to the critical value given in Table I.3 of MARSSIM. The table contains critical values for given values of N and α. The value of α is set at 0.05 during survey design. If S+ is greater than the critical value given in the table, the survey unit meets the site release criterion. If S+ is less than or equal to the critical value, the survey unit fails to meet the release criterion.

5.6.2 Unity Rule

5.6.2.1 Multiple Radionuclide Evaluations

The Cs-137 to Co-60 (or other gamma nuclide) ratio will vary in the final survey soil samples, and this will be accounted for using a "unity rule" approach as described in NUREG-1505 Chapter 11. Unity Rule Equivalents will be calculated for each measurement result using the surrogate adjusted Cs-137 DCGL and the Co-60 DCGL, as shown in the following Equation 5-13.

$$Unity\ Rule\ Equivalent\ \leq 1 = \frac{Cs-137}{DCGL_{Cs-137_s}} + \frac{Co-60}{DCGL_{Co-60}} + \cdots + \frac{R_n}{DCGL_n}$$

Equation 5-13

where:

Cs-137 and Co-60 are the gamma results,

$DCGL_{Cs\text{-}137\,s}$ = the surrogate Cs-137, DCGL, as applicable,

$DCGL_{Co\text{-}60}$ = the Co-60 DCGL,

R_{n} = any other identified gamma emitting radionuclide, and

$DCGL_n$ = the DCGL for radionuclide N.

The unity rule equivalent results will be used to demonstrate compliance assuming the DCGL is equal to 1.0 using the criteria listed in the LTP, Tables 5-14 and 5-15. If the application of the WRS or Sign test is necessary, these tests will be applied using the unity rule equivalent results and assuming that the DCGL is equal to 1.0. An example of a WRS test using the unity rule is provided in NUREG-1505, Page 11-3;

Section 11.4. (If the WRS test was used, or background subtraction was used in conjunction with the Sign test, background concentrations would also be converted to Unity Rule Equivalents prior to performing test). The Sign test will be used without background subtraction if background Cs-137 is not considered a significant fraction of the DCGL. Note that the surrogate Cs-137 DCGL will be used for both the statistical tests and comparisons with the criteria in LTP Tables 5-14 and 5-15. The same general surrogate and unity rule methods described above for soil would be applied to other materials, such as activated concrete, where sample gamma spectroscopy is used for final survey as opposed to gross beta measurements.

5.6.2.2 Elevated Measurement Comparison Evaluations

During final surveys, areas of elevated activity may be detected and they must be evaluated both individually and in total to ensure compliance with the release criteria. Each elevated area is compared to the specific $DCGL_{EMC}$ value calculated for the size of the specific elevated area. If the individual elevated area passes, then the elevated areas are combined and evaluated under the unity rule.

The average activity of each elevated area is determined as well as the average value for the survey unit. The survey unit average value is divided by the $DCGL_W$, the survey unit average value is subtracted from the elevated area average activity value and the result is divided by the elevated area $DCGL_{EMC}$. Each elevated area net average activity is evaluated against its $DCGL_{EMC}$. The fractions are summed and the result must be less than unity for the survey unit to pass. This is summarized in Equation 5-14 below.

$$\frac{\delta}{DCGL} + \frac{\overline{C}_{elevated} - \delta}{(AreaFactor)\ x\ DCGL} < 1$$

Equation 5-14

Where:

δ = average concentration outside the elevated area,

$\overline{C}_{elevated}$ = average concentration in the elevated area

A separate term will be used in the equation for each elevated area identified in a survey unit.

5.6.3 Data Conclusions

The results of the statistical tests, including application of the EMC, allow one of two conclusions to be made. The first conclusion is that the survey unit meets the site release dose criterion. The data provide statistically significant evidence that the level of residual radioactivity in the survey unit does not exceed the release criterion. The decision to release the survey unit is made with sufficient confidence and without further analysis. The second conclusion that can be made is that the survey unit fails to meet the release criterion. The data are not conclusive in showing that the residual radioactivity is less than the release criterion. The data are analyzed further to determine the reason for the failure.

Possible reasons are that:

- The average residual radioactivity exceeds the $DCGL_W$,
- The average residual radioactivity is less than the $DCGL_W$; however the survey unit fails the elevated measurement comparison,
- The survey design or implementation was insufficient to demonstrate compliance for unrestricted release, or
- The test did not have sufficient power to reject the null hypothesis (i.e., the result is due to random statistical fluctuation).

The power of the statistical test is a function of the number of measurements made and the standard deviation in measurement data. The power is determined from 1-β where β is the value for Type II errors. A retrospective power analysis may be performed using the methods described in Appendices I.9 of MARSSIM. If the power of the test is insufficient due to the number of measurements, additional samples may be collected as directed by procedure. A greater number of measurements increase the probability of passing if the survey unit actually meets the release criterion. Retrospective power analyses will be developed for each EF1 survey units regardless if the unit passes FSS or not.

If failure was due to the presence of residual radioactivity in excess of the release criterion, the survey unit shall be remediated and as necessary, reclassified. Survey unit failure due to inadequate design or implementation shall require investigation and re-initiation of the FSS process.

5.6.4 Compliance

The FSS is designed to demonstrate licensed radioactive materials have been removed from the EF1 site to the extent that remaining residual radioactivity is below the radiological criteria for unrestricted release. The site-specific radiological criteria presented in this plan demonstrate compliance with the criteria of 10 CFR 20.1402. If the measurement results pass the requirements of Table 5-5 and the elevated areas evaluated per Section 5.3.6.3 pass the elevated measurement comparison, the survey unit is suitable for unrestricted release. If survey measurements do not meet the criteria specified in Table 5-5, an investigation will be performed. Investigations will include an evaluation of survey design, instrumentation use and calculations, as necessary. Investigations of this nature will be documented using the corrective action process as discussed in Section 5.8.2.

5.7 Final Status Survey Reporting Format

Survey results and a brief operating history are documented in the FSS Report. Other reports may be generated as requested by the NRC.

5.7.1 Operating History

A brief operational history including relevant operational and decommissioning data is compiled. The purpose of the historical information is to provide additional, substantive data which forms a portion of the basis for the survey unit classification, and hence, the level of intensity of the FSS. The historical information includes the following items:

- Operating history which could affect radiological status,
- Summarized scoping and site characterization data, and
- Other relevant information, as deemed necessary.

5.7.2 Final Status Survey Report

Survey results will be described in a written report for each Survey Area and submitted to the NRC. The final status survey report provides a summary of the survey results and the overall conclusions that demonstrate that the EF1 site meets the radiological criteria for unrestricted use. Information such as the number and type of measurements, basic statistical quantities, and statistical analysis results are included in the report. The level of detail is sufficient to clearly describe the final status survey program and to certify the results. The format of the final report will contain the following topics:

- Overview of the results;
- Discussion of changes to FSS;
- Final Status Survey Methodology;
  - Survey unit sample size,
  - Justification for sample size;
- Final Status Survey Results;
  - Number of measurements taken,
  - Survey maps,
  - Sample concentrations,
  - Statistical evaluations,
  - Judgmental and miscellaneous data sets;
- Anomalous data;
- Conclusion for each survey unit; and
- Any changes from initial assumptions on extent of residual activity.

5.7.3 Other Reports

Other reports relating to final status survey activities may be prepared and submitted as necessary.

5.8 Final Status Survey Program Quality

Quality is built in to each phase of the FSS Program and measures must be taken during the execution of the plan to determine whether the expected level of quality is being achieved. The FSS Program will ensure that the site will be surveyed, evaluated and determined to be acceptable for unrestricted release if the residual activity results in an annual Total Effective

Dose Equivalent (TEDE) to the average member of the critical group of 25 mrem/year or less for all pathways. The following sections provide a description of applicable EF1 quality programs and specific quality elements of the FSS Program.

5.8.1 FSS Quality Assurance Project Plan (QAPP)

The objective of the FSS QAPP is to ensure the survey data collected are of the type and quality needed to demonstrate with sufficient confidence the site is suitable for unrestricted release. The objective is met through use of the DQO process for FSS design, analysis and evaluation. The plan ensures the following items are accomplished:

1) The elements of the final status survey plan are implemented in accordance with the approved procedures,
2) Surveys are conducted by trained personnel using calibrated instrumentation,
3) The quality of the data collected is adequate,
4) All phases of package design and survey are properly reviewed, with management oversight provided, and
5) Corrective actions, when identified, are implemented in a timely manner and are determined to be effective.

The following sections describe the basic elements of the FSS QAPP.

5.8.1.1 Project Management and Organization

Compliance with this QAPP and the LTP shall be the responsibility of all personnel involved with FSS activities. The Fermi 1 staff and Review Subcommittee perform the specific responsibilities identified below. Outside vendors may be contracted to perform specific review activities:

- Surveillance of the implementation of the FSS
- Performing periodic audits of the FSS program
- Perform conformance reviews of selected FSS implementing procedures

- Perform conformance reviews of selected FSS reports

The Fermi 1 Radiation Protection Organization is responsible for the quality of those activities necessary to achieve a final status of unrestricted use for the EF1 site.

Key Radiation Protection positions are listed below. The responsibilities for the key positions are described in MEF200, "Final Status Survey Program" and responsibilities may be assigned to a designee as appropriate.

- EF1 Health Physicist
- License Termination Manager
- FSS Engineers
- FSS Lead Technician
- FSS Technician

Figure 5-3 provides an organizational chart of the projected EF1 License Termination Organization.

5.8.1.1.1 EF1 Health Physicist

The EF1 Health Physicist is responsible for ensuring that all decommissioning survey activities are performed by qualified personnel in accordance with approved procedures and implemented in coordination with, and support of, ongoing decommissioning activities.

5.8.1.1.2 License Termination Manager

The License Termination Manager is responsible for the implementation of the FSS.

5.8.1.1.3 FSS Engineer

The FSS Engineer is responsible for the development of FSS Plans and performing the Data Quality Assessment (DQA) of the completed FSS. The FSS Engineer is responsible for the construction of the FSS reports. Responsibilities of FSS Engineer may include technical support and development of FSS procedures, preparation of survey execution instructions, development of specific technical analysis documents supporting FSS activities, and review of survey packages and data collected in support of the FSS.

5.8.1.1.4 FSS Lead Technicians

Final Status Survey Lead Technicians are responsible for control and implementation of survey packages during field activities. Specific responsibilities are likely to include:

- Coordination of turnover surveys,
- Survey area preparation (e.g., gridding),
- Ensuring final status survey measurements and sampling is conducted in accordance with applicable procedures and work instructions,
- Maintaining access controls over completed FSS survey areas,
- Determining survey area accessibility requirements,
- Coordination and scheduling of FSS Technicians to support the decommissioning schedule, and
- Ensuring all necessary instrumentation and other equipment is available to support survey activities.

5.8.1.1.5 Final Status Survey Technician

Final Status Survey Technicians are responsible for performance of final status survey measurements and collection of final status survey samples in accordance with applicable site procedures and survey package instructions. The FSS Technician will be responsible for maintaining the pedigree of instrumentation used in the survey by implementing the procedural requirements for maintenance and daily checks. Final Status Survey Technicians will be trained and task-qualified for the performance of the final status activities assigned to them. Final Status Survey Technicians may also participate in survey area preparations.

5.8.1.2 Procedural Control(s)

Sampling and survey tasks must be performed properly and consistently in order to assure the quality of FSS results. The measurements will be performed in accordance with approved, written procedures. Approved procedures describe the methods and techniques used for final status survey measurements. Those procedures have been cited in Section 5.9.1. The list includes currently approved procedures and those to be prepared and approved prior to use.

5.8.1.3 Training and Qualification

Personnel performing final status survey measurements will be trained and qualified. Training will include the following topics:

- Procedures governing the conduct of the FSS,
- Operation of field and laboratory instrumentation used in the FSS, and
- Collection of final status survey measurements and samples.

Qualification is obtained upon satisfactory demonstration of proficiency in implementation of procedural requirements. The extent of training and qualification will be commensurate with the education, experience and proficiency of the individual and the scope, complexity and nature of the activity required to be performed by that individual. Records of training and qualification will be maintained in accordance with approved training procedures

5.8.1.4 Measurement and Data Acquisitions

The FSS records have been designated as quality documents and will be governed by EF1 quality programs and procedures. Generation, handling and storage of the original final status survey design and data packages will be controlled by site procedures. Each final status survey measurement will be identified by individual, date, instrument, location and type of measurement.

5.8.1.4.1 Quality Control Surveys

Procedures establish built-in Quality Control checks in the survey process for both field and laboratory measurements, as described in the EF1 QAPP and applicable EF1 procedures. For structures and systems, QC replicate scan measurements will consist of resurveys of a minimum of 5% of randomly selected class 1, 2, or 3 survey units typically performed by a different technician with results compared to the original survey result. The acceptance criterion shall be that the same conclusion as the original survey was reached based on the repeat scan. If the acceptance criterion is not met, an investigation will be conducted to determine the cause of the discrepancy and corrective action.

Quality Control for direct surface contamination and/or gamma direct measurements will consist of repeat measurements of a minimum of 5% of the survey units using the same instrument type, taken by a different technician (except in cases where there is only one instrument or specialized training is required to operate the equipment) and the results compared to the original measurements using the same instrument type. The acceptance criterion for direct measurements is specified in approved procedures.

For soil, and sediment samples, Quality Control will consist of participation in the laboratory Inter-comparison Program. The acceptance criterion for blank samples is that no plant-derived radionuclides are detected. The criterion for blind duplicates is that the two measurements are within the value specified by approved procedure. Some sample media, such as asphalt, will not be subjected to split or blind duplicate analyses due to the lack of homogeneity. These samples will simply be recounted to determine if the two counts are within 20% of each other, when necessary.

If QC replicate measurements or sample analyses fall outside of their acceptance criteria, a documented investigation will be performed in the form of a Corrective Action Report (CAR).

The investigation will typically involve verification that the proper data sets were compared, the relevant instruments were operating properly and the survey/sample points were properly identified and located. Relevant personnel are interviewed, as appropriate, to determine if proper instructions and procedures were followed and proper measurement and handling techniques were used including chain of custody, where applicable. When deemed appropriate, additional measurements are taken. Following the investigation, a documented determination is made regarding the usability of the survey data and if the impact of the discrepancy adversely affects the decision on the radiological status of the survey unit.

5.8.1.4.2 Instrumentation Selection, Calibration and Operation

Proper selection and use of instrumentation will ensure that sensitivities are sufficient to detect radionuclides at the minimum detection capabilities as specified in <u>Section 5.4.3.4</u> as well as assure the validity of the survey data. Instrument calibration of field instrumentation will be performed, by an off-site vendor, with NIST traceable sources using approved procedures. Issuance, control and operation of the survey instruments will be conducted in accordance with the EF1 FSS instrumentation procedures.

5.8.1.5 Chain of Custody

Responsibility for custody of samples from the point of collection through the determination of the final survey results is established by procedure. When custody is transferred, a chain of custody form (per

EF1 FSS procedure) will accompany the sample for tracking purposes. Secure storage will be provided for archived samples.

5.8.1.6 Control of Consumables

In order to ensure the quality of data obtained from FSS surveys and samples, new sample containers will be used for each sample taken. Tools used to collect samples will be cleaned to remove contamination prior to taking additional samples. Tools will be decontaminated after each sample collection and surveyed for contamination.

5.8.1.7 Control of Vendor-Supplied Services

Quality related services, such as instrument calibration and laboratory analysis, are procured from qualified vendors whose internal QA program is subject to approval by EF1.

5.8.1.8 Database Control

Software used for data reduction, storage or evaluation will be fully documented and certified by the vendor. The software will be verified and validated prior to use by an appropriate test data set.

5.8.1.9 Data Management

Survey data control from the time of collection through evaluation is specified by procedure. Manual data entries will be secondarily verified.

5.8.2 FSS Programmatic Assessment

5.8.2.1 Assessment Requirements

The FSS Program shall be assessed periodically in accordance with MEF 201 "FSS Quality Assurance Program Plan (QAPP)" to ensure that the program is being implemented in accordance with approved procedures.

Periodic assessments refer to selected activities observed and documented periodically. These assessments include: confirmatory surveys, survey technique, instrument download, data quality, design and implementation of Final Status Survey plans. Self-assessments may be used to assess adherence to regulations and management expectations for selected activities. Personnel performing self-assessments will be knowledgeable in the activities they are assessing.

Aspects of the FSS Program to be assessed at least annually include survey performance, data retrieval, data evaluation, quality control and document control.

5.8.2.2 Special Assessments

The EF1 Health Physicist or the License Termination Manager shall establish criteria for special assessments of the FSS Program beyond those assessments addressed in Section 5.8.2.1.

There is no required frequency for special assessments, but if a special assessment of the FSS Program is not performed annually, then the EF1 Health Physicist shall document the basis for not doing so.

5.8.2.3 Corrective Action Process

The corrective action process, already established in the EF1 Manual, will be applied to FSS for the documentation, evaluation, and implementation of corrective actions. The process will be conducted in accordance with the approved procedure which describes the methods used to initiate Corrective Action Requests (CARs) and resolve self assessment and corrective action issues related to FSS.

5.8.3 Data Validation and Verification

Survey data will be reviewed prior to evaluation or analysis for completeness and for the presence of statistically variant data. Comparisons to investigation levels will be made and measurements exceeding the investigation levels will be evaluated. Procedurally verified data will be subjected to the Sign test, the Unity Sign test, the WRS test, or WRS Unity test as appropriate. Technical evaluations or calculations used to support the development of DCGLs will be verified and validated to ensure correctness of the method and the quality of data.

5.8.4 Confirmatory Measurements

The NRC may take confirmatory measurements to make a determination in accordance with 10 CFR 50.82(a)(11) whether the FSS and associated documentation demonstrate the site is suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E. Confirmatory measurements may include collecting radiological measurements for the purpose of confirming and verifying compliance with NRC standards for unrestricted license termination. Timely and frequent communications with the NRC will ensure it is afforded sufficient opportunity for these confirmatory measurements prior to the implementation of any irreversible decommissioning actions.

The State of Michigan may also perform confirmatory measurements. Communicating with the Department of Environmental Quality will be conducted to afford the State opportunity to perform confirmatory measurements.

Figure 5-1 Fermi 1 Cutaway

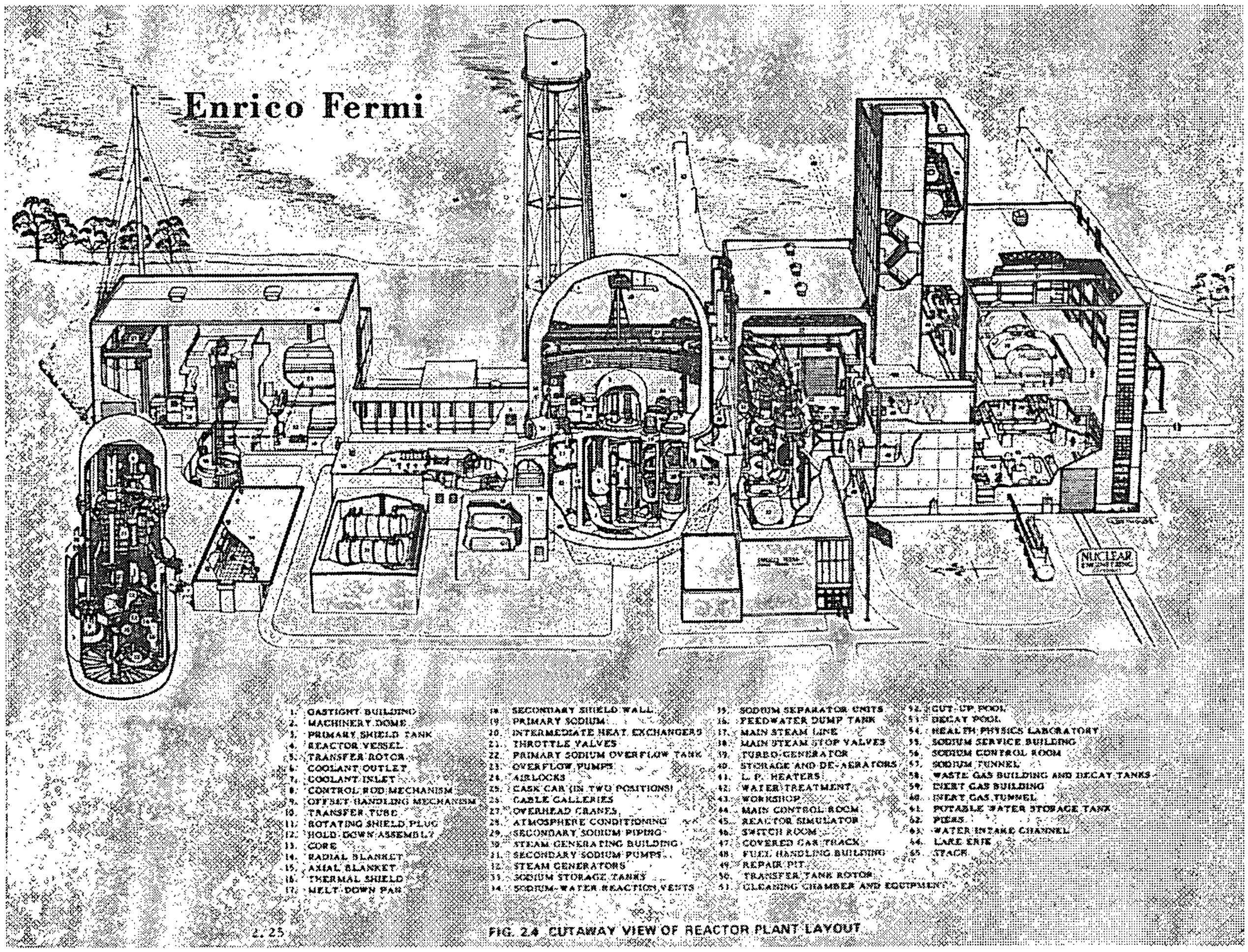


Figure 5-2 FSS Process Overview

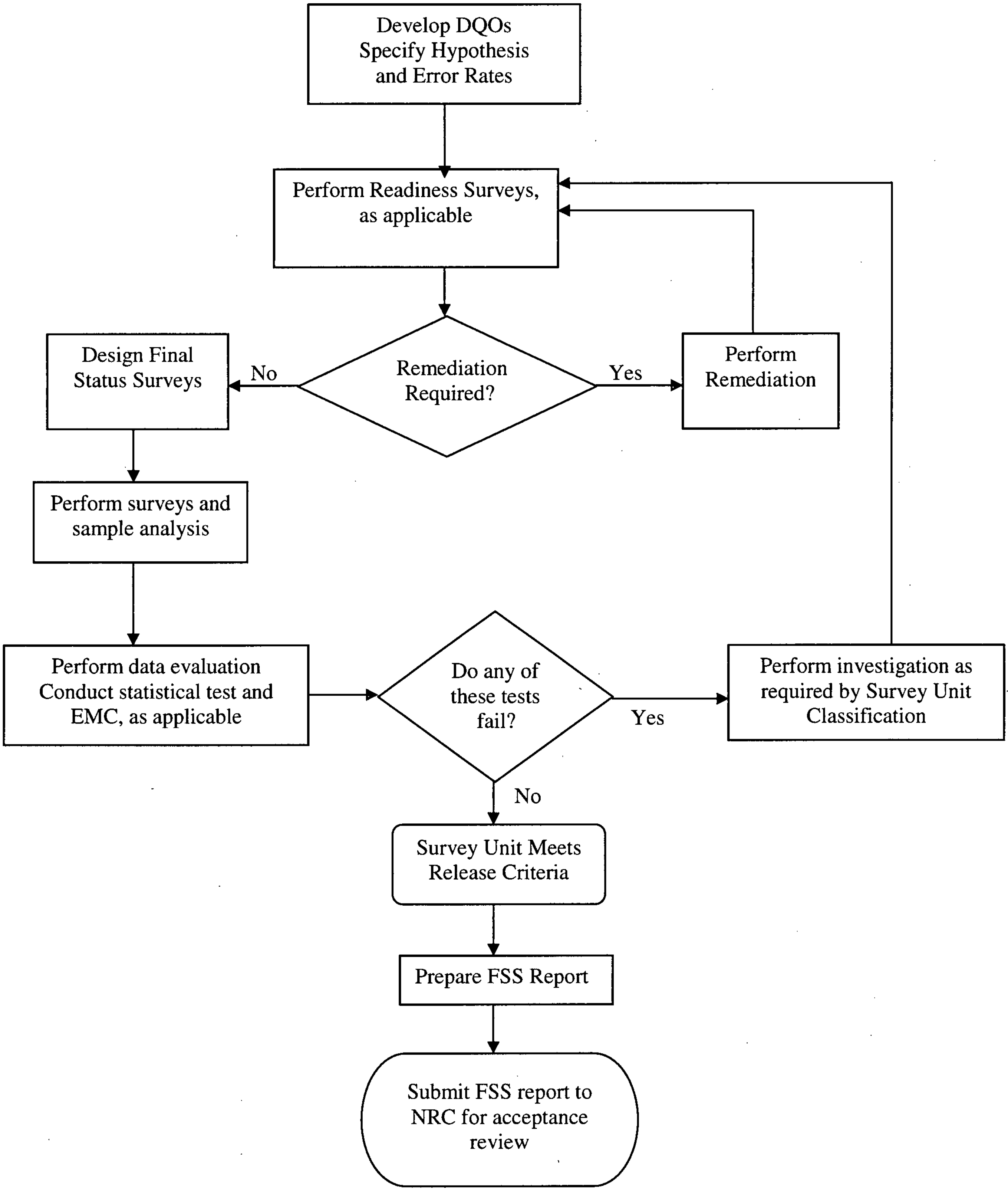
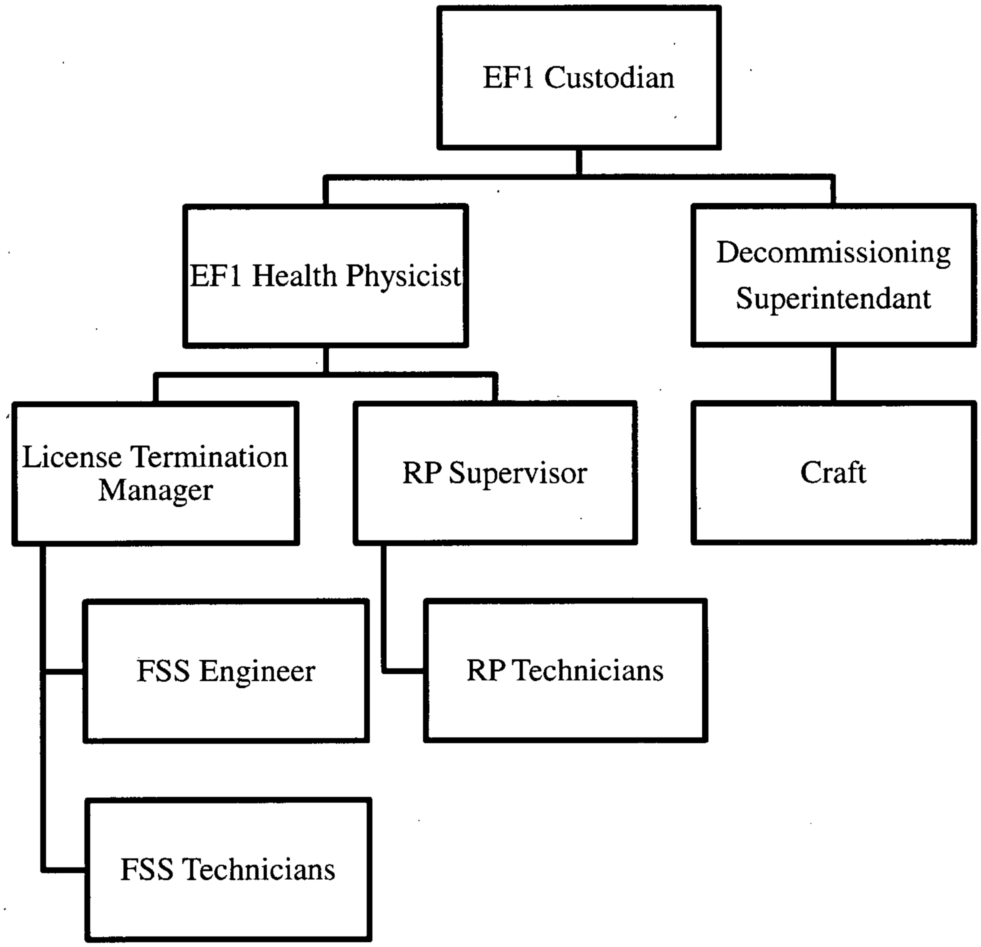


Figure 5-3 Projected FSS Organizational Chart



5.9 References

5.9.1 U.S. Nuclear Regulatory Commission NUREG-1757, Vol. 2, "Consolidated NMSS Decommissioning Guidance - Characterization, Survey, and Determination of Radiological Criteria, Final Report," September 2003

5.9.2 U.S. Nuclear Regulatory Commission NUREG-1575, Revision 1, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," August 2000

5.9.3 U.S. Nuclear Regulatory Commission NUREG-1505, Revision 1, "A Nonparametric Statistical
Methodology for the Design and Analysis of Final Status Decommissioning Surveys," June 1998 draft

5.9.4 U.S. Nuclear Regulatory Commission NUREG-1507, "Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions," June 1998

5.9.5 U.S. Nuclear Regulatory Commission NUREG-1700, Revision 1, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans," April 2003

5.9.6 U.S. Nuclear Regulatory Commission Regulatory Guide 1.179, "Standard Format and Content of License Termination Plans for Nuclear Power Reactors," January 1999

5.9.7 U.S. Nuclear Regulatory Commission NUREG/CR-5512, Volume 1, Final Report, "Residual Radioactive Contamination from Decommissioning," October 1992

5.9.8 U.S. Nuclear Regulatory Commission Staffs Response to Detroit Edison's Letter dated July 12, 2000, Fermi 2 "shine" influence on EF1 decommissioning, September 20, 2000

5.9.9 Technical Based Document, (TBD) NESF-08-0018, "Radionuclide Selection for DCGL Development"

5.9.10 Technical Based Document, (TBD) NESF-08-0022, "Instrument Efficiency Determination for Use in Minimum Detectable Concentration Calculations

5.9.11 International Organization for Standardization, ISO 7503-1, "Evaluation of Surface Contamination - Part 1: Beta Emitters and Alpha Emitters (first edition)," 1988

5.9.12 Enrico Fermi Atomic Power Plant, Unit 1, Fermi 1 Manual

5.9.13 Enrico Fermi Atomic Power Plant, Unit 1, Fermi 1 Safety Analysis Report

5.9.14 Brodsky, A, 1992 "Exact Calculation of Probabilities of False Positives and False Negatives for Low Background Counting" Health Physics 63(2): 198-204

5.9.15 Applicable Site Procedures for FSS

MEF200 Final Status Survey (FSS) Program
MEF201 FSS Quality Assurance Program Procedure (QAPP)
MEF202 Collection of Site Characterization and FSS Samples
MEF203 Sample Security and Chain of Custody
MEF204 Sample Receipt and Preparation
MEF205 Determination of the Number and Locations of FSS Samples
MEF206 Turnover and Control of Areas for FSS
MEF207 Survey Unit Classification
MEF208 Preparation of FSS Survey Plans
MEF209 Statistical Tests
MEF210 Area Surveillance Following FSS
MEF211 Data Quality Assessment

MEF212 Preparation of FSS Reports
MEF213 Split Sample Assessment for Final Status Survey
MEF214 Computer Determination of the Number and Location of FSS Samples and Measurements
MEF215 FSS Background Assessment
MEF216 ALARA Evaluations for Final Status Survey Areas
MEF217 Setup and Operation of the Ludlum 2350-1 Digital Survey Instrument
MEF218 Control and Accountability of FSS Portable Survey Instruments

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6.0 COMPLIANCE WITH THE RADIOLOGICAL CRITERIA FOR LICENSE TERMINATION

6.1 Site Release Criteria

6.1.1 Radiological Criteria for Unrestricted Use

The site release criteria for the Detroit Edison (DECo) Enrico Fermi 1 (EF1) site are the NRC's radiological criteria for unrestricted use established in 10 CFR 20.1402 (Reference 6-1):

- Dose Criterion: The residual radioactivity that is distinguishable from background radiation results in a Total Effective Dose Equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem/year, including that from groundwater sources; and
- ALARA Criterion: The residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA).

"Background radiation" in the above criteria means radiation from cosmic sources, naturally occurring radioactive material (including radon - except as a decay product of source or special nuclear material), and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl. All of these sources of radiation contribute to background radiation and are not under the control of the licensee. Background radiation does not include radiation from source, byproduct, or special nuclear materials regulated by the Nuclear Regulatory Commission (NRC).

6.1.2 Conditions Satisfying the Site Release Criteria

Derived concentration guideline levels (DCGLs) are radionuclide-specific activity concentrations that correspond to release criteria described in Section 6.1.1 above. DCGL values are derived from activity-dose relationships through the analyses of various exposure pathway scenarios. LTP Section 6.3.2 discusses the potential radionuclides of concern for the EF1 site.

DCGL values for assessing residual radioactivity on building surfaces and in site soil have been calculated for each potential radionuclide of concern. The DCGLs form the basis for the following conditions which, when met, satisfy the site release criteria as prescribed in 10 CFR 20.1402:

- The average residual radioactivity above background is less than or equal to the DCGL. For mixtures of radionuclides, the sum of the fractions of the contaminant's concentration over the contaminant's $DCGL_w$ must be less or equal to one.
- Individual measurements representing small areas of residual radioactivity that exceed the DCGL, but do not exceed the elevated measurement comparison DCGL ($DCGL_{EMC}$). Section 5 provides a discussion of the use of the $DCGL_{EMC}$ during the final radiation survey for the EF1 site.
- Where one or more individual measurements exceed the DCGL, but the average residual radioactivity passes the Wilcoxon Rank Sum (WRS) or Sign statistical

test. Section 5 of this Plan provides a discussion of the use of statistical tests during the final radiation survey for the EF1 site.

- Remediation of contaminated areas is performed where ALARA considerations require that levels of residual radioactivity be below DCGLs. Section 4 provides a detailed discussion for ALARA Analysis.

The methods in MARSSIM (Reference 6-2) and the DCGLs may not be appropriate for non-structural components, such as conduit and non-embedded piping. For those non-structural components and systems to which MARSSIM does not apply, the current "no detectable" criteria (consistent with I&E Circular 81-07) will be applied to free release these items. Section 6.4 provides a discussion of the treatment of embedded piping.

6.2 Dose Modeling Approach

6.2.1 Overview

Dose models allow the translation of residual radioactivity levels into potential radiation doses to the public. For the EF1 site, dose models have been developed based on the guidance found in NUREG/CR-5512 (Reference 6-3), Volumes 1, 2, and 3. The conceptual model reflects the anticipated site conditions at the time of unrestricted release. The dose modeling approach for the EF1 site is consistent with the information for site-specific modeling provided in Appendix I of NUREG-1757 (Reference 6-4), including source term abstraction and scenarios, pathways, and critical groups.

There are three defining factors for a dose model: 1) the scenario, 2) the critical group and 3) the exposure pathways. The scenarios described in NUREG/CR-5512 (Reference 6-3), Volume 1, address the major exposure pathways of direct exposure to penetrating radiation and inhalation and ingestion of radioactive materials. The scenarios also identify the critical group, which is defined as the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity within the assumptions of a particular scenario. The design for scenarios and the site-specific modeling provide reasonable and conservative estimates of the potential doses associated with residual radioactivity.

The dose models supporting the building surface and soil DCGLs were developed using the approach outlined above. The scenarios described in NUREG/CR-5512 (Reference 6-3), Volume 1, were selected for the EF1 site to estimate potential radiation doses from radioactive material in buildings (building occupancy scenario) and soil (resident farmer scenario).

6.2.2 Potential Radionuclides of Concern

The identification of potential radionuclides present at the time of the final survey of the EF1 site is part of the development process for site-specific DCGLs. Radionuclide selection consisted of a systematic approach to identify all potential radionuclides of concern for the EF1 site and a de-selection protocol for excluding those potential radionuclides present in insignificant concentrations.

Potential radionuclides of concern have been evaluated for the EF1 site (Reference 6-5). The selection and identification process began with an initial theoretical set of potential radionuclides that could be present at the time of reactor shutdown based on information provided by technical reports, EF1 waste stream analyses, and an EF1 activation analysis. The selection process omitted short-lived radionuclides (i.e., radionuclides possessing half-lives less than or equal to two years) as potential radionuclides of concern because of the impact of radiological decay since the time of reactor shutdown. Additionally, radionuclides that contributed 0.1 percent or less to the total activity present were discounted with the provision that the total dose from all discounted nuclides did not exceed one percent of the total estimated dose. The total dose associated with all discounted radionuclides equaled approximately 0.52 percent of the total dose estimated using the resident farmer scenario and approximately 0.02 percent of the total dose estimated using the building occupancy scenario (Reference 6-5). However, several nuclides that met this elimination criterion were retained as potential radionuclides because they (i) are produced by methods other than activation of reactor components, and/or (ii) have been observed in 10 CFR Part 61 waste stream analyses or site characterization samples. A more detailed description of the selection process for potential radionuclides at the EF1 site is provided in a technical basis document (Reference 6-5). Table 6-1 presents potential radionuclides of concern for the EF1 site.

6.2.3 Modeling for Building Surface DCGLs

6.2.3.1 Scenario Definition

The Building Occupancy scenario is described in NUREG/CR-5512 (Reference 6-3), Volume 1. Modeling of this scenario provides an estimate of human radiation exposure to residual radioactivity on surfaces inside standing buildings and permits the determination of DCGLs for building surfaces. This scenario was selected as the modeling basis for building surface DCGLs.

6.2.3.2 Critical Group

The average member of the critical group is defined as an adult individual engaging in industrial work within the buildings following decommissioning of the site. The person occupies and carries out light to moderate work activities inside the building for a full year of employment. The breathing rate applied in the sensitivity analysis was appropriate for light to moderate activity. For conservatism, a higher breathing (appropriate for moderate to heavy activity) was used in the development of the building surface DCGLs. The dose to the individual from residual radioactivity on building surfaces is evaluated as required by 10 CFR Part 20, Subpart E, and described in Appendix I to NUREG -1757 (Reference 6-4).

6.2.3.3 Conceptual Model and Exposure Pathways

The conceptual model is an EF1 worker who occupies the building as a routine work area and performs light to moderate decommissioning activities for a full employment year, receiving radiation exposure via the following potential exposure pathways:

- Direct exposure to external radiation from
  - Material deposited on the room surfaces (i.e., walls, floor, and ceiling)
  - Submersion in airborne dust
- Internal dose from inhalation of airborne radionuclides
- Internal dose from inadvertent ingestion of radionuclides

In the development of building surface DCGL values, the Building Occupancy scenario modeled for the EF1 site accounted for moderate to heavy decommissioning activities carried out inside EF1 site buildings through use of conservative input for breathing rate and including the inadvertent ingestion of surface contamination. This approach produced reasonably conservative estimates of annual doses associated with contaminated building surfaces.

6.2.4 Modeling for Soil DCGLs

6.2.4.1 Scenario Definition

The resident farmer scenario, described as the "Residential Scenario" in NUREG/CR-5512 (Reference 6-3), Volume 1, conservatively estimates human radiation exposures resulting from residual radioactivity in soil. This scenario was selected as the modeling basis for soil DCGLs.

6.2.4.2 Critical Group

The average member of the critical group was determined to be the resident farmer who lives on the EF1 site following decommissioning, grows all or a portion of his/her diet on site, and uses the water from a groundwater source on the site for drinking water and irrigation. The dose from residual radioactivity in soil is evaluated for the critical receptor as required by 10 CFR Part 20, Subpart E, and described in Appendix I to NUREG -1757 (Reference 6-4).

6.2.4.3 Conceptual Model and Exposure Pathways

The conceptual model for this scenario is a residential farming family that lives onsite, raises crops and livestock for consumption, and drinks water from an onsite ground water source.

It is unlikely that any other set of plausible human activities that would result in a dose exceeding that calculated for the hypothetical resident farmer could occur on the EF1 site. It is more likely that the behavior of future occupants would result in a lower dose. For example, it is more likely that the EF1 site will be reused for industrial purposes. The EF1 site is located on the same site as EF2 and it is likely to be used as an industrial site rather than a site for a residential farmer. The hypothetical dose from residual contamination in the soil to an individual in these settings would be less than for a resident farmer because such an individual would not reside on the site and ingest food grown onsite. Therefore, the use of the resident farmer as the average member of the critical group is both conservative and bounding for the calculation of soil DCGLs. The potential exposure pathways that apply to the resident farmer are listed below and are based upon those in NUREG/CR-5512 (Reference 6-3), Volume 1:

- Direct exposure to external radiation from residual radioactivity;
- Internal dose from inhalation of airborne radionuclides; and
- Internal dose from ingestion of
  - Plant foods grown in media containing residual radioactivity and irrigated with water containing residual radioactivity,
  - Meat and milk from livestock fed with fodder grown in soil containing residual radioactivity and water containing residual radioactivity,
  - Drinking water (containing residual radioactivity) from a well,
  - Fish from a pond containing residual radioactivity, and
  - Soil containing residual radioactivity.

6.2.5 Computer Code Selection

The RESRAD Family of Codes has been selected for use in determining DCGL values at the EF1 site. The RESRAD computer codes are pathway-analysis models developed at Argonne National Laboratory (ANL). This family of computer codes includes RESRAD-Build, used to analyze pathways associated with buildings, and RESRAD, used to analyze pathways associated with soil.

The RESRAD-Build computer code is a pathway analysis model designed to evaluate the potential radiological dose incurred by an individual who works in a building contaminated with radioactive material. Version 3.4 of the RESRAD-BUILD computer code was used in this analysis to consider four primary exposure pathways to occupants of a building:

- External exposure directly from the sources (walls, floors, and ceilings);
- External exposure due to air submersion;
- Inhalation of airborne radioactive particulates; and
- Inadvertent ingestion of radioactive material directly from the sources.

As with the RESRAD-Build code, the RESRAD computer code was developed by ANL as a multifunctional tool to assist in developing radiological criteria for unrestricted release and assessing the dose or risk associated with residual radioactive material. The RESRAD computer code is a pathway analysis model designed to evaluate the potential radiological dose associated with residual radioactive material in land areas. Version 6.4 of the RESRAD computer code was used in this analysis to consider three major exposure pathways to a resident farmer:

- Direct exposure to external radiation from soil containing residual radioactivity;
- Internal exposure from inhalation of airborne radionuclides; and
- Internal exposure from ingestion of radionuclides.

Both the RESRAD-Build and the RESRAD codes incorporate probabilistic modules that permit the user to perform a sensitivity analysis to identify those parameters that have the greatest impact on dose. In addition, the probabilistic modules allow the evaluation of dose as a function of parameter distributions. Information on the use of these codes and their applications are outlined in NUREG/CRs-6676, -6692, -6697, -6755 (References 6-6, 6-7, 6-8 and 6-9) and the "Users Manual for RESRAD, Version 6.0" (Reference 6-10).

6.2.6 Sensitivity Analyses

6.2.6.1 Input Parameter Selection Process

The dose and conceptual models are quantified by a set of input parameters. Probabilistic modules that allow the evaluation of dose as a function of parameter distributions are incorporated within RESRAD-BUILD Version 3.4 and RESRAD Version 6.4. A schematic flow diagram of the parameter selection process is provided in Figure 6-1.

a.) Classification (Type)

The input parameters were classified as behavioral, metabolic or physical, consistent with NUREG/CR-6697 (Reference 6-8). Behavioral parameters depend on the behavior of the receptor and the scenario definition. Metabolic parameters represent the metabolic characteristics of the receptor and are independent of the scenario definition. Physical parameters are those parameters that do not change with changes to the receptor.

b.) Prioritization

The parameters were prioritized in order of importance consistent with NUREG/CR-6697 (Reference 6-8). Prioritization was based on:

- The relevance of the parameter in dose calculations,
- The variability of the dose as a result of changes in the parameter value,
- The parameter type and
- The availability of parameter-specific data.

Priority 1 parameters are considered high priority; priority 2 parameters are considered medium priority; and priority 3 parameters are considered low priority.

c.) Treatment

The parameters were treated as either deterministic or stochastic depending on parameter type, priority, availability of site-specific data and the relevance of the parameter in dose calculations. The deterministic modules of the code use a single value for input parameters and generate a single value for dose. The probabilistic modules of the code use probability distributions for stochastic input parameters and generate a range of doses.

The behavioral and metabolic parameters are treated as deterministic and were assigned values from NUREG/CR-5512 (Reference 6-3), Volume 3, NUREG/CR-6697 (Reference 6-8), or the applicable code's default library. Physical parameters for which site-specific data are available were also treated as deterministic.

The remaining physical parameters, for which no site-specific data are available to quantify, are classified as either Priority 1, 2, or 3. Priority 1 and 2 parameters are treated as stochastic and are assigned a probability distribution from NUREG/CR-6697 (Reference 6-8). The priority 3 physical parameters are treated as deterministic and are assigned values from NUREG/CR-5512 (Reference 6-3), Volume 3, NUREG/CR-6697 (Reference 6-8), or the applicable code's default library.

6.2.6.2 Sensitivity Criteria

In order to determine values for parameters not already assigned a value, as discussed in Section 6.2.6.1, a sensitivity analysis was performed to determine which of the stochastic parameters influence have an influence on the resulting dose and associated DCGLs. The analyses were performed using the probabilistic modules of RESRAD-Build, Version 3.4, and RESRAD, Version 6.4.

The stochastic parameters identified in the preceding paragraphs were generally assigned distribution types and corresponding distribution statistical parameters from NUREG/CR-6697 (Reference 6-8), Attachment C Sensitivity analyses were performed on the stochastic parameters using the assigned distributions. To perform the sensitivity analysis, the following information was required:

- Sample Specifications: The analyses were run using 300 observations for building surfaces, 2000 observations for soils, and 1 repetition for both scenarios. The Latin Hypercube Sampling (LHS) technique was used to sample the probability distributions for each of the stochastic input parameters. The correlated or uncorrelated grouping option was used to preserve the prescribed correlation. Correlation coefficients were assigned to correlated parameters.

- Sensitivity Indicator: Sensitivity analyses were performed for each of the radionuclides. The Partial Rank Correlation Coefficient (PRCC) for the peak of the mean dose was used as a measure of the sensitivity of each parameter.
- Sensitivity Thresholds: For the building occupancy scenario, a parameter was identified as sensitive if the absolute value of its PRCC (|PRCC|) was greater than or equal to 0.10 and non-sensitive if the |PRCC| value was less than 0.10. For the resident farmer scenario, a parameter was identified as sensitive if the |PRCC| was greater than or equal to 0.25 and non-sensitive if the |PRCC| value was less than 0.25. These sensitivity thresholds (So) were selected based on the guidance included in NUREG/CR-6676 (Reference 6-6) and NUREG/CR-6692 (Reference 6-7).

6.2.6.3 Parameter Value Assignment for DCGL Determination

As discussed previously, behavioral and metabolic parameters were assigned values from NUREG/CR-5512 (Reference 6-3) Volume 3, NUREG/CR-6697 (Reference 6-8), or NUREG/CR-6755 (Reference 6-9). When available, site data served as input for physical parameters. For Priority 3 physical parameters without site data, values from NUREG/CR-5512 (Reference 6-3) Volume 3 or NUREG/CR-6697 (Reference6-8) were used.

Priority 1 and 2 physical parameters were assigned values as follows:

- Priority 1 and 2 physical parameters shown to be sensitive were assigned conservative values:
  - A site-specific value, or
  - The 75th or 25th percentile value of the distribution was used, respectively, depending on whether the parameter was positively or negatively correlated with dose. Use of 25th and 75th percentiles values provides assurance that the DCGL calculations take into account the uncertainties associated with the sensitive input parameters.
- Priority 1 and 2 physical parameters shown to be non-sensitive were assigned:
  - A distribution or site-specific value, or
  - The median value of the distribution

6.2.7 Code Output and Calculation of DCGL

RESRAD-BUILD code determines an average annual dose at the time of the peak dose in mrem/yr, whereas RESRAD code determines an annual peak of the mean dose in mrem/yr. By specifying a unit radionuclide concentration (i.e., 1 pCi/m^2 in RESRAD-BUILD or 1 pCi/g in RESRAD) to be used in conjunction with the parameters values determined by the process described previously, both codes produce a dose conversion factor (DCF). The DCF from RESRAD-Build is in units of mrem/yr per pCi/m^2 and the DCF from RESRAD is in units of mrem/yr per pCi/g. As suggested in NUREG-1757 (Reference 6-4), DCFs based upon peak mean doses were used to calculate DCGLs with units of dpm/100cm^2 for building surfaces and pCi/g for soil. The EF1 DCGLs correspond to the site release criterion, 25 mrem/y (described in Section 6.1), and were calculated using the following equations:

For building surfaces,

$$DCGL(pCi/m^2) = \frac{25mrem/y}{DCF\ mrem/yr/pCi/m^2} \qquad \text{(Equation 6-1)}$$

$$DCGL(dpm/cm^2) = DCGL(pCi/m^2)\times 2.22dpm/pCi\times(1m/100cm)^2 \qquad \text{(Equation 6-2)}$$

$$DCGL(dpm/100cm^2) = DCGL(pCi/m^2)\times 2.22dpm/pCi\times(1m/100cm)^2\times 100 \qquad \text{(Equation 6-3)}$$

Or for soil,

$$DCGL(pCi/g) = \frac{25mrem/y}{DCFmrem/y/pCi/g} \qquad \text{(Equation 6-4)}$$

6.3 Calculation of DCGLs

6.3.1 Building Surface DCGL

6.3.1.1 Dose Model

The dose model used to calculate the building surface DCGLs is based upon the building occupancy scenario as defined in NUREG/CR-5512 (Reference 6-3), Volumes 1, 2, and 3 and NUREG-1757 (Reference 6-4). The scenario assumes that the critical group consists of industrial workers performing routine work activities in the building following license termination. The pathways used in this analysis are those identified in Section 6.2.3.3.

6.3.1.2 Conceptual Model

The conceptual model was based on site characteristics expected at the time of license termination. The model is comprised of a room representative of rooms inside EF1 buildings expected to remain at the site. The four walls, floor, and ceiling of the room are assumed to be uniformly contaminated to equal levels. This is a conservative assumption as normally the amount of contamination on room walls and ceiling is less than that on the floor and would be expected to decrease as the distance from the floor increases.

6.3.1.3 Parameter Value Assignment

The process described in Section 6.2.6 was used to determine the parameter input values or distributions. Appendix 6A provides the details for the determination of the room dimensions and the bases for other site-specific parameters impacting the modeling for building surfaces DCGLs. The values and distributions assigned to all parameters for the sensitivity analyses and the bases for assigning such values and distributions are summarized in Appendix 6B. The time in which the maximum dose occurred was taken into account in the sensitivity analyses.

6.3.1.4 Sensitivity Analysis

The results of the sensitivity analysis performed for RESRAD-Build input parameters are provided in Appendix 6C.

6.3.1.5 DCGL Determination

The DCGL determination was performed using RESRAD-BUILD Version 3.4. The input values, including the 25^{th} and 75^{th} percentile values for sensitive input parameters, are summarized in Appendix 6D. The resulting DCFs, based upon the average dose during the year that the maximum dose occurs, are provided in Appendix 6E. These DCGL values, which represent an annual dose of 25 mrem, were calculated using Equations 6-1 through 6-3 and are shown in Table 6-2 and also are provided in Appendix 6E.

6.3.2 Soil DCGL

6.3.2.1 Dose Model

The DCGLs for soil were calculated using the resident farmer scenario. The residual radioactive materials were assumed to be contained in a soil layer on the property that can be used for residential and light farming activities. The average member of the critical group is the resident farmer that lives on the plant site, grows all of his/her diet onsite and drinks water from a groundwater source onsite. The pathways used in this analysis are identified in Section 6.2.4.3.

6.3.2.2 Conceptual Model

The conceptual model used in the code was based on the site characteristics expected at the time of release of the site. The model is comprised of a contaminated zone underlain by an unsaturated zone underlain by a saturated zone. The contaminated zone is assumed to be at the ground surface with no cover material and the ground water is initially uncontaminated. The model as described is consistent with that described the RESRAD User's Manual (Reference 6-10).

6.3.2.3 Parameter Value Assignment

The process described in Section 6.2.6 was used to determine the parameter input values or distributions. The evaluation of site/regional data and the justification of values assigned to the site-specific parameters are provided in Appendix 6F. The values/distributions assigned to all parameters for the sensitivity analyses and the basis for assigning such values/distributions are summarized in Appendix 6G.

6.3.2.4 Sensitivity Analysis

The results of the sensitivity analysis performed for RESRAD input parameters are provided in Appendix 6H.

6.3.2.5 DCGL Determination

The DCGL determination was performed using RESRAD Version 6.4. The input values, including the 25^{th} and 75^{th} percentile values for sensitive input parameters, are summarized in Appendix 6I. The resulting DCFs, based upon the peak of the mean doses, are provided in Appendix 6J. The DCGLs, which represent an annual dose equal to 25 mrem, were calculated using Equation 6-4. The DCGL values are shown in Table 6-2 and are also provided in Appendix 6J.

6.4 Embedded Piping

Residual radioactivity on internal surfaces, such as floor drains, embedded piping, and buried piping may be inaccessible or difficult to measure directly using field survey detectors and established techniques. Where no remediation has occurred, inaccessible or difficult to measure internal surfaces are assumed to have the same level of residual radioactivity as that found on accessible internal surfaces. No special measurement methods are applied. Where remediation has occurred, representative samples of the inaccessible internal surfaces are obtained, an assessment of pre-remediation survey data is performed, or other appropriate measures are taken (e.g., calibrated detectors extended into piping runs in a controlled manner) such that a reasonable approximation of the residual radioactivity on the inaccessible internal surfaces can be made. Accessible internal surfaces are surveyed the same as other structural surfaces. Scale and sediment samples may be obtained, if appropriate. The activity of the internal surfaces will be compared to the building surface DCGLs which is a conservative measure. The contribution to the building surface dose rate for the survey unit will be calculated and the remainder of the building surface DCGLs will be scaled to account for the contribution. If the amount of activity observed on the internal surfaces is so great as to fail a survey unit, and the cost of remediation or removal is deemed "prohibitively expensive", specialized embedded piping DCGLs will be developed in a technical based document and a revision will be made to this LTP.

6.5 Residual Radioactivity in Groundwater

Assessment of residual radioactivity in groundwater at the EF1 site is described in Chapter 2. In addition, LTP Chapter 5 requires that the concentration of available well water (based upon the well supply requirements assumed in Chapter 6 for the resident farmer) be below the EPA Maximum Contaminant Levels (MCLs) at the time of license termination to ensure that the dose contribution from groundwater is restricted to a small fraction of the limit in 10CFR20.1402. An initial characterization study for groundwater at the EF1 site has been performed (Reference 6-17). The groundwater samples collected and analyzed during that effort (November 2003 to December 2005) detected only naturally-occurring radioactivity; no indications of detectable radioactivity resulting from EF1 operations were found.

6.6 Combining Dose Contributions from Different Media

In accordance with 10CFR20.1402, EF1 considers residual contamination in soil, on building surfaces, and in groundwater concurrently when calculating the total dose from the site.

If ongoing site characterization or the final status survey of the EF1 site identifies residual plant-related radioactivity in groundwater, then the dose contribution from groundwater (D_{gw}) will be determined and subtracted from the 25 mrem/yr dose limit. The building surfaces and soil $DCGL_W$ values will be adjusted to account for the dose contribution from groundwater using the relationship described in equation 6.5.

$$adjustedDCGL_w = DCGL_w \frac{25mrem/y - D_{gw}}{25mrem/y} \qquad \text{Equation 6-5}$$

6.7 Calculation of Area Factors

Area factors (AFs) for both building surface DCGLs and soil DCGLs may be required during final status survey activities. AF values are calculated in a step process. First, the total doses from all pathways are calculated for each radionuclide and for each area of contamination. Then, the AF values are determined from the ratio of the dose for the base case to the dose for each smaller area evaluated.

6.7.1 Calculation of Area Factors for the Building Surfaces

For the building occupancy scenario, a different approach than that used for the building surface DCGLs was applied in the computation of the area factors used to establish the $DCGL_{EMC}$. While the $DCGL_W$ is the average concentration over the entire surface area of the EF1 representative room, the $DCGL_{EMC}$ should reflect the exposure an occupant would receive from an area of elevated activity having dimensions that are much smaller than the total interior area of the room. The total surface area of contaminated sources for the EF1 representative room is 918 m^2, which includes the floor, four walls, and ceiling. The calculation of AFs assumed activity on a single surface that did not exceed 100 m^2. Elevated measurement comparisons (i.e., assessments of residual activity greater than the DCGL value) will occur only in Class 1 areas. Contamination levels exceeding DCGL values (or for a radionuclide mixture, a sum of the fraction exceeding one) are not expected in Class 2 or Class 3 survey units and, if found, would result in re-classification of the entire area (or a portion of the area) to Class 1. Accordingly, the recommended limit to the size of a Class 1 structure, 100 m^2, given in Reference 6-2, was established as the upper bound (or base case) for sizes used to develop AFs for building surfaces.

The total doses for various areas of the contaminated source are calculated using RESRAD-BUILD Version 3.4. The model used in RESRAD-BUILD is similar to that used in the model for calculating building surface $DCGL_w$ values. However, only one source is modeled, instead of the five sources considered in calculating the building surface $DCGL_w$ values. The receptor is located at the source midpoint at a distance of 1 m away. All other input parameters and assumed active exposure pathways are the same as those used in the calculations for building surface DCGLs and are presented in Appendix 6K. Appendix 6L presents the radionuclide-specific area factors.

6.7.2 Calculation of Area Factors for the Soils

Area factors for the resident farmer are calculated using the RESRAD 6.4 computer code using the input parameters from the original soils analysis and a unit activity of 1 pCi/g. As the contaminated area (A) decreases, some members of the set of ingestion pathway input parameters referred to as Contamination Fractions also decreases, using the equation in Reference 6-10. A Contamination Fraction indicates the fraction of a person's total diet that is obtained from the contaminated area. As the contaminated area decreases below a certain size, it is reasonable to assume that the fraction of the person's total diet from the contaminated area will also decrease proportionately.

The contaminated fractions for drinking water, livestock water, irrigation water, and aquatic food are not allowed to decrease as the size of the contaminated zone decreases. Use of a value equal to 1.0 incorporates the assumption that all water used by the resident farmer comes from the site (i.e., residential well), regardless of the size of the contaminated area.

Adjustments to the contaminated fractions for plants, meat, and milk are made using equations from the RESRAD User's Manual (Reference 6-10). Values of the multiplier are listed in Appendix 6M as a function of the size of the contaminated zone. Appendix 6P provides contaminated fraction values as a function of the area of the contaminated zone.

The fraction of household water remains set at 1.0 for all sizes of contaminated zones, which is consistent with the RESRAD code input screen that does not allow deviation from the default value of 1.0.

As with buildings, elevated measurement comparisons (i.e., assessments of residual activity greater than the DCGL value) will occur only in Class 1 survey units. Contamination levels exceeding DCGL values (or for a radionuclide mixture, a sum of the fraction exceeding one) are not expected in Class 2 or Class 3 open land areas and, if found, would result in re-classification of the entire area (or a portion of the area) to a Class 1 open land survey unit. Accordingly, the recommended limit to the size of a Class 1 open land survey unit, 2,000 m^2 given in Reference 6-2, was established as the upper bound (or base case) for sizes used to develop AFs for the soil DCGLs.

The total doses corresponding to the various areas of the contaminated zone are calculated using the input parameter values listed in Appendix 6M. Appendix 6N provides the soil AF values by radionuclide and area.

6.8 References

6.8.1 Code of Federal Regulations, Title 10, Section 20.1402, "Radiological Criteria for Unrestricted Uses."

6.8.2 NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," December 1997.

6.8.3 NUREG/CR-5512, "Residual Radioactivity from Contamination"

Volume 1: "Technical Basis for Translating Contamination Levels to Annual Total

Effective Dose Equivalent," dated October 1992.

Volume 2: "User's Manual DandD Version 2.1," April 2001

Volume 3: "Parameter Analysis, Draft Report for Comment," October 1999.

6.8.4 NUREG-1757, "Consolidated NMSS Decommissioning Guidance," September 2003.

6.8.5 Detroit Edison Technical Based Document, "Radionuclide Selection for DCGL Development," Enrico Fermi Unit 1, NSEF-08-0018, July 21, 2008.

6.8.6 NUREG/CR-6676, "Probabilistic Dose Analysis Using Parameter Distributions Developed for RESRAD and RESRAD-BUILD Codes," May 2000.

6.8.7 NUREG/CR-6692, "Probabilistic Modules for the RESRAD and RESRAD-BUILD Computer Codes," November 2000.

6.8.8 NUREG/CR-6697, "Development of Probabilistic RESRAD 6.0 and RESRAD-BUILD 3.0 Computer Codes, November 2000.

6.8.9 NUREG/CR-6755, "Technical Basis for Calculating Radiation Doses for the Building Occupancy Scenario Using the Probabilistic RESRAD-BUILD 3.0 Code," February 2002.

6.8.10 ANL/EAD-4, "Users Manual for RESRAD Version 6.0," Yu, C. et al., July 2001.

6.8.11 Bartlett Engineering Calculation ENG-001, Sensitivity Analyses to Support EF1 Building Surface DCGLs, July 2008.

6.8.12 Bartlett Engineering Calculation ENG-002, Sensitivity Analysis for EF1 DCGLs for Soil, July 2008.

6.8.13 Bartlett Engineering Calculation ENG-003, Calculation of EF1 Building Surface DCGLs, September 2008.

6.8.14 Bartlett Engineering Calculation ENG-004, Calculation of EF1 Soil DCGLs, September 2008.

6.8.15 Bartlett Engineering Calculation ENG-005, Calculation of EF1 Building Surface Area Factors, October 2008.

6.8.16 Bartlett Engineering Calculation ENG-006, Calculation of DECo EF1 Area Factor for Soil, October 2008.

6.8.17 Report on Groundwater Characterization, Enrico Fermi 1 License Termination, Golder Associates, Inc, October 2007.

Table 6-1: Potential Radionuclides of Concern at the EF1 Site

Radionuclide	Half-Life[a] (y)	Primary Decay Mode[b]
Ag-108m	1.27E+02	γ
Am-241	4.32E+02	α
C-14	5.73E+03	β
Cm-242	2.85E+01	α
Cm243	1.81E+01	α
Co-60	5.27E+00	γ
Cs-134	2.06E+00	γ
Cs-137	3.02E+01	γ
Eu-152	1.36E+01	γ
Eu-154	8.80E+00	γ
Eu-155	4.96E+00	γ
Fe-55	2.70E+00	β
H-3	1.23E+01	β
Na-22	2.60E+00	γ
Nb-94	2.03E+04	γ
Ni-59	7.50E+04	β
Ni-63	1.00E+02	β
Pu-238	8.78E+01	α
Pu-239	2.41E+04	α
Pu-240	6.60E+03	α
Pu-241	1.44E+01	α
Sb-125	2.77E+00	γ
Sr-90	2.86E+01	β
Tc-99	2.13E+05	β

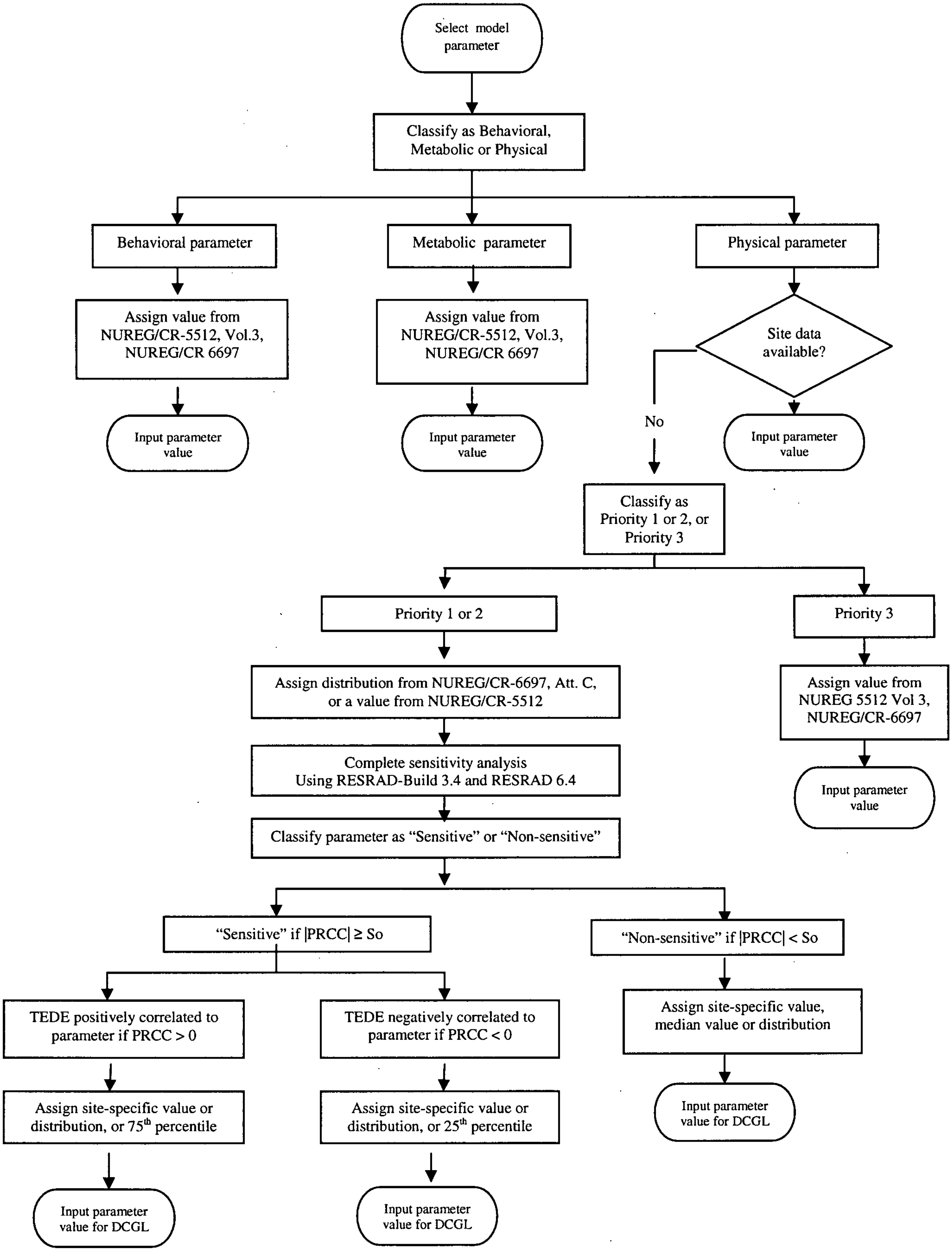
[a] Half-life values taken from Table 1 in Reference 6-5.
[b] γ denotes gamma decay, β denotes beta decay, and α denotes alpha decay

Table 6-2: DCGLs by Radionuclide and Medium Type

Radionuclide	Building Surface[a] (dpm/100cm^2)	Soil[a] (pCi/g)
Ag-108m	1.8E+04	7.8E+00
Am-241	5.0E+03	1.3E+02
C-14	1.0E+07	4.5E+02
Cm-242	3.1E+05	7.7E+03
Cm-243	7.2E+03	7.8E+01
Co-60	1.1E+04	5.1E+00
Cs-134	1.7E+04	8.3E+00
Cs-137	3.9E+04	1.7E+01
Eu-152	2.2E+04	1.1E+01
Eu-154	2.0E+04	1.1E+01
Eu-155	3.6E+05	4.0E+02
Fe-55	4.1E+07	3.4E+04
H-3	2.9E+08	3.1E+04
Na-22	1.3E+04	6.2E+00
Nb-94	1.5E+04	1.2E+02
Ni-59	6.0E+05	1.1E+04
Ni-63	3.6E+07	4.0E+03
Pu-238	5.7E+03	1.6E+02
Pu-239	5.0E+03	1.4E+02
Pu-240	5.0E+03	1.4E+02
Pu241	2.7E+05	5.2E+03
Sb-125	5.9E+04	3.4E+01
Sr-90	1.4E+05	1.2E+01
Tc-99	1.4E+07	1.2E+02

[a] DCGL values correspond to an annual dose of 25 mrem.

Figure 6-1: Parameter Selection Process



Appendix 6A

Basis for Site-Specific Parameter Values: Building Surfaces

Site-specific information was used when available as the basis for the RESRAD-Build input parameter discussed below. Reference 6-11, which documents the calculations of site-specific parameter values, provides the information presented below.

1. Room Dimensions.

The room on the second floor of the Sodium Building was selected as a representative room for the EF1 site buildings and was used as the modeling basis for the building surfaces DCGLs. Table 6A-1 shows the dimensions, unit conversion, and the area associated with each source (i.e., floor, walls, and ceiling) for the modeled room.

Table 6A-1: Representative Room for EF1 Site

Source No.	Description	Recorded Dimension[a]	ft	m[b]	m^2
1	floor				315.97
2	north wall	39' 2"	39.17	11.94	43.67
3	east wall	86' 10"	86.83	26.47	96.81
4	south wall	39' 2"	39.17	11.94	43.67
5	west wall	86' 10"	86.83	26.47	96.81
6	ceiling				315.97
	wall height	12'	12.00	3.66	
				total room area:	912.88

[a] Recorded dimensions for representative room.
[b] Feet to meter conversion factor: 1ft = 0.3048m.

The wall length and height dimensions defined the room model and the location of the receptor.

2. Source Configuration.

NUREG/CR-6755 (Reference 6-9), Section 4.0, describes three principal assumptions inherent in the building scenario: a fixed room area, uniform surface contamination, and the receptor location at the center of the floor at a height of 1meter. The room dimensions in Table 1-1 were used as the configuration bases for the source and the receptor locations. The RESRAD-Build input parameters for receptor location and the centers of sources are provided in Table 6A-2.

Table 6A-2: Location of Center of Sources and Receptor

Source No.	Description	Location (m)		
		X-axis	Y-axis	Z-axis
1	floor	5.97	13.23	0.00
2	north wall	5.97	26.47	1.83
3	east wall	11.94	13.23	1.83
4	south wall	5.97	0.00	1.83
5	west wall	0.00	13.23	1.83
6	ceiling	5.97	13.23	3.66
	receptor	5.97	13.23	1.0

3. Direct Ingestion Rate.

The RESRAD-Build source-specific input parameter, Direct Ingestion Rate, is the direct ingestion rate of the source by any receptor in the room. Direct ingestion represents the fraction of the source ingested per hour. NUREG/CR-5512 (Reference 6-3), Volume 3, defines the average ingestion rate of 1.1E-4 m^2/h as representative for the average individual in an industrial setting. The Direct Ingestion Rate for use in the Building Occupancy Scenario was calculated based on the total room surface area (i.e., source area). The surface area is equal to the sum of the surface area of four walls, plus the surface areas of the floor and ceiling (912.88 m^2, as shown in Table 6A-1).

Direct Ingestion Rate = Average Ingestion Rate/Source Area
= (1.1E-4m^2/h)/(912.88 m^2)
= 1.2E-7 h^{-1}

Appendix 6B

Input Parameter Values for Sensitivity Analysis: Building Surfaces

(Extracted from Reference 6-11)

Table 6B-1: Input Parameter Values for Sensitivity Analysis: Building Occupancy Scenario

Parameter	Type[a]	Priority[b]	Treat-ment[c]	Value or Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]			
						1	2	3	4
Exposure Duration (d)	B	3	D	365.25	NUREG/CR-5512, Vol.3,section 5.2.1	NR[e]	NR	NR	NR
Indoor Fraction	B	2	D	0.267	NUREG/CR-5512, Vol.3,section 5.2.2.4	NR	NR	NR	NR
Evaluation Time (y)	P	3	D	1 or multiple (e.g., 1,10, 50, 100)	T=1 corresponds to dose over the 1st year	NR	NR	NR	NR
Number of Rooms	P	3	D	1	NUREG/CR-5512	NR	NR	NR	NR
Deposition Velocity (m/s)	P	2	S	Loguniform	NUREG/CR-6755, Section 3.3; NUREG/CR-6697, Att.C, section 7.5	2.70E-06	2.70E-03	-	-
Resuspension Rate (s^{-1})	P	1	S	Loguniform	NUREG/CR-6755, Section 3.1; NUREG/CR-6697, Att.C, section 7.2	2.5E-11	1.35E-5	-	-
Air Exchange Rate for Room (h^{-1})	B	2	D	1.52	NUREG/CR-6697, Att. C, section 7.4 and NUREG/CR-6755, section 3.2	NR	NR	NR	NR
Room Area (m^2)	P	2	D	315.97	Site-specific data	NR	NR	NR	NR
Room Height (m)	P	2	D	3.66	Site-specific data	NR	NR	NR	NR
Time Fraction	B	3	D	1	NUREG/CR-5512	NR	NR	NR	NR
Inhalation Rate (m^3/d)	M	2	D	33.6	NUREG/CR-6697; NUREG/CR-5512, vol. 3, section 5.3.4	NR	NR	NR	NR
Indirect Ingestion Rate (m^2/h)	B	2	D	0.00011	NUREG/CR6755, A.3.3, Table A.12	NR	NR	NR	NR
Receptor Location	B	3	D	5.97, 13.23, 1	NUREG/CR-5512; center of room based on site-specific room dimensions	NR	NR	NR	NR

Table 6B-1: Input Parameter Values for Sensitivity Analysis: Building Occupancy Scenario

Parameter	Type[a]	Priority[b]	Treat-ment[c]	Value or Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]			
						1	2	3	4
Shielding Thickness (cm)	P	2	D	0	Site-specific model-no shielding assumed	NR	NR	NR	NR
Shielding Density (g/cm^3)	P	1	D	0	Site-specific model-no shielding assumed	NR	NR	NR	NR
Shielding Material	P	3	D	None	Site-specific model-no shielding assumed	NR	NR	NR	NR
Number of Sources	P	3	D	6	Site-specific modeling (includes floor, 4 walls, plus ceiling)				
External Dose Conversion Factor, (mrem/y per pCi/cm^2)	M	3	D	RESRAD-Build default	FGR12				
Air Submersion Dose Conversion Factor, (mrem/y per pCi/m^3)	M	3	D	RESRAD-Build default	FGR12				
Inhalation Dose Conversion Factor, (mrem/pCi)	M	3	D	RESRAD-Build default	FGR11				
Ingestionl Dose Conversion Factor, (mrem/pCi)	M	3	D	RESRAD-Build default	FGR11				
Source 1: Floor									
Type	P	3	D	area	NUREG/CR-5512				
Direction	P	3	D	Z	NUREG/CR-5512				
Location of Center of Source: x,y,z (m)	P	3	D	5.97, 13.23, 0	Site-Specific Modeling				
Source length X-axis (m)	P	2	D	11.94	Site-Specific Modeling				
Source length Y-axis (m)	P	2	D	26.47	Site-Specific Modeling				
Area (m^2)	P	2	D	315.97	Site-Specific Modeling				
Air Fraction for H-3	B	2	D	1.0	NUREG/CR-6697, Att. C Section 8.6				
Air Fraction (all nuclides other than H-3)	B	2	D	0.07	NUREG/CR-6697, Att. C Section 8.6				
Direct Ingestion (h^{-1})	B	2	D	1.2E-7	NUREG/CR6755, A.3.3				

Table 6B-1: Input Parameter Values for Sensitivity Analysis: Building Occupancy Scenario

Parameter	Type[a]	Priority[b]	Treat-ment[c]	Value or Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]			
						1	2	3	4
Removable Fraction	P	1	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5				
Time for Source Removal (d)	P	2	S	Triangular	NUREG/CR-6755, Section 3.6; NUREG/CR-6697, Att.C, 8.8	1000	100000	10000	-
Radionuclide Concentration (pCi/m^2)	P	2	D	1.0	-	-	-	-	-
Source 2: North Wall									
Type	P	3	D	Area	NUREG/CR-5512				
Direction	P	3	D	Y	NUREG/CR-5512				
Location of Center of Source: x,y,z (m)	P	3	D	5.97, 26.47, 1.83	Site-Specific Modeling				
Source length X-axis (m)	P	2	D	11.94	Site-Specific Modeling				
Source length Z-axis (m)	P	2	D	3.66	Site-Specific Modeling				
Area (m^2)	P	2	D	43.67	Site-Specific Modeling				
Air Fraction for H-3	B	2	D	1.0	NUREG/CR-6697, Att. C, Section 8.6				
Air Fraction (all nuclides other than H-3)	B	2	D	0.07	NUREG/CR-6697, Att. C, Section 8.6				
Direct Ingestion (h^{-1})	B	2	D	1.2E-7	NUREG/CR6755, A.3.3				
Removable Fraction	P	1	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5				
Time for Source Removal (d)	P	2	S	Triangular	NUREG/CR-6755, Section 3.6; NUREG/CR-6697, Att.C, 8.8	1000	100000	10000	-
Radionuclide Concentration (pCi/m^2)	P	2	D	1.0	-	-	-	-	-
Source 3: East Wall									
Type	P	3	D	Area	NUREG/CR-5512				

Table 6B-1: Input Parameter Values for Sensitivity Analysis: Building Occupancy Scenario									
Parameter	Type[a]	Priority[b]	Treat-ment[c]	Value or Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]			
						1	2	3	4
Direction	P	3	D	X	NUREG/CR-5512				
Location of Center of Source: x,y,z (m)	P	3	D	11.94, 13.23, 1.83	Site-Specific Modeling				
Source length Y-axis (m)	P	2	D	26.47	Site-Specific Modeling				
Source length Z-axis (m)	P	2	D	3.66	Site-Specific Modeling				
Area (m^2)	P	2	D	96.81	Site-Specific Modeling				
Air Fraction for H-3	B	2	D	1.0	NUREG/CR-6697, Att. C Section 8.6				
Air Fraction (all nuclides other than H-3)	B	2	D	0.07	NUREG/CR-6697, Att. C Section 8.6				
Direct Ingestion (h^{-1})	B	2	D	1.2E-7	NUREG/CR6755, A.3.3				
Removable Fraction	P	1	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5				
Time for Source Removal (d)	P	2	S	Triangular	NUREG/CR-6755, Section 3.6; NUREG/CR-6697, Att.C, 8.8	1000	100000	10000	-
Radionuclide Concentration (pCi/m^2)	P	2	D	1.0	-	-	-	-	-
Source 4: South Wall									
Type	P	3	D	area	NUREG/CR-5512				
Direction	P	3	D	Y	NUREG/CR-5512				
Location of Center of Source: x,y,z (m)	P	3	D	5.97, 0, 1.83	Site-Specific Modeling				
Source length X-axis (m)	P	2	D	11.94	Site-Specific Modeling				
Source length Z-axis (m)	P	2	D	3.66	Site-Specific Modeling				
Area (m^2)	P	2	D	43.67	Site-Specific Modeling				
Air Fraction for H-3	B	2	D	1.0	NUREG/CR-6697, Att. C Section 8.6				
Air Fraction (all nuclides other than H-3)	B	2	D	0.07	NUREG/CR-6697, Att. C Section 8.6				

Table 6B-1: Input Parameter Values for Sensitivity Analysis: Building Occupancy Scenario

Parameter	Type[a]	Priority[b]	Treat-ment[c]	Value or Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]			
						1	2	3	4
Direct Ingestion (h^{-1})	B	2	D	1.2E-7	NUREG/CR6755, A.3.3				
Removable Fraction	P	1	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5				
Time for Source Removal (d)	P	2	S	Triangular	NUREG/CR-6755, Section 3.6; NUREG/CR-6697, Att.C, 8.8	1000	100000	10000	-
Radionuclide Concentration (pCi/m^2)	P	2	D	1.0	-	-	-	-	-
Source 5: West Wall									
Type	P	3	D	area	NUREG/CR-5512				
Direction	P	3	D	X	NUREG/CR-5512				
Location of Center of Source: x,y,z (m)	P	3	D	0, 13.23, 1.83	Site-Specific Modeling				
Source length Y-axis (m)	P	2	D	26.47	Site-Specific Modeling				
Source length Z-axis (m)	P	2	D	3.66	Site-Specific Modeling				
Area (m^2)	P	2	D	96.81	Site-Specific Modeling				
Air Fraction for H-3	B	2	D	1.0	NUREG/CR-6697, Att. C Section 8.6				
Air Fraction (all nuclides other than H-3)	B	2	D	0.07	NUREG/CR-6697, Att. C Section 8.6				
Direct Ingestion (h^{-1})	B	2	D	1.2E-7	NUREG/CR6755, A.3.3				
Removable Fraction	P	1	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5				
Time for Source Removal (d)	P	2	S	Triangular	NUREG/CR-6755, Section 3.6; NUREG/CR-6697, Att.C, 8.8	1000	100000	10000	-
Radionuclide Concentration (pCi/m^2)	P	2	D	1.0	-	-	-	-	-

Table 6B-1: Input Parameter Values for Sensitivity Analysis: Building Occupancy Scenario

Parameter	Type[a]	Priority[b]	Treat-ment[c]	Value or Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]			
						1	2	3	4
Source 6: Ceiling									
Type	P	3	D	area	NUREG/CR-5512				
Direction	P	3	D	Z	NUREG/CR-5512				
Location of Center of Source: x,y,z (m)	P	3	D	5.97, 13.23, 3.66	Site-Specific Modeling				
Source length X-axis (m)	P	2	D	11.94	Site-Specific Modeling				
Source length Y-axis (m)	P	2	D	26.47	Site-Specific Modeling				
Area (m^2)	P	2	D	315.97	Site-Specific Modeling				
Air Fraction for H-3	B	2	D	1.0	NUREG/CR-6697, Att. C Section 8.6				
Air Fraction (all nuclides other than H-3)	B	2	D	0.07	NUREG/CR-6697, Att. C Section 8.6				
Direct Ingestion (h^{-1})	B	2	D	1.2E-7	NUREG/CR6755, A.3.3				
Removable Fraction	P	1	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5				
Time for Source Removal (d)	P	2	S	Triangular	NUREG/CR-6755, Section 3.6; NUREG/CR-6697, Att.C, 8.8	1000	100000	10000	-
Radionuclide Concentration (pCi/m^2)	P	2	D	1.0	-	-	-	-	-

[a] P = physical, B = behavioral, M = metabolic; (see NUREG/CR-6697, Attachment B, Table 4.)
[b] 1 = high-priority parameter, 2 = medium-priority parameter, 3 = low-priority parameter (see NUREG/CR-6697, Attachment B, Table 4.1)
[c] D = deterministic, S = stochastic
[d] Distribution Statistical Parameters:
Loguniform: 1= minimum, 2 = maximum
Triangular: 1 = minimum, 2 = maximum, 3 = most likely
[e] NR = none recommended
Additional Sensitivity Analysis Data:
Random Seed = 1000
Number of observations = 300
Number of repetitions = 1
Input Rank Correlation Coefficients:
Resuspension Rate and Deposition Velocity = 0.9
Time for source removal (correlation set between sources) = 0.9

Appendix 6C

Results of Sensitivity Analysis: Building Surfaces

(Extracted from Reference 6-11)

Table 6C-1: Results of Sensitivity Analysis: Building Surface

Radionuclide	PRCC values in descending rank order		
	RFO[a] (source #)	UD[b] (source #)	DKSUS[c] (source #)
Ag-108m	0.82 (1) 0.69 (6) 0.38 (5) 0.35 (3)	0.61 (2) 0.59 (4) 0.46 (6) 0.45 (1) 0.39 (5) 0.34 (3)	-0.77 (2, 4) -0.53 (6) -0.50 (1) -0.46 (5) -0.44 (3)
Am-241	-1.00 (1, 2, 3, 4, 5, 6)	0.49 (2, 3) 0.46 (1) 0.43 (6) 0.42 (4, 5)	-0.63 (3) -0.62 (2) -0.59 (1) -0.58 (4, 6) -0.57 (5)
C-14	0.53 (3) 0.50 (2) 0.49 (5) 0.48 (4, 6) 0.47 (1)	0.43 (1, 3, 4, 5) 0.42 (2, 6)	-0.65 (4) -0.64 (1, 2, 3, 5, 6)
Co-60	0.73 (4) 0.72 (2, 5) 0.70 (1, 3) 0.43 (6)	0.54 (4) 0.52 (2) 0.28 (5) 0.21 (3) 0.15 (6)	-0.55 (2, 4) -0.30 (5) -0.20 (3) -0.18 (6)
Cm-242	-0.99 (1, 2, 5) -0.98 (3, 4, 6)	-0.60 (2, 5) -0.58 (1, 3, 6) -0.56 (4)	0.55 (2) 0.54 (5) 0.52 (1, 3) 0.50 (6) 0.49 (4)
Cm-243	-1.00 (1, 2, 3, 4, 5, 6)	0.36 (3) 0.30 (2, 5) 0.25 (1) 0.23 (6) 0.22 (4)	-0.40 (3) -0.34 (5) -0.30 (2) -0.26 (1, 4) -0.25 (6)
Cs-134	0.90 (2, 4) 0.70 (3) 0.69 (5) 0.51 (1) 0.32 (6)	0.41 (2, 4) 0.15 (3) 0.12 (5)	-0.41 (4) -0.40 (2) -0.17 (3) -0.11 (5)
Cs-137	0.85 (1) 0.80 (6) 0.77 (3, 5) 0.71 (2) 0.69 (4)	0.54 (3) 0.53 (5) 0.52 (4) 0.49 (2) 0.47 (6) 0.45 (1)	-0.58 (5) -0.57 (3, 4) -0.54 (2) -0.50 (6) -0.49 (1)

Radionuclide	PRCC values in descending rank order		
	RFO[a] (source #)	UD[b] (source #)	DKSUS[c] (source #)
Eu-152	0.81 (6) 0.67 (1) 0.44 (5) 0.43 (3) 0.25 (2) -0.13 (4)	0.51 (4) 0.42 (2) 0.38 (6) 0.26 (3, 5)	-0.54 (4) -0.51 (2) -0.40 (6) -0.30 (5) -0.26 (3) -0.11 (1)
Eu-154	0.86 (6) 0.56 (3) 0.52 (5) 0.36 (1) -0.15 (4)	0.67 (4) 0.40 (6) 0.39 (2) 0.32 (5) 0.24 (3)	-0.71 (4) -0.44 (2) -0.40 (6) -0.35 (5) -0.26 (3)
Eu-155	0.89 (1) 0.70 (6) 0.45 (3) 0.44 (5) -0.71 (2) -0.70 (4)	0.49 (5) 0.39 (3) 0.23 (6) 0.16 (4) 0.15 (1, 2)	-0.50 (5) -0.40 (3) -0.25 (6) -0.15 (1) -0.14 (2, 4)
Fe-55	0.98 (4) 0.97 (1, 2, 6) 0.91 (3, 5)	0.59 (4, 6) 0.57 (2) 0.53 (1) 0.40 (3) 0.36 (5)	-0.58 (4, 6) -0.57 (2) -0.52 (1) -0.39 (3) -0.38 (5)
H-3	-0.74 (5) -0.71 (2) -0.70 (4, 6) -0.69 (1) -0.68 (3)	0.67 (1, 2) 0.66 (3, 4, 5) 0.65 (6)	-0.73 (1, 5) -0.72 (2, 3, 4) -0.71 (6)
Mn-54	0.93 (5) 0.92 (1, 3) 0.78 (6) 0.67 (2) 0.60 (4)	0.16 (3) 0.15 (2) 0.14 (4) 0.12 (5)	-0.16(2) -0.13 (5) -0.12 (3, 4) -0.11 (6)
Na-22	0.80 (2) 0.77 (4) 0.73 (3) 0.71 (5) 0.66 (1) 0.40 (6)	0.46 (2) 0.38 (4) 0.18 (3) 0.16 (5)	-0.44 (2) -0.37 (4) -0.17 (5) -0.16 (3)
Nb-94	0.52 (1) 0.27 (6) 0.21 (5) 0.18 (3) -0.43 (2) -0.49 (4)	0.50 (4) 0.48 (2) 0.37 (5) 0.35 (3) 0.25 (1) 0.24 (6)	-0.76 (4) -0.73 (2) -0.59 (5) -0.57 (3) -0.37 (1) -0.34 (6)

Radionuclide	PRCC values in descending rank order		
	RFO[a] (source #)	UD[b] (source #)	DKSUS[c] (source #)
Ni-59	-0.72 (5) -0.71 (4) -0.70 (2) -0.69 (1, 6) -0.66 (3)	0.48 (5) 0.47 (1, 2, 3) 0.46 (4) 0.43 (6)	-0.74 (5) -0.73 (2, 3, 4) -0.72 (1) -0.70 (6)
Ni-63	-0.70 (2, 4) -0.69 (1) -0.67 (6) -0.66 (5) -0.59 (3)	0.65 (2, 4) 0.64 (1) 0.62 (6) 0.56 (5) 0.53 (3)	-0.79 (4) -0.78 (1, 2) -0.77 (6) -0.70 (5) -0.69 (3)
Pu-238	-0.92 (6) -0.91 (1) -0.58 (5) -0.57 (3) -0.41 (2) -0.26 (4)	0.17 (1, 2, 3, 4, 5, 6)	-0.15 (1, 2, 3, 4, 5, 6)
Pu-239	-1.00 (1, 2, 3, 4, 5, 6)	0.41 (2) 0.39 (3) 0.37 (1) 0.36 (5) 0.34 (4) 0.33 (6)	-0.60 (2, 3) -0.57 (5) -0.56 (1) -0.55 (4) -0.54 (6)
Pu-240	-1.00 (1, 2, 3, 4, 5, 6)	0.42 (2) 0.41 (3) 0.37 (5) 0.36 (1, 4) 0.35 (6)	-0.61 (2, 3) -0.57 (4, 5) -0.55 (1, 6)
Pu-241	-1.00 (1, 2, 3, 4, 5, 6)	-0.37 (4) -0.33 (1) -0.31 (6) -0.29 (5) -0.27 (2, 3)	0.38 (4) 0.34 (1) 0.32 (6) 0.31 (2) 0.28 (5) 0.26 (3)
Sb-125	0.88 (1) 0.87 (5) 0.86 (2) 0.85 (3) 0.83 (4) 0.76 (6)	0.54 (2) 0.51 (4) 0.19 (3, 5, 6)	-0.52 (2) -0.49 (4) -0.19 (6) -0.18 (3, 5)
Sr-90	0.31 (2, 4, 6) 0.29 (3) 0.28 (5) 0.25 (1)	0.66 (3) 0.65 (5) 0.63 (2, 4, 6) 0.60 (1)	-0.76 (3, 5) -0.73 (2, 4, 6) -0.71 (1)

Radionuclide	PRCC values in descending rank order		
	RFO[a] (source #)	UD[b] (source #)	DKSUS[c] (source #)
Tc-99	0.41 (3) 0.36 (5) 0.34 (2, 6) 0.33 (1) 0.26 (4)	0.47 (5) 0.46 (3, 4, 6) 0.44 (1) 0.42 (2)	-0.72 (4, 5, 6) -0.71 (3) -0.70 (1) -0.69 (2)

[a] RFO(#) = source removal time (for source number)
[b] UD = deposition velocity
[c] DKSUS = resuspension rate

Appendix 6D

Input Parameter Values for DCGL Determination: Building Surfaces

(Extracted from Reference 6-13)

Table 6D-1: Input Parameter Values for Building Surface DCGLs

Parameter	Type[a]	Nuclide	Treatment[b]	Value/Distribution	Value Reference Source
Exposure Duration (d)	B	All	D	365.25	NUREG/CR-5512, Vol.3,section 5.2.1
Indoor Fraction	B	All	D	0.267	NUREG/CR-5512, Vol.3,section 5.2.2.9
Evaluation Time (y)	P	All		1	Use of 1y provides doses at t=0y and t=1y.
Number of Rooms	P	All	D	1	NUREG/CR-5512
Deposition Velocity (m/s)	P	Cm-242 Pu-241 All Others	D D D	1.5179E-05 1.5179E-05 4.78217E-04	25th percentile value 25th percentile value 75th percentile value
Resuspension Rate (s^{-1})	P	Cm-242 Pu-241 All Others	D D D	4.87543E-07 4.87543E-07 6.70403E-10	75th percentile value 75th percentile value 25th percentile value
Air Exchange Rate for Room (h^{-1})	B	All	D	1.52	NUREG/CR-6697, Att. C, sec. 7.4 and NUREG/CR-6755, sec. 3.2
Room Area (m^2)	P	All	D	315.97	Site-specific data
Room Height (m)	P	All	D	3.66	Site-specific data
Time Fraction	B	All	D	1	NUREG/CR-5512
Inhalation Rate (m^3/d)	M	All	D	45.6	Inhalation rate for moderate to heavy activities - NUREG/CR-6697, Attachment C, section 5.1; NUREG/CR-5512, vol. 3, section 5.3.4
Indirect Ingestion Rate (m^2/h)	B	All	D	0.00011	NUREG/CR6755, A.3.3, Table A.12
Receptor Location	B	All	D	5.97, 13.23, 1	NUREG/CR-5512; site-specific room dimensions
Shielding Thickness (cm)	P	All	D	0	Site-specific model-no shielding assumed
Shielding Density (g/cm^3)	P	All	D	2.4	RESRAD-Build default value for concrete – not used in DCGL calculations
Shielding Material	P	All	D	concrete	Default input – not used in DCGL calculations
Number of Sources	P	All		6	Modeling for representative room
External Dose Conversion Factor, (mrem/y per pCi/cm^2)	M	All	D	RESRAD-Build default	FGR12
Air Submersion Dose Conversion Factor, (mrem/y per pCi/m^3)	M	All	D	RESRAD-Build default	FGR12
Inhalation Dose Conversion Factor, (mrem/pCi)	M	All	D	RESRAD-Build default	FGR11
Ingestionl Dose Conversion Factor, (mrem/pCi)	M	All	D	RESRAD-Build default	FGR11
Source 1: Floor					
Type	P	All		area	NUREG/CR-5512
Direction	P	All		Z	NUREG/CR-5512
Location of Center of Source: x,y,z (m)	P	All	D	5.97, 13.23, 0	Site-Specific Modeling
Source length X-axis (m)	P	All	D	11.94	Site-Specific Modeling
Source length Y-axis (m)	P	All	D	26.47	Site-Specific Modeling
Area (m^2)	P	All	D	---	Source length inputs used
Air Fraction	B	H-3 All others	D	1.0 0.07	NUREG/CR-6697, Att. C Section 8.6

Table 6D-1: Input Parameter Values for Building Surface DCGLs

Parameter	Type[a]	Nuclide	Treatment[b]	Value/Distribution	Value Reference Source
Direct Ingestion (h^{-1})	B	All	D	1.2E-7	NUREG/CR6755, A.3.3
Removable Fraction	P	All	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5
Time for Source Removal (d)	P	Ag-108m	D	52,695.2	75th percentile value
		Am-241	D	18,249.3	25Th percentile value
		C-14	D	52,695.2	75Th percentile value
		Co-60	D	52,695.2	75Th percentile value
		Cm-242	D	18,249.3	25Th percentile value
		Cm-243	D	18,249.3	25Th percentile value
		Cs-134	D	52,695.2	75Th percentile value
		Cs-137	D	52,695.2	75Th percentile value
		Eu-152	D	52,695.2	75Th percentile value
		Eu-154	D	52,695.2	75Th percentile value
		Eu-155	D	52,695.2	75Th percentile value
		Fe-55	D	52,695.2	75Th percentile value
		H-3	D	18,249.3	25Th percentile value
		Mn-54	D	52,695.2	75Th percentile value
		Na_22	D	52,695.2	75Th percentile value
		Nb-94	D	52,695.2	75Th percentile value
		Ni-59	D	18,249.3	25Th percentile value
		Ni-63	D	18,249.3	25Th percentile value
		Pu-238	D	18,249.3	25Th percentile value
		Pu-239	D	18,249.3	25Th percentile value
		Pu-240	D	18,249.3	25Th percentile value
		Pu-241	D	18,249.3	25Th percentile value
		Sb-125	D	52,695.2	75Th percentile value
		Sr-90	D	52,695.2	75Th percentile value
		Tc-99	D	52,695.2	75Th percentile value
Radionuclide Concentration (pCi/m^2)	P	All	D	1.0	-
Source 2: North Wall					
Type	P	3		Area	NUREG/CR-5512
Direction	P	3		Y	NUREG/CR-5512
Location of Center of Source: x,y,z (m)	P	3	D	5.97, 26.47, 1.83	Site-Specific Modeling
Source length X-axis (m)	P	2	D	11.94	Site-Specific Modeling
Source length Z-axis (m)	P	2	D	3.66	Site-Specific Modeling
Area (m^2)	P	2	D	---	Source length inputs used
Air Fraction	B	H-3 All others	D	1.0 0.07	NUREG/CR-6697, Att. C Section 8.6
Direct Ingestion (h^{-1})	B	2	D	1.2E-7	NUREG/CR6755, A.3.3
Removable Fraction	P	1	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5

Table 6D-1: Input Parameter Values for Building Surface DCGLs					
Parameter	Type[a]	Nuclide	Treatment[b]	Value/Distribution	Value Reference Source
Time for Source Removal (d)	P	Ag-108m	S	Triangular[c]	NUREG/CR-6755, Section 3.6; NUREG/CR-6697, Att.C, 8.8
		Am-241	D	18,230.1	25[Th] percentile value
		C-14	D	52,718.8	75[Th] percentile value
		Co-60	D	52,718.8	75[Th] percentile value
		Cm-242	D	18,230.1	25[Th] percentile value
		Cm-243	D	18,230.1	25[Th] percentile value
		Cs-134	D	52,718.8	75[Th] percentile value
		Cs-137	D	52,718.8	75[Th] percentile value
		Eu-152	D	52,718.8	75[Th] percentile value
		Eu-154	S	Triangular[c]	NUREG/CR-6755, Section 3.6; NUREG/CR-6697, Att.C, 8.8
		Eu-155	D	18,230.1	25[Th] percentile value
		Fe-55	D	52,718.8	75[Th] percentile value
		H-3	D	18,230.1	25[Th] percentile value
		Mn-54	D	52,718.8	75[Th] percentile value
		Na_22	D	52,718.8	75[Th] percentile value
		Nb-94	D	18,230.1	25[Th] percentile value
		Ni-59	D	18,230.1	25[Th] percentile value
		Ni-63	D	18,230.1	25[Th] percentile value
		Pu-238	D	18,230.1	25[Th] percentile value
		Pu-239	D	18,230.1	25[Th] percentile value
		Pu-240	D	18,230.1	25[Th] percentile value
		Pu-241	D	18,230.1	25[Th] percentile value
		Sb-125	D	52,718.8	75[Th] percentile value
		Sr-90	D	52,718.8	75[Th] percentile value
		Tc-99	D	52,718.8	75[Th] percentile value
Radionuclide Concentration (pCi/m^2)	P	2	D	1.0	-
Source 3: East Wall					
Type	P	3		Area	NUREG/CR-5512
Direction	P	3		X	NUREG/CR-5512
Location of Center of Source: x,y,z (m)	P	3	D	11.94, 13.23, 1.83	Site-Specific Modeling
Source length Y-axis (m)	P	2	D	26.47	Site-Specific Modeling
Source length Z-axis (m)	P	2	D	3.66	Site-Specific Modeling
Area (m^2)	P	2	D	---	Source length inputs used
Air Fraction	B	H-3 All others	D	1.0 0.07	NUREG/CR-6697, Att. C Section 8.6
Direct Ingestion (h^{-1})	B	2	D	1.2E-7	NUREG/CR6755, A.3.3
Removable Fraction	P	1	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5

Table 6D-1: Input Parameter Values for Building Surface DCGLs					
Parameter	Type[a]	Nuclide	Treatment[b]	Value/Distribution	Value Reference Source
Time for Source Removal (d)	P	Ag-108m	D	52,775.6	75th percentile value
		Am-241	D	18,130.2	25Th percentile value
		C-14	D	52,775.6	75Th percentile value
		Co-60	D	52,775.6	75Th percentile value
		Cm-242	D	18,130.2	25Th percentile value
		Cm-243	D	18,130.2	25Th percentile value
		Cs-134	D	52,775.6	75Th percentile value
		Cs-137	D	52,775.6	75Th percentile value
		Eu-152	D	52,775.6	75Th percentile value
		Eu-154	D	52,775.6	75Th percentile value
		Eu-155	D	52,775.6	75Th percentile value
		Fe-55	D	52,775.6	75Th percentile value
		H-3	D	18,130.2	25Th percentile value
		Mn-54	D	52,775.6	75Th percentile value
		Na_22	D	52,775.6	75Th percentile value
		Nb-94	D	52,775.6	75Th percentile value
		Ni-59	D	18,130.2	25Th percentile value
		Ni-63	D	18,130.2	25Th percentile value
		Pu-238	D	18,130.2	25Th percentile value
		Pu-239	D	18,130.2	25Th percentile value
		Pu-240	D	18,130.2	25Th percentile value
		Pu-241	D	18,130.2	25Th percentile value
		Sb-125	D	52,775.6	75Th percentile value
		Sr-90	D	52,775.6	75Th percentile value
		Tc-99	D	52,775.6	75Th percentile value
Radionuclide Concentration (pCi/m^2)	P	2	D	1.0	-
Source 4: South Wall					
Type	P	3		area	NUREG/CR-5512
Direction	P	3		Y	NUREG/CR-5512
Location of Center of Source: x,y,z (m)	P	3	D	5.97, 0, 1.83	Site-Specific Modeling
Source length X-axis (m)	P	2	D	11.94	Site-Specific Modeling
Source length Z-axis (m)	P	2	D	3.66	Site-Specific Modeling
Area (m^2)	P	2	D	---	Source length inputs used
Air Fraction	B	H-3 All others	D	1.0 0.07	NUREG/CR-6697, Att. C Section 8.6
Direct Ingestion (h^{-1})	B	2	D	1.2E-7	NUREG/CR6755, A.3.3
Removable Fraction	P	1	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5

Table 6D-1: Input Parameter Values for Building Surface DCGLs					
Parameter	Type[a]	Nuclide	Treatment[b]	Value/Distribution	Value Reference Source
Time for Source Removal (d)	P	Ag-108m	S	Triangular[c]	NUREG/CR-6755, Section 3.6; NUREG/CR-6697, Att.C, sec 8.8
		Am-241	D	18,207.1	25[Th] percentile value
		C-14	D	52,726.9	75[Th] percentile value
		Co-60	D	52,726.9	75[Th] percentile value
		Cm-242	D	18,207.1	25[Th] percentile value
		Cm-243	D	18,207.1	25[Th] percentile value
		Cs-134	D	52,726.9	75[Th] percentile value
		Cs-137	D	52,726.9	75[Th] percentile value
		Eu-152	D	18,207.1	25[Th] percentile value
		Eu-154	D	18,207.1	25[th] percentile value
		Eu-155	D	18,207.1	25[Th] percentile value
		Fe-55	D	52,726.9	75[Th] percentile value
		H-3	D	18,207.1	25[Th] percentile value
		Mn-54	D	52,726.9	75[Th] percentile value
		Na-22	D	52,726.9	75[Th] percentile value
		Nb-94	D	18,207.1	25[Th] percentile value
		Ni-59	D	18,207.1	25[Th] percentile value
		Ni-63	D	18,207.1	25[Th] percentile value
		Pu-238	D	18,207.1	25[Th] percentile value
		Pu-239	D	18,207.1	25[Th] percentile value
		Pu-240	D	18,207.1	25[Th] percentile value
		Pu-241	D	18,207.1	25[Th] percentile value
		Sb-125	D	52,726.9	75[Th] percentile value
		Sr-90	D	52,726.9	75[Th] percentile value
		Tc-99	D	52,726.9	75[Th] percentile value
Radionuclide Concentration (pCi/m^2)	P	2	D	1.0	-
Source 5: West Wall					
Type	P	3		area	NUREG/CR-5512
Direction	P	3		X	NUREG/CR-5512
Location of Center of Source: x,y,z (m)	P	3	D	0, 13.23, 1.83	Site-Specific Modeling
Source length Y-axis (m)	P	2	D	26.47	Site-Specific Modeling
Source length Z-axis (m)	P	2	D	3.66	Site-Specific Modeling
Area (m^2)	P	2	D	---	Source length inputs used
Air Fraction	B	H-3 All others	D	1.0 0.07	NUREG/CR-6697, Att. C Section 8.6
Direct Ingestion (h^{-1})	B	2	D	1.2E-7	NUREG/CR6755, A.3.3
Removable Fraction	P	1	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5

Table 6D-1: Input Parameter Values for Building Surface DCGLs

Parameter	Type[a]	Nuclide	Treatment[b]	Value/Distribution	Value Reference Source
Time for Source Removal (d)	P	Ag-108m	D	52,713.2	75Th percentile value
		Am-241	D	18,094.8	25Th percentile value
		C-14	D	52,713.2	75Th percentile value
		Co-60	D	52,713.2	75Th percentile value
		Cm-242	D	18,094.8	25Th percentile value
		Cm-243	D	18,094.8	25Th percentile value
		Cs-134	D	52,713.2	75Th percentile value
		Cs-137	D	52,713.2	75Th percentile value
		Eu-152	D	52,713.2	75Th percentile value
		Eu-154	D	52,713.2	75th percentile value
		Eu-155	D	52,713.2	75Th percentile value
		Fe-55	D	52,713.2	75Th percentile value
		H-3	D	18,094.8	25Th percentile value
		Mn-54	D	52,713.2	75Th percentile value
		Na-22	D	52,713.2	75Th percentile value
		Nb-94	D	52,713.2	75Th percentile value
		Ni-59	D	18,094.8	25Th percentile value
		Ni-63	D	18,094.8	25Th percentile value
		Pu-238	D	18,094.8	25Th percentile value
		Pu-239	D	18,094.8	25Th percentile value
		Pu-240	D	18,094.8	25Th percentile value
		Pu-241	D	18,094.8	25Th percentile value
		Sb-125	D	52,713.2	75Th percentile value
		Sr-90	D	52,713.2	75Th percentile value
		Tc-99	D	52,713.2	75Th percentile value
Radionuclide Concentration (pCi/m^2)	P	2	D	1.0	-
Source 6: Ceiling					
Type	P	3		area	NUREG/CR-5512
Direction	P	3		Z	NUREG/CR-5512
Location of Center of Source: x,y,z (m)	P	3	D	5.97, 13.23, 3.66	Site-Specific Modeling
Source length X-axis (m)	P	2	D	11.94	Site-Specific Modeling
Source length Y-axis (m)	P	2	D	26.47	Site-Specific Modeling
Area (m^2)	P	2	D	---	Source length inputs used
Air Fraction	B	H-3 All others	D	1.0 0.07	NUREG/CR-6697, Att. C Section 8.6 (p. 8-14 and 8-15)
Direct Ingestion (h^{-1})	B	2	D	1.2E-7	NUREG/CR6755, A.3.3
Removable Fraction	P	1	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5

Table 6D-1: Input Parameter Values for Building Surface DCGLs

Parameter	Type[a]	Nuclide	Treatment[b]	Value/Distribution	Value Reference Source
Time for Source Removal (d)	P	Ag-108m	D	52,622.2	75th percentile value
		Am-241	D	18,246.6	25Th percentile value
		C-14	D	52,622.2	75Th percentile value
		Co-54	D	52,622.2	75Th percentile value
		Cm-242	D	18,246.6	25Th percentile value
		Cm-243	D	18,246.6	25Th percentile value
		Cs-134	D	52,622.2	75Th percentile value
		Cs-137	D	52,622.2	75Th percentile value
		Eu-152	D	52,622.2	75Th percentile value
		Eu-154	D	52,622.2	75th percentile value
		Eu-155	D	52,622.2	75Th percentile value
		Fe-55	D	52,622.2	75Th percentile value
		H-3	D	18,246.6	25Th percentile value
		Mn-54	D	52,622.2	75Th percentile value
		Na-22	D	52,622.2	75Th percentile value
		Nb-94	D	52,622.2	75Th percentile value
		Ni-59	D	18,246.6	25Th percentile value
		Ni-63	D	18,246.6	25Th percentile value
		Pu-238	D	18,246.6	25Th percentile value
		Pu-239	D	18,246.6	25Th percentile value
		Pu-240	D	18,246.6	25Th percentile value
		Pu-241	D	18,246.6	25Th percentile value
		Sb-125	D	52,622.2	75Th percentile value
		Sr-90	D	52,622.2	75Th percentile value
		Tc-99	D	52,622.2	75Th percentile value
Radionuclide Concentration (pCi/m^2)	P	2	D	1.0	-

[a] P = physical, B = behavioral, M = metabolic; (see NUREG/CR-6697, Attachment B, Table 4.)
[b] D = deterministic
[c] Triangular with defining values for distribution: minimum = 1,000, maximum = 100,000, and most likely = 10,000.

Appendix 6E

Building Surface DCGL Results

(Extracted from Reference 6-13)

Table 6E-1: Building Surface DCGL Results

Nuclide	RESRAD-Build DCF (mrem/y per pCi/m^2)	DCGL$_w$ (pCi/m^2)	DCGL$_w$ (dpm/100cm^2)
Ag-108m	3.1E-05	8.0E+05	1.8E+04
Am-241	1.1E-04	2.3E+05	5.0E+03
C-14	5.5E-08	4.5E+08	1.0E+07
Cm-242	1.8E-06	1.4E+07	3.1E+05
Cm-243	7.7E-05	3.2E+05	7.2E+03
Co-60	5.2E-05	4.8E+05	1.1E+04
Cs-134	3.2E-05	7.8E+05	1.7E+04
Cs-137	1.4E-05	1.8E+06	3.9E+04
Eu-152	2.6E-05	9.7E+05	2.2E+04
Eu-154	2.7E-05	9.2E+05	2.0E+04
Eu-155	1.5E-06	1.6E+07	3.6E+05
Fe-55	1.4E-08	1.8E+09	4.1E+07
H-3	1.9E-09	1.3E+10	2.9E+08
Mn-54	1.3E-05	1.9E+06	4.2E+04
Na22	4.4E-05	5.7E+05	1.3E+04
Nb-94	3.6E-05	6.9E+05	1.5E+04
Ni-59	9.3E-07	2.7E+07	6.0E+05
Ni-63	1.5E-08	1.6E+09	3.6E+07
Pu-238	9.8E-05	2.6E+05	5.7E+03
Pu-239	1.1E-04	2.3E+05	5.0E+03
Pu-240	1.1E-04	2.3E+05	5.0E+03
Pu-241	2.1E-06	1.2E+07	2.7E+05
Sb-125	9.3E-06	2.7E+06	5.9E+04
Sr-90	4.0E-06	6.2E+06	1.4E+05
Tc-99	4.0E-08	6.2E+08	1.4E+07

Appendix 6F

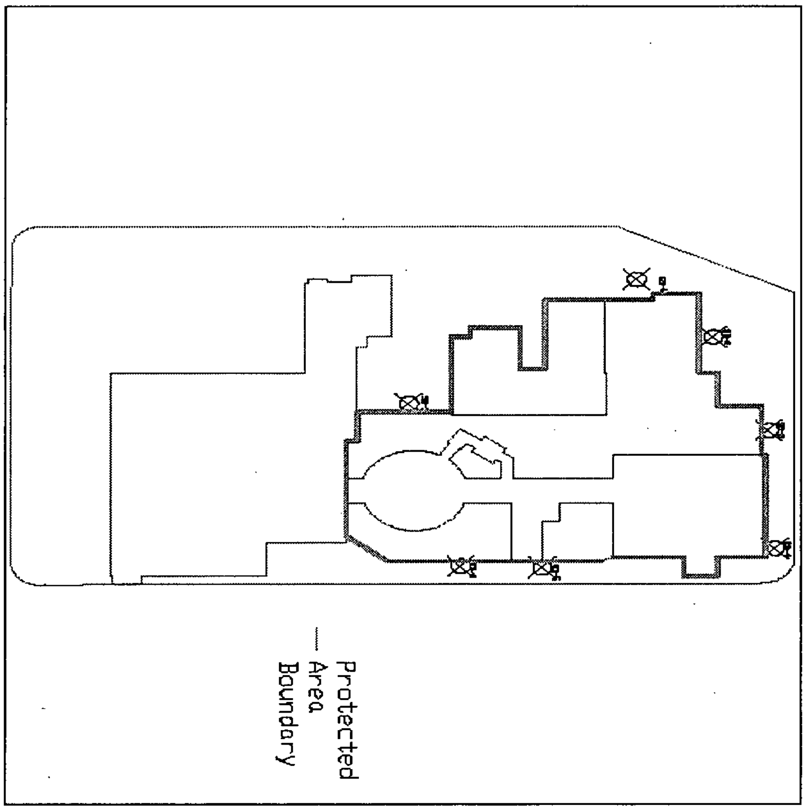
Basis for Site-Specific Parameter Values: Soil

Site-specific information was used when available as the basis for the RESRAD input parameter discussed below. Reference 6-12, which documents the calculations of site-specific parameter values, provides the information presented below.

1. Area of the Contaminated Zone

Figure 1-1, Area of the Contaminated Zone, was generated with AutoCAD. The AutoCAD software calculated the area of the contaminated zone. The value for the area was 7,855.06 m^2. For RESRAD modeling purposes, the area of the contaminated zone was assumed equivalent to the area of the EF1 Controlled Area, which is designated as "Protected Area" and outlined with a bold line in Figure 6F-1.

Figure 6F-1: EF-1 Area of Contaminated Zone



2. Length Parallel to Aquifer Flow

The length parallel to aquifer flow is the maximum horizontal distance in the contaminated zone, from its up gradient edge to the down gradient edge, along the direction of the groundwater flow in the underlying aquifer. The area of the contaminated zone was approximated by a circle with an area of 7,855 m^2. The diameter of the circle is equivalent to the length parallel to flow and is calculated as follows:

Area of a Circle $A = \pi r^2$

Where A is the Area in m^2 and r is the radius in meters.

r = square root $(\pi/7855m^2)$
$r = 50$ m

Diameter, $D = 2 \bullet r$
$D = 2 \bullet 50m$
$D = 100$ m

Therefore, the length parallel to aquifer flow for the EF1 site is 100 m.

3. Contaminated Zone Erosion Rate

The slope of the contaminated zone was determined from a 2006 DECo groundwater elevation map. The distance between two groundwater monitoring wells, MW- EFT-10S and MW-EF-8S, was determined to be approximately 313 feet with a decreasing change in elevation of 6 feet. Using this information, a 1.9% slope was calculated for the DECo Contaminated Area.

The data in Table 1 of ENG-002 provides values for erosion rate (m/y) corresponding to different percent slopes. The value for erosion rate that is representative of row-crop agriculture and a 2% slope was 6.0x10-4m/y. Because the calculated slope for the EF1 site was very close to 2%, a value of 6.0x10-4 m/y was assumed as an appropriate erosion rate for the EF1 site.

4. Soil Type

Analyses of soil samples collected along the perimeter of the EF1 protected area indicated that the EF1 site soil falls into the sandy loam category, based on the U.S. Dept. of Agriculture method for classifying soils. Because monitoring well construction logs for the EF1 site show that the soil type is uniform from the ground surface to the saturated zone, sandy loam was used as the soil type for the contaminated, unsaturated, and saturated zones. All other RESRAD geo-hydrological input parameters appropriate for sandy loam were selected to complete the site modeling.

5. Field Capacity: Contaminated Zone, Unsaturated zone and Saturated zone

The RESRAD Data Collection Handbook defines the relationship of field capacity (residual water content) to effective porosity. The field capacity is the ratio of the volume of water retained in the soil sample, after all drainage has ceased, to the total volume of the soil sample. Equation 4.4 of the RESRAD Data Collection Handbook relates Total and Effective Porosities to Field Capacity as follows:

Effective Porosity = Total Porosity - Field Capacity

Rearranging this equation:

Field Capacity = Total Porosity - Effective Porosity

The total porosity of 0.410 and the effective porosity value of 0.346 were used for each of the three zones. These values are the mean values of the NUREG/CR-6697 distributions for sandy loam. Therefore, the field capacity is approximately:

Field Capacity = 0.410 – 0.346 = 0.064

6. Humidity in Air

"Regional and Site-Specific Absolute Humidity Data for Use in Tritium Dose Calculations", Health Physics, Vol.39, pp. 318-320, 1980 provides a table of absolute humidity for selected locations in the U.S. These values were calculated from data from the National Oceanic and Atmospheric Administration, 1977, Climatological Data, Annual Summary, volume 28, U.S. Dept. of Commerce. The value of 4.6 g/m^3 was chosen for the RESRAD humidity parameter corresponding to the Detroit, Michigan, a region approximately 50 miles north of the EF1 site.

7. Precipitation

Table 6F-1 provides monthly mean precipitation totals for Detroit, Michigan. These rain gauge measurements were taken over the period 1971 to 2000.

Table 6F-1: Precipitation Rate

Detroit,MI Monthly Mean Precipitation Totals (inches of water)	
Period:1971-2000	
Month	Precipitation (inches)
Jan	1.91
Feb	1.88
Mar	2.52
April	3.05
May	3.05
Jun	3.55
Jul	3.16
Aug	3.1
Sept	3.27
Oct	2.23
Nov	2.66
Dec	2.51
Year Total	32.89

Converting to meters/year: 32.89 inches/year divided by 39.37inches/meter = 0.84 meters/year. The precipitation rate was assigned a value of 0.84 meters/year.

8. Irrigation Rate (Evapotranspiration and Runoff Coefficients)

NUREG/CR-6697 Attachment C, Section 4.3 discusses the Irrigation Rate in terms of the Evapotranspiration Coefficient. Equation 4.3-1 expresses the Evapotranspiration Coefficient as:

$$Ce = \frac{ETr}{(1-Cr)(\mathrm{Pr}) + IRr}$$

Where: ETr = the Evapotransporation Rate (m/y)
Pr = the Precipitation Rate (m/y)

IRr = the Irrigation Rate (m/y) and
Cr = the Runoff Coefficient.

Rearranging this equation, the Irrigation Rate can be expressed as:

$$IRr = \frac{ETr}{Ce} - (1 - Cr)(\mathrm{Pr})$$

The input values for the variables in the equation above follow:

- Figure 12.1 in the RESRAD Data Collection Handbook provides a map of the United States with the regional Average Annual Potential Evapotranspiration Rate in inches per year. The midpoint of the average annual evapotranspiration rate for the region around Newport, Michigan is 30 inches/year. Converting to m/yr by multipling by 2.54 cm/in and dividing by 100 cm/m yields 0.762 m/yr for the ETr, evapotranspiration rate.
- The Precipitation Rate, Pr, has been assigned a site-specific value of 0.84 m/yr.
- Table 10.1 in the RESRAD Data Collection Handbook provides the equation below to calculate the Runoff Coefficient, C_r, for an agricultural environment. Table 10.1 also lists values for c_1, c_2 and c_3 for various environments:

  $C_r = 1 - c_1 - c_2 - c_3$

  $c_1 = 0.3$ for Flat land with an average slope between 0.3 and 0.9 m/mi.
  (Even though this slope does not equal a 2% slope the c_1 was chosen to be the most representative based on a visual inspection of the site)
  $c_2 = 0.4$ for open sandy loam as identified at the EF-1 Protected Area.
  $c_3 = 0.1$ for cultivated lands which also fits the scenario for the EF-1 site.

  $C_r = 1 - 0.3 - 0.4 - 0.1 = 0.2$

- NUREG/CR-6697, Attachment C, Section 4.3 - Evapotranspiration Coefficient, Ce, defines this parameter as the ratio of the total volume of water (a combination of evaporation from soil surfaces and transpiration from vegetation) transferred to the atmosphere to the total volume of water available within the root zone of the soil. The NUREG/CR recommends the use of a uniform distribution with minimum and maximum values of 0.5 and 0.75, respectively and with 0.625 as median

Making the appropriate substitution of minimum and maximum values of Ce into the rearranged equation above results in the following range for the Irrigation Rate, IRr, shown in Table 6F-2.

Table 6F-2: Irrigation Rate

Variable	min value	max value
Evapotranspiration Rate (m/y) ETr	0.762	0.762
Precipitation Rate (m/y) Pr	0.84	0.84
Runoff Coefficient Cr	0.2	0.2
Evapotranspiration Coefficient Ce	0.75	0.5
Irrigation Rate (m/y) IRr	0.344	0.852

The calculated minimum and maximum IRr values are 0.344 and 0.852 m/y, respectively. A uniform distribution was assigned for this parameter and a positive input correlation to the Well Pumping Rate was assigned based on the guidance in NUREG/CR-6697 and NUREG/CR-6676.

9. Well Pumping Rate

NUREG/CR-6697, Attachment C, Section 3.10 states that "A site-specific input distribution for well pumping rate can be determined as the sum of individual water needs." A uniform distribution was assigned for this parameter with a positive correlation to the Irrigation Rate. The household use component is calculated from the domestic use in Table 6F-3.

Table 6F-3: Resident Farmer Water Use

Water Use Component (Family of four)	Median	Minimum	Maximum
Household[a] (m^3/y)	374	374	374
Livestock (m^3/y)	76.7	76.7	76.7
Contaminated fraction for Irrigation *f_p = 1 (assumes irrigation of the entire area))*	*1*	*1*	*1*
Irrigation rate *I_r (m/y)*	*0.598*	*0.344*	*0.852*
Irrigation water (m^3/y) $f_p \times I_r \times 2000$	1196	688	1704
Drinking Water (m^3/y)[b]	1.91	1.91	1.91
Total for Family of Four (m^3/y)	1649	1141	2157

[a] Household Use: Domestic Water Use for family of 4 of 272 gallons per day minus the drinking water component of 1.91m3/y. 272 gal/day * 3.79E-3 m^3/gal * 365.25day/y = 376 m^3/y

[b] 478.5 L/y per individual adjusted to family of 4 and converted to m^3/y. Conversion:
478 L/y-Ind * 4 Ind * 1m^3/1000L = 1.91 m^3/y

10. Unsaturated Zone Thickness

The Golder Associates Report on Groundwater Characterization for Enrico Fermi 1 License Termination, October 2007, provided groundwater elevation measurements from collected between 11/17/03 to 12/11/06. The groundwater elevation data collected between 9/22/05 to 12/11/06 were used to determine the average depth to groundwater because this time period had full data sets with the exception of EFT-8S the shallow monitoring wells. Table 6F-4 present the recorded groundwater elevations and the calculated average elevation for each shallow monitoring well.

Table 6F-4: Groundwater Elevations in Shallow Monitoring Wells at EF-1

EF Shallow MW	9/22/05	2/7/06	6/6/06	12/11/06	Average
EFT-1S	576.93	576.73	577.64	578.5	577.45
EFT-2S	578.46	575.57	578.34	576.75	577.28
EFT-4S	579.31	582.76	581.07	580.6	580.94
EFT-5S	580.19	581.69	571.44	580.79	578.53
EFT-6S	577.85	579.23	578.88	578.16	578.53
EFT-7S	579.4	578.11	578.02	578.74	578.57
EFT-8S		575.12	575.96	575.36	575.48
EFT-8S/D	575.83	574.25	573.92	573.25	574.31
EFT-9S	579.07	578.26	578.82	578.02	578.54
EFT-10S	570.49	575.29	574.78	574.06	573.66
				Site Average	577.3

The Golder Associates Report also provided Borehole and Monitoring Well Construction Logs for the shallow monitoring wells listed in Table 11-1, which provided an estimated surface elevation at each well. Table 6F-5 provides the estimated ground surface elevations recorded at the time of well construction.

Table 6F-5: Ground Elevation for Shallow Monitoring Wells at EF-1

EF Shallow MW	Ground Elevation (ft, M)
EFT-1S	582.20
EFT-2S	583.40
EFT-4S	584.60
EFT-5S	584.20
EFT-6S/D	583.00
EFT-7S	582.30
EFT-8S	583.00
EFT-9S	583.10
EFT-10S	588.50
Average Ground Elevation	583.8

The average depth to ground water and the average ground elevation were used to calculate the thickness of the unsaturated zone.

Average ground surface elevation	=	583.8 feet
Average groundwater elevation	=	- 577.3 feet
Average Depth to groundwater	=	6.5 feet
Assumed contaminated zone thickness	=	- 0.5 feet
Unsaturated Zone Thickness	=	6.0 feet

Converting 6.0 feet to meters by multiplying by 0.3048 results in an unsaturated zone thickness of 1.8 meters.

11. Watershed for Nearby Stream or Pond

The Detroit Edison EF 2 Final Safety Analysis Report, section 2.4.1.2.2, states, "The Fermi site is in the Swan Creek drainage basin. The watershed is an area of 109 square miles, elongated in shape from northwest to southeast. The basin is about 25 miles long with a maximum topographic relief of about 130 ft".

Converting the area of 109 square miles to square meters:

$$\text{Area} = 109\ \text{mi}^2 \text{ x } 2.59\ \text{km}^2/\ \text{mi}^2 \text{ x } 10^6\ \text{m}^2/\ \text{km}^2 = 2.82\text{x } 10^8\ \text{m}^2$$

12. Average Annual Wind Speed

The Detroit Edison wind speed and direction joint frequency distributions were used to calculate the average annual wind speed. The mid-range value and the associated frequency for each of the wind speed ranges over the five year period from 2003 to 2007 are shown in Table 6F-6. An average wind speed was calculated by summing the product of the mid-range value for each range and the fraction of time the wind was recorded to be within the range. A value of 2.91 m/s was assigned to this parameter.

Table 6F-6: DECo EF-1 Average Wind Speed

2003 Wind Measured at 10 m.	≤0.34 m/s	0.35 to 1.12m/s	1.13 to 2.01 m/s	2.02 to 2.91 m/s	2.92 to 3.80 m/s	3.81 to 5.14 m/s	5.15 to 6.48 m/s	6.49 to 8.27 m/s	8.28 to 10.51 m/s	Avg Annual WS (m/s)	
Avg. Wind Speed (m/s)	0.168	0.726	1.565	2.459	3.353	4.47	5.812	7.376	9.388	2.748	2003 Avg WS
Frequency	0.65	12.8	22.87	23.83	18.84	13.85	4.91	1.83	0.42	100	
2004 Wind Measured at 10 m.											
Avg. Wind Speed (m/s)	0.168	0.726	1.565	2.459	3.353	4.47	5.812	7.376	9.388	3.038	2004 Avg WS
Frequency	1.42	8.7	18.5	22.1	20.91	19.11	6.74	2.17	0.35	100	
2005 Wind Measured at 10 m.											
Avg. Wind Speed (m/s)	0.168	0.726	1.565	2.459	3.353	4.47	5.812	7.376	9.388	2.939	2005 Avg WS
Frequency	0	6.83	21.92	26.26	22.09	15.44	5.45	1.79	0.22	100	
2006 Wind Measured at 10 m.											
Avg. Wind Speed (m/s)	0.168	0.726	1.565	2.459	3.353	4.47	5.812	7.376	9.388	2.928	2006 Avg WS
Frequency	0	8.07	21.54	24.68	21.68	16.7	5.77	1.46	0.09	99.99	
2007 Wind Measured at 10 m.											
Avg. Wind Speed (m/s)	0.168	0.726	1.565	2.459	3.353	4.47	5.812	7.376	9.388	2.908	2007 Avg WS
Frequency	0.39	10.28	20.49	23.9	20.67	16.56	5.44	1.94	0.34	100	
										2.91	5 yr Avg WS

Appendix 6G

Input Parameter Values for Sensitivity Analysis: Soil

(Extracted from Reference 6-12)

Table 6G-1: Input Parameter Values for Sensitivity Analysis Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Soil Concentrations										
Basic radiation dose limit (mrem/y)		3	D	25	10 CFR 20.1402	NR	NR	NR	NR	
Initial principal radionuclide concentration in soil (pCi/g)	P	2	D	1	Unit Value	NR	NR	NR	NR	
Distribution Coefficients for Contaminated, Unsaturated, and Saturated Zones (cm^3/g)										
Ac-227	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.72	3.22	0.001	0.999	825
Ag-108m*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	5.38	2.1	0.001	0.999	216
Am-241*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	7.28	3.15	0.001	0.999	1445
Am-243	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	7.28	3.15	0.001	0.999	1445
C-14*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	2.4	3.22	0.001	0.999	11
Cm-242*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	8.82	1.82	0.001	0.999	6761
Cm-243*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	8.82	1.82	0.001	0.999	6761
Co-60*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	5.46	2.53	0.001	0.999	235
Cs-134*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.1	2.33	0.001	0.999	446
Cs-137*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.1	2.33	0.001	0.999	446
Eu-152*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.72	3.22	0.001	0.999	825
Eu-154*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.72	3.22	0.001	0.999	825
Eu-155*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.72	3.22	0.001	0.999	825
Fe-55*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	5.34	2.67	0.001	0.999	209
Gd-152	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.72	3.22	0.001	0.999	825
H-3*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	-2.81	0.5	0.001	0.999	0.06
Mn-54*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	5.06	2.29	0.001	0.999	158
Na-22*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	5.04	3.22	0.001	0.999	154
Nb-94*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	5.94	3.22	0.001	0.999	380
Ni-59*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.05	1.46	0.001	0.999	424
Ni-63*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.05	1.46	0.001	0.999	424
Np-237	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	2.84	2.25	0.001	0.999	17
Pa-231	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	5.94	3.22	0.001	0.999	380
Pb-210	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	7.78	2.76	0.001	0.999	2392

Table 6G-1: Input Parameter Values for Sensitivity Analysis Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Po-210	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	5.20	1.68	0.001	0.999	181
Pu-238*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.86	1.89	0.001	0.999	953
Pu-239*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.86	1.89	0.001	0.999	953
Pu-240*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.86	1.89	0.001	0.999	953
Pu-241*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	6.86	1.89	0.001	0.999	953
Ra-226	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	8.17	1.7	0.001	0.999	3533
Ra-228	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	8.17	1.7	0.001	0.999	3533
Sb-125*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	5.94	3.22	0.001	0.999	380
Sr-90*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	3.45	2.12	0.001	0.999	32
Tc-99*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	-0.67	3.16	0.001	0.999	0.51
Te-125m	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-30	3.64	3.22	0.001	0.999	38.1
Th-228	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-31	8.68	3.62	0.001	0.999	5884
Th-229	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-31	8.68	3.62	0.001	0.999	5884
Th-230	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-31	8.68	3.62	0.001	0.999	5884
Th-232	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-31	8.68	3.62	0.001	0.999	5884
U-233	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-31	4.84	3.13	0.001	0.999	126
U-234	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-31	4.84	3.13	0.001	0.999	126
U-235	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-31	4.84	3.13	0.001	0.999	126
U-236	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 3-31	4.84	3.13	0.001	0.999	126
Initial concentration of radionuclides present in groundwater (pCi/l)	P	3	D	0	Ground water uncontaminated	NR	NR	NR	NR	
Calculation Times										
Time since placement of material (y)	P	3	D	0		NR	NR	NR	NR	
Time for calculations (y)	P	3	D	0, 1, 3, 10, 30, 100, 300, 1000	RESRAD Defaults	NR	NR	NR	NR	
Contaminated Zone										
Area of contaminated zone (m^2)	P	2	D	7,855.06	Site-specific Value - EF-1 Protected Area, M. Erickson , E-mail June 18, 2008. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	

Table 6G-1: Input Parameter Values for Sensitivity Analysis Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Thickness of contaminated zone (m)	P	2	D	0.1524	Site-specific Value. Assumed topsoil contamination only, i.e. top 6 inches.	NR	NR	NR	NR	
Length parallel to aquifer flow (m)	P	2	D	100	Site-specific Value - Diameter of circle with an area = EF-1 Protected Area. M. Erickson, E-mail June 18, 2008. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Cover and Contaminated Zone Hydrological Data										
Cover depth (m)	P	2	D	0	Site-specific Value - no cover assumed	NR	NR	NR	NR	
Density of contaminated zone (g/cm^3)	P	1	S	Bounded Normal	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.1-1 for site soil type - sandy loam p. 3-3. See CRA e-mail – July 1, 2008.	1.5635	0.2385	0.827	2.3	
Contaminated zone erosion rate (m/y)	P	2	D	6.00E-04	Site-specific Value - Calculated value based on site-specific slope of dx/dz and interpolated value in Figure 3.8-11 from NUREG/CR-6697 pp. 3-25 to 3-28. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Contaminated zone total porosity	P	2	S	Bounded Normal	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.2-1 for site soil type - sandy loam p. 3-6. See CRA e-mail – July 1, 2008.	0.41	0.0899	0.1322	0.6878	
Contaminated zone field capacity	P	3	D	0.064	Site-specific Value - Calculated value using Equation 4.4 for the Field Capacity. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Contaminated zone hydraulic conductivity (m/y)	P	2	S	Bounded Log normal-n	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.4-1 for site soil type - sandy loam p. 3-13. See CRA e-mail –July 1, 2008.	5.022	1.33	2.49	9,250	
Contaminated zone b parameter	P	2	S	Bounded Lognormal-n	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.5-1 for site soil type - sandy loam p. 3-16. See CRA e-mail –July 1, 2008.	0.632	0.282	0.786	4.50	
Humidity in air (g/m^3)	P	3	D	4.6	Site-specific Value, Health Physics, Vol. 39 p. 319. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Evapotranspiration coefficient	P	2	S	Uniform	Site-specific Value - NUREG/CR-6697 Att. C, p. 4-9 (Median = midpoint).	0.5	0.75	NR	NR	0.625
Average annual wind speed (m/s)	P	2	D	2.91	Site-specific Value – DECo site meteorological data (10 m) Tables: 2003 – 2007). See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Precipitation (m/y)	P	2	D	0.84	Site-specific value; www.rssWeather. Com/climate/Michigan/Detroit from 1971 - 2000. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Irrigation (m/y)	B	3	S	Uniform	Site-specific Value - NUREG/CR-6697, Att C methodology. See calc. ENG-002 Section 6.1.	0.344	0.852	NR	NR	0.598
Irrigation mode	B	3	D	Overhead	Site-specific Value - overhead irrigation is standard practice in Midwest.	NR	NR	NR	NR	
Runoff coefficient	P	2	D	0.2	Site-specific Value - Calculated value using Equation 10.1 for Runoff Coefficient. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Watershed area for nearby stream or pond (m^2)	P	3	D	2.82E8	Site-specific Value- drainage area, EF2 FSAR. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Accuracy for water/soil computations	-	3	D	1.00E-03	RESRAD Default (applicable to provide accuracy)	NR	NR	NR	NR	
Saturated Zone Hydrological Data										
Density of saturated zone (g/cm^3)	P	1	S	Bounded Normal	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.1-1 for site soil type - sandy loam p. 3-3. See CRA e-mail – July 1, 2008.	1.5635	0.2385	0.827	2.3	
Saturated zone total porosity	P	1	S	Bounded Normal	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.2-1 for site soil type - sandy loam p. 3-6. See CRA e-mail – July 1, 2008.	0.41	0.0899	0.1322	0.6878	
Saturated zone effective porosity	P	1	S	Bounded Normal	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.3-1 for site soil type - sandy loam p. 3-9. See CRA e-mail – July 1, 2008.	0.346	0.0915	0.0629	0.628	

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Saturated zone field capacity	P	3	D	0.064	Site-specific Value - calculated using Equation 4.4 from Field Capacity. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Saturated zone hydraulic conductivity (m/y)	P	1	S	Bounded Log Normal	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.4-1 for site soil type - sandy loam p. 3-13. See CRA e-mail –July 1, 2008.	5.022	1.33	2.49	9,250	
Saturated zone hydraulic gradient	P	2	D	0.002	Site-specific Value - Golder Associates Report on Groundwater Characterization p. 17.	NR	NR	NR	NR	
Saturated zone b parameter	P	2	S	Bounded Lognormal-n	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.5-1 for site soil type - sandy loam p. 3-16. See CRA e-mail –July 1, 2008.	0.632	0.282	0.786	4.50	
Water table drop rate (m/y)	P	3	D	1.00E-03	RESRAD Default ANL/EAIS-8, Table 1.3 p. 11. (to account for little water table drop)	NR	NR	NR	NR	
Well pump intake depth (m below water table)	P	2	S	Triangular	Site-specific Value – Used distribution from NUREG/CR-6697, Att. C.	6	10	30		10
Model: Nondispersion (ND) or Mass-Balance (MB)	P	3	D	ND	ND model recommended for contaminant areas > 1,000 m^2	NR	NR	NR	NR	
Well pumping rate (m^3/y)	P	2	S	Uniform	Site-specific Value - Min, Max, and Median value based on NUREG/CR-6697, Att. C section 3.10 method using site irrigation method and area.	1141	2157			1649
Unsaturated Zone Hydrological Data										
Number of unsaturated zone strata	P	3	D	1	Site-specific Value - Golder Associates Report on Groundwater Characterization (Table 1 and Appendix B)	NR	NR	NR	NR	
Unsat. zone 1, thickness (m)	P	1	D	1.8	Site-specific Value - Golder Associates Report on Groundwater Characterization (Table 1 and Appendix B) See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Unsat. zone 1, soil density (g/cm^3)	P	2	S	Bounded Normal	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.1-1 for site soil type - sandy loam p. 3-3. See CRA e-mail – July 1,.	1.5635	0.2385	0.827	2.3	
Unsat. zone 1, total porosity	P	2	S	Bounded Normal	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.2-1 for site soil type - sandy loam p. 3-6. See CRA e-mail – July 1, 2008.	0.41	0.0899	0.1322	0.6878	
Unsat. zone 1, effective porosity	P	2	D	Bounded Normal	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.3-1 for site soil type - sandy loam p. 3-9. See CRA e-mail – July 1, 2008.	0.346	0.0915	0.0629	0.628	
Unsat. zone 1, field capacity	P	3	D	0.064	Site-specific Value - calculated using Equation 4.4 for Field Capacity from ANL/EAIS-8. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Unsat. zone 1, hydraulic conductivity (m/y)	P	2	S	Bounded Log Normal	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.4-1 for site soil type - sandy loam p. 3-13. See CRA e-mail –July 1, 2008.	5.022	1.33	2.49	9,250	
Unsat. zone 1, soil-specific b parameter	P	2	S	Bounded Lognormal-n	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.5-1 for site soil type - sandy loam p. 3-16. See CRA e-mail –July 1, 2008.	0.632	0.282	0.786	4.50	
Occupancy										
Inhalation rate (m^3/y)	B	3	D	8,400	NUREG/CR-6697, Att. C , p. 5-1. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Mass loading for inhalation (g/m^3)	P	2	S	Continuous linear	Used distribution median from NUREG/CR-6697, Att. C , p. 4-16, Fig 4.6-1.					2.33E-05
Exposure duration (y)	B	3	D	30	RESRAD default, ANL/EAD-4, p. 2-22.	NR	NR	NR	NR	
Indoor dust filtration factor	P	2	S	Uniform	Used distribution values from NUREG/CR-6697, Att. C, p. 7-1 & 7-3.	0.15	0.95			0.58

Table 6G-1: Input Parameter Values for Sensitivity Analysis Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Shielding factor, external gamma	P	2	S	Bounded Lognormal-n	Used distribution values from NUREG/CR-6697, Att. C, p. 7-35 .	-1.3	0.59	0.044	1	
Fraction of time spent indoors	B	3	D	0.6571	NUREG/CR-5512, Vol. 3, Table 6.87, p. 6-126 . See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Fraction of time spent outdoors (on site)	B	3	D	0.118	NUREG/CR-5512, Vol. 3, Table 6.87 (outdoors + gardening) p. 6-126. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Shape factor flag, external gamma	P	3	D	Circular	RESRAD Default - Circular contaminated zone assumed for EF-1 Protected area, ANL/EAIS-8, Table 1.3 p. 12 .	NR	NR	NR	NR	
Ingestion, Dietary										
Fruits, vegetables, grain consumption (kg/y)	B	2	D	112	NUREG/CR-5512, Vol. 3, (other vegetables + fruit + grain), Table 6.87 p. 6-127. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Leafy vegetables consumption (kg/y)	B	3	D	21.4	NUREG/CR-5512, Vol. 3, Table 6.87 p. 6-127. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Milk consumption (L/y)	B	2	D	233	NUREG/CR-5512, Vol. 3, Table 6.87 p. 6-127. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Meat and poultry consumption (kg/y)	B	3	D	65.1	NUREG/CR-5512, Vol. 3 (beef + poultry), Table 6.87 p. 6-127. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Fish consumption (kg/y)	B	3	D	20.6	NUREG/CR-5512, Vol. 3, Table 6.87 p. 6-127. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Other seafood consumption (kg/y)	B	3	D	0.9	RESRAD Default -- ANL/EAD-4, Table D-2, p. D-10.	NR	NR	NR	NR	
Soil ingestion rate (g/y)	B	2	D	18.26	NUREG/CR-5512, Vol. 3, Table 6.87 p. 6-126. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Drinking water intake (L/y)	B	2	D	478.5	NUREG/CR-5512, Vol. 3, Table 6.87 p. 6-126. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Contamination fraction of drinking water	P	3	D	1	RESRAD Default – all water assumed contaminated ANL/EAIS-8 Table 1.3 p. 12 (Ref 1).	NR	NR	NR	NR	

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Contamination fraction of livestock	P	3	D	1	RESRAD Default – all water assumed contaminated ANL/EAIS-8 Table 1.3 p. 12.	NR	NR	NR	NR	
Contamination fraction of irrigation	P	3	D	1	RESRAD Default – all water assumed contaminated ANL/EAIS-8 Table 1.3 p. 12.	NR	NR	NR	NR	
Contamination fraction of aquatic food	P	3	D	1	NUREG/CR-5512, Vol. 3, p. 6-5&6.	NR	NR	NR	NR	
Contamination fraction of plant food	P	3	D	1	NUREG/CR-5512, Vol. 3, p. 6-5&6.	NR	NR	NR	NR	
Contamination fraction of meat	P	3	D	1	RESRAD Default -- ANL/EAD-4, Table 2.3, p. 2-22	NR	NR	NR	NR	
Contamination fraction of milk	P	3	D	1	RESRAD Default -- ANL/EAD-4, Table 2.3, p. 2-22.	NR	NR	NR	NR	
Ingestion, Non-Dietary										
Livestock fodder intake for meat (kg/day)	M	3	D	27.1	NUREG/CR5512, Vol. 3 Table 6.87, beef cattle + poultry + layer hen					
Livestock fodder intake for milk (kg/day)	M	3	D	63.2	NUREG/CR5512, Vol. 3 Table 6.87, forage + grain + hay p. 6-131.					
Livestock water intake for meat (L/day)	M	3	D	50	NUREG/CR5512, Vol. 3 Table 6.87, beef cattle + poultry + layer hen p. 6-131.					
Livestock water intake for milk (L/day)	M	3	D	60	NUREG/CR5512, Vol. 3 Table 6.87 p. 6-131.					
Livestock soil intake (kg/day)	M	3	D	0.5	RESRAD Default, ANL/AED-4 p. D-15 (Ref. 3).	NR	NR	NR	NR	
Mass loading for foliar deposition (g/m**3)	P	3	D	4.00E-04	NUREG/CR-5512, Vol. 3 Table 6.87, gardening p. 6-126.	NR	NR	NR	NR	
Depth of soil mixing layer (m)	P	2	S	Triangular	NUREG/CR-6697, Att. C p. 3-42.	0	0.15	0.6		
Depth of roots (m)	P	1	S	Uniform	Min. from NUREG/CR-6697, A Used distribution values from tt. C p. 6-1.	0.3	4.0			
Drinking water fraction from ground water	P	3	D	1	RESRAD Default - all water assumed to be supplied from groundwater, ANL/EAIS-8 Table 1.3 p. 12 .	NR	NR	NR	NR	

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Livestock water fraction from ground water	P	3	D	1	RESRAD Default - all water assumed to be supplied from groundwater, ANL/EAIS-8 Table 1.3 p. 12 .	NR	NR	NR	NR	
Irrigation fraction from ground water	P	3	D	1	RESRAD Default - all water assumed to be supplied from groundwater, ANL/EAIS-8 Table 1.3 p. 12 .	NR	NR	NR	NR	
Wet weight crop yield for Non-Leafy (kg/m**2)	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C p. 6-13.	0.56	0.48	0.001	0.999	
Wet weight crop yield for Leafy (kg/m**2)	P	3	D	2.88921	NUREG/CR-5512, Vol. 3 Table 6.87 p. 6-130.	NR	NR	NR	NR	
Wet weight crop yield for Fodder (kg/m**2)	P	3	D	1.8868	NUREG/CR-5512, Vol. 3 Table 6.87 p. 6-130.	NR	NR	NR	NR	
Growing Season for Non-Leafy (years)	P	3	D	0.246	NUREG/CR-5512, Vol. 3 Table 6.87 p. 6-128.	NR	NR	NR	NR	
Growing Season for Leafy (years)	P	3	D	0.123	NUREG/CR-5512, Vol. 3 Table 6.87 p. 6-128.	NR	NR	NR	NR	
Growing Season for Fodder (years)	P	3	D	0.082	NUREG/CR-5512, Vol. 3 Table 6.87 p. 6-128	NR	NR	NR	NR	
Translocation Factor for Fodder	P	3	D	1	NUREG/CR-5512, Vol. 3 Table 6.87 p. 6-129.	NR	NR	NR	NR	
Weathering Removal Constant for Vegetation (1/yr)	P	2	S	Triangular	NUREG/CR-6697, Att. C p. 6-15.	5.1	18	84		
Wet Foliar Interception Fraction for Non-Leafy	P	3	D	0.35	NUREG/CR-5512, Vol. 3 Table 6.87 p. 6-128.	NR	NR	NR	NR	
Wet Foliar Interception Fraction for Leafy	P	2	S	Triangular	NUREG/CR-6697, Att. C p. 6-17.	0.06	0.67	0.95		
Wet Foliar Interception Fraction for Fodder	P	3	D	0.35	NUREG/CR-5512, Vol. 3 Table 6.87 p. 6-128.	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Non-Leafy	P	3	D	0.35	NUREG/CR-5512, Vol. 3 Table 6.87 p. 6-128.	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Leafy	P	3	D	0.35	NUREG/CR-5512, Vol. 3 p. 6-128.	NR	NR	NR	NR	

Table 6G-1: Input Parameter Values for Sensitivity Analysis Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Dry Foliar Interception Fraction for Fodder	P	3	D	0.35	NUREG/CR-5512, Vol. 3 p. 6-128.	NR	NR	NR	NR	
Storage times of contaminated foodstuffs (days)										
Fruits, non-leafy vegetables, and grain	B	3	D	14	NUREG/CR-5512, Vol. 3 Table 6.87 p. 6-127.	NR	NR	NR	NR	
Leafy vegetables	B	3	D	1	NUREG/CR-5512, Vol. 3 Table 6.87 p. 6-127.	NR	NR	NR	NR	
Milk	B	3	D	1	NUREG/CR-5512, Vol. 3 Table 6.87 p. 6-127.	NR	NR	NR	NR	
Meat and poultry	B	3	D	20	NUREG/CR-5512, Vol. 3 Table 6.87 (holdup period for beef) p. 6-127.	NR	NR	NR	NR	
Fish	B	3	D	7	RESRAD Default, ANL/EAD-4 , Table D.6, p. D-21.	NR	NR	NR	NR	
Crustacea and Mollusk	B	3	D	7	RESRAD Default, ANL/EAD-4 , Table D.6, p. D-21.	NR	NR	NR	NR	
Well water	B	3	D	1	RESRAD Default, ANL/EAD-4 , Table D.6, p. D-21.	NR	NR	NR	NR	
Surface water	B	3	D	1	RESRAD Default, ANL/EAD-4 , Table D.6, p. D-21.	NR	NR	NR	NR	
Livestock fodder	B	3	D	45	RESRAD Default, ANL/EAD-4 , Table D.6, p. D-21.	NR	NR	NR	NR	
Special Radionuclides (C-14)										
C-12 concentration in water (g/cm^3)	P	3	D	2.00E-05	RESRAD Default, ANL/EAD-4, p. L-22	NR	NR	NR	NR	
C-12 concentration in contaminated soil (g/g)	P	3	D	3.00E-02	RESRAD Default, ANL/EAD-4, p. L-19	NR	NR	NR	NR	
C-14 evasion layer thickness in soil (m)	P	2	S	Triangular	NUREG/CR-6697, Att. C p. 8-27.	0.2	0.3	0.6		0.3
C-14 evasion flux rate from soil (1/s)	P	3	D	7.00E-07	RESRAD Default, ANL/EAD-4, p. L-16. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	

Table 6G-1: Input Parameter Values for Sensitivity Analysis Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
C-12 evasion flux rate from soil (1/s)	P	3	D	1.01E-10	RESRAD Default, ANL/EAD-4, p. L-16. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Fraction of grain in beef cattle feed	B	3	D	0.8	NUREG/CR-6697, Table 3.2 p. 64	NR	NR	NR	NR	
Fraction of grain in milk cow feed	B	3	D	0.2	NUREG/CR-6697, Table 3.2 p. 64.	NR	NR	NR	NR	
Fraction of vegetation carbon from soil	P	3	D	2.00E-02	RESRAD Default, ANL/EAD-4, p. L-20.	NR	NR	NR	NR	
Fraction of vegetation carbon from air	P	3	D	9.80E-01	RESRAD Default, ANL/EAD-4, p. L-20.	NR	NR	NR	NR	
Inhalation Dose Conversion Factors (mrem/pCi)										
Ac-227	M	3	D	6.72E+00	FGR11 (RESRAD Dose Conversion Library)	NR	NR	NR	NR	
Ag-108m*	M	3	D	2.83E-04	FGR11	NR	NR	NR	NR	
Am-241*	M	3	D	4.44E-01	FGR11	NR	NR	NR	NR	
Am-243	M	3	D	4.40E-01	FGR11	NR	NR	NR	NR	
C-14*	M	3	D	2.09E-06	FGR11	NR	NR	NR	NR	
Cm-242*	M	3	D	1.73E-02	FGR11	NR	NR	NR	NR	
Cm-243*	M	3	D	3.07E-01	FGR11	NR	NR	NR	NR	
Co-60*	M	3	D	2.19E-04	FGR11	NR	NR	NR	NR	
Cs-134*	M	3	D	4.63E-05	FGR11	NR	NR	NR	NR	
Cs-137*	M	3	D	3.19E-05	FGR11	NR	NR	NR	NR	
Eu-152*	M	3	D	2.21E-04	FGR11	NR	NR	NR	NR	
Eu-154*	M	3	D	2.86E-04	FGR11	NR	NR	NR	NR	
Eu-155*	M	3	D	4.14E-05	FGR11	NR	NR	NR	NR	
Fe-55*	M	3	D	2.69E-06	FGR11	NR	NR	NR	NR	
Gd-152	M	3	D	2.43E-01	FGR11	NR	NR	NR	NR	
H-3*	M	3	D	6.40E-08	FGR11	NR	NR	NR	NR	
Mn-54*	M	3	D	6.70E-06	FGR11	NR	NR	NR	NR	
Na-22*	M	3	D	7.66E-06	FGR11	NR	NR	NR	NR	
Nb-94*	M	3	D	4.14E-04	FGR11	NR	NR	NR	NR	
Ni-59*	M	3	D	2.70E-06	FGR11	NR	NR	NR	NR	

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Ni-63*	M	3	D	6.29E-06	FGR11	NR	NR	NR	NR	
Np-237	M	3	D	5.40E-01	FGR11	NR	NR	NR	NR	
Pa-231	M	3	D	1.28E+00	FGR11	NR	NR	NR	NR	
Pb-210	M	3	D	1.38E-02	FGR11	NR	NR	NR	NR	
Po-210	M	3	D	9.40E-03	FGR11	NR	NR	NR	NR	
Pu-238*	M	3	D	3.92E-01	FGR11	NR	NR	NR	NR	
Pu-239*	M	3	D	4.29E-01	FGR11	NR	NR	NR	NR	
Pu-240*	M	3	D	4.29E-01	FGR11	NR	NR	NR	NR	
Pu-241*	M	3	D	8.25E-03	FGR11	NR	NR	NR	NR	
Ra-226	M	3	D	8.60E-03	FGR11	NR	NR	NR	NR	
Ra-228	M	3	D	4.77E-03	FGR11	NR	NR	NR	NR	
Sb-125*	M	3	D	1.22E-05	FGR11	NR	NR	NR	NR	
Sr-90*	M	3	D	1.31E-03	FGR11	NR	NR	NR	NR	
Tc-99*	M	3	D	8.33E-06	FGR11	NR	NR	NR	NR	
Te-125m	M	3	D	7.29E-06	FGR11	NR	NR	NR	NR	
Th-228	M	3	D	3.42E-01	FGR11	NR	NR	NR	NR	
Th-229	M	3	D	2.16E+00	FGR11	NR	NR	NR	NR	
Th-230	M	3	D	3.26E-01	FGR11	NR	NR	NR	NR	
Th-232	M	3	D	1.64E+00	FGR11	NR	NR	NR	NR	
U-233	M	3	D	1.35E-01	FGR11	NR	NR	NR	NR	
U-234	M	3	D	1.32E-01	FGR11	NR	NR	NR	NR	
U-235	M	3	D	1.23E-01	FGR11	NR	NR	NR	NR	
U-236	M	3	D	1.25e-01						
Ingestion Dose Conversion Factors (mrem/pCi)										
Ac-227	M	3	D	1.48E-02	FGR11	NR	NR	NR	NR	
Ag-108m*	M	3	D	7.62E-06	FGR11	NR	NR	NR	NR	
Am-241*	M	3	D	3.64E-03	FGR11	NR	NR	NR	NR	
Am-243	M	3	D	3.63E-03	FGR11	NR	NR	NR	NR	
C-14*	M	3	D	2.09E-06	FGR11	NR	NR	NR	NR	

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Cm-242*	M	3	D	2.51E-03	FGR11	NR	NR	NR	NR	
Cm-243*	M	3	D	2.69E-05	FGR11	NR	NR	NR	NR	
Co-60*	M	3	D	7.33E-05	FGR11	NR	NR	NR	NR	
Cs-134*	M	3	D	5.00E-05	FGR11	NR	NR	NR	NR	
Cs-137*	M	3	D	6.48E-06	FGR11	NR	NR	NR	NR	
Eu-152*	M	3	D	9.55E-06	FGR11	NR	NR	NR	NR	
Eu-154*	M	3	D	1.53E-06	FGR11	NR	NR	NR	NR	
Eu-155*	M	3	D	6.07E-07	FGR11	NR	NR	NR	NR	
Fe-55*	M	3	D	1.61E-04	FGR11	NR	NR	NR	NR	
Gd-152	M	3	D	6.40E-08	FGR11	NR	NR	NR	NR	
H-3*	M	3	D	2.51E-03	FGR11	NR	NR	NR	NR	
Mn-54*	M	3	D	2.77E-06	FGR11	NR	NR	NR	NR	
Na-22*	M	3	D	1.15E-05	FGR11	NR	NR	NR	NR	
Nb-94*	M	3	D	7.14E-06	FGR11	NR	NR	NR	NR	
Ni-59*	M	3	D	2.10E-07	FGR11	NR	NR	NR	NR	
Ni-63*	M	3	D	5.77E-07	FGR11	NR	NR	NR	NR	
Np-237	M	3	D	4.44E-03	FGR11	NR	NR	NR	NR	
Pa-231	M	3	D	1.06E-02	FGR11	NR	NR	NR	NR	
Pb-210	M	3	D	5.37E-03	FGR11	NR	NR	NR	NR	
Po-210	M	3	D	1.90E-03	FGR11	NR	NR	NR	NR	
Pu-238*	M	3	D	3.20E-03	FGR11	NR	NR	NR	NR	
Pu-239*	M	3	D	3.54E-03	FGR11	NR	NR	NR	NR	
Pu-240*	M	3	D	3.54E-03	FGR11	NR	NR	NR	NR	
Pu-241*	M	3	D	6.85E-05	FGR11	NR	NR	NR	NR	
Ra-226	M	3	D	1.33E-03	FGR11	NR	NR	NR	NR	
Ra-228	M	3	D	1.44E-03	FGR11	NR	NR	NR	NR	
Sb-125*	M	3	D	2.81E-06	FGR11	NR	NR	NR	NR	
Sr-90*	M	3	D	1.53E-04	FGR11	NR	NR	NR	NR	
Tc-99*	M	3	D	1.46E-06	FGR11	NR	NR	NR	NR	

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Te-125m	M	3	D	3.67E-06	FGR11	NR	NR	NR	NR	
Th-228	M	3	D	4.03E-03	FGR11	NR	NR	NR	NR	
Th-229	M	3	D	5.48E-04	FGR11	NR	NR	NR	NR	
Th-230	M	3	D	5.48E-04	FGR11	NR	NR	NR	NR	
Th-232	M	3	D	2.73E-03	FGR11	NR	NR	NR	NR	
U-233	M	3	D	2.89E-04	FGR11	NR	NR	NR	NR	
U-234	M	3	D	2.83E-04	FGR11	NR	NR	NR	NR	
U-235	M	3	D	2.67E-04	FGR11	NR	NR	NR	NR	
U-236	M	3	D	2.69E-04	FGR11	NR	NR	NR	NR	
Plant Transfer Factors ((pCi/g plant)/(pCi/g soil))										
Ac-227	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	1.1	0.001	0.999	1.0E-03
Ag-108m*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-5.52	0.9	0.001	0.999	4.0E-03
Am-241*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
Am-243	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
C-14*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-0.36	0.9	0.001	0.999	7.0E-01
Cm-242*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
Cm-243*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
Co-60*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-2.53	0.9	0.001	0.999	8.0E-02
Cs-134*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-3.22	1.0	0.001	0.999	4.0E-02
Cs-137*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-3.22	1.0	0.001	0.999	4.0E-02
Eu-152*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.21	1.1	0.001	0.999	2.0E-03
Eu-154*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.21	1.1	0.001	0.999	2.0E-03
Eu-155*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.21	1.1	0.001	0.999	2.0E-03
Fe-55*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
Gd-152	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.21	1.1	0.001	0.999	2.0E-03
H-3*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	1.57	1.1	0.001	0.999	4.8E+00
Mn-54*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-1.20	0.9	0.001	0.999	3.0E-01
Na-22*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-3.00	1.0	0.001	0.999	5.0E-02
Nb-94*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-4.61	1.1	0.001	0.999	1.0E-02

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Ni-59*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-3.0	0.9	0.001	0.999	5.0E-02
Ni-63*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-3.0	0.9	0.001	0.999	5.0E-02
Np-237	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-3.91	0.9	0.001	0.999	2.0E-02
Pa-231	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-4.61	1.1	0.001	0.999	1.0E-02
Pb-210	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-5.52	0.9	0.001	0.999	4.0E-03
Po-210	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.90	0.9	0.001	0.999	1.0E-03
Pu-238*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
Pu-239*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
Pu-240*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
Pu-241*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
Ra-226	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-3.22	0.9	0.001	0.999	4.0E-02
Ra-228	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-3.22	0.9	0.001	0.999	4.0E-02
Sb-125*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-4.61	1.0	0.001	0.999	1.0E-02
Sr-90*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-1.20	1.0	0.001	0.999	3.0E-01
Tc-99*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	1.61	0.9	0.001	0.999	5.0E+00
Te-125m	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-2.30	1.0	0.001	0.999	1.0E-01
Th-228	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
Th-229	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
Th-230	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
Th-232	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.91	0.9	0.001	0.999	1.0E-03
U-233	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.21	0.9	0.001	0.999	2.0E-03
U-234	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.21	0.9	0.001	0.999	2.0E-03
U-235	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.21	0.9	0.001	0.999	2.0E-03
U-236	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-5.	-6.21	0.9	0.001	0.999	2.0E-03
Meat Transfer Factors ((pCi/Kg)/(pCi/d))										
Ac-227	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-10.82	1.0	0.001	0.999	2.0E-05
Ag-108m*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-6.21	0.7	0.001	0.999	2.0E-03
Am-241*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-9.90	0.2	0.001	0.999	5.0E-05
Am-243	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-9.90	0.2	0.001	0.999	5.0E-05

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
C-14*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-3.47	1.0	0.001	0.999	3.1E-02
Cm-242*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-10.82	1.0	0.001	0.999	2.0E-05
Cm-243*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-10.82	1.0	0.001	0.999	2.0E-05
Co-60*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-3.51	1.0	0.001	0.999	3.0E-02
Cs-134*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-3.00	0.4	0.001	0.999	5.0E-02
Cs-137*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-3.00	0.4	0.001	0.999	5.0E-02
Eu-152*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-6.21	1.0	0.001	0.999	2.0E-03
Eu-154*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-6.21	1.0	0.001	0.999	2.0E-03
Eu-155*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-6.21	1.0	0.001	0.999	2.0E-03
Fe-55*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-3.51	0.4	0.001	0.999	3.0E-02
Gd-152	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-6.21	1.0	0.001	0.999	2.0E-03
H-3*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-4.42	1.0	0.001	0.999	1.2E-02
Mn-54*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-6.91	0.7	0.001	0.999	1.0E-03
Na-22*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-2.53	0.2	0.001	0.999	8.0E-02
Nb-94*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-13.82	0.9	0.001	0.999	1.0E-06
Ni-59*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-5.30	0.9	0.001	0.999	5.0E-03
Ni-63*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-5.30	0.9	0.001	0.999	5.0E-03
Np-237	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C p. 6-8.	-6.91	0.7	0.001	0.999	1.0E-03
Pa-231	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-12.21	1.0	0.001	0.999	5.0E-06
Pb-210	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-7.13	0.7	0.001	0.999	8.0E-04
Po-210	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-5.30	0.7	0.001	0.999	5.0E-03
Pu-238*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-9.21	0.2	0.001	0.999	1.0E-04
Pu-239*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-9.21	0.2	0.001	0.999	1.0E-04
Pu-240*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-9.21	0.2	0.001	0.999	1.0E-04
Pu-241*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-9.21	0.2	0.001	0.999	1.0E-04
Ra-226	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-6.91	0.7	0.001	0.999	1.0E-03
Ra-228	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-6.91	0.7	0.001	0.999	1.0E-03
Sb-125*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-6.91	0.9	0.001	0.999	1.0E-03
Sr-90*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-4.61	0.4	0.001	0.999	1.0E-02

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Tc-99*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-9.21	0.7	0.001	0.999	1.0E-04
Te-125m	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-4.96	0.9	0.001	0.999	7.0E-03
Th-228	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-9.21	1.0	0.001	0.999	1.0E-04
Th-229	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-9.21	1.0	0.001	0.999	1.0E-04
Th-230	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-9.21	1.0	0.001	0.999	1.0E-04
Th-232	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-9.21	1.0	0.001	0.999	1.0E-04
U-233	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-7.13	0.7	0.001	0.999	8.0E-04
U-234	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-7.13	0.7	0.001	0.999	8.0E-04
U-235	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-7.13	0.7	0.001	0.999	8.0E-04
U-236	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-8.	-7.13	0.7	0.001	0.999	8.0E-04
Milk Transfer Factors ((pCi/L)/(pCi/d))										
Ac-227	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-13.12	0.9	0.001	0.999	2.0E-06
Ag-108m*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-5.12	0.7	0.001	0.999	6.0E-03
Am-241*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-13.12	0.7	0.001	0.999	2.0E-06
Am-243	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-13.12	0.7	0.001	0.999	2.0E-06
C-14*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-4.4	0.9	0.001	0.999	1.2E-02
Cm-242*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-13.12	0.9	0.001	0.999	2.0E-06
Cm-243*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-13.12	0.9	0.001	0.999	2.0E-06
Co-60*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-6.21	0.7	0.001	0.999	2.0E-03
Cs-134*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-4.61	0.5	0.001	0.999	1.0E-02
Cs-137*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-4.61	0.5	0.001	0.999	1.0E-02
Eu-152*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-9.72	0.9	0.001	0.999	6.0E-05
Eu-154*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-9.72	0.9	0.001	0.999	6.0E-05
Eu-155*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-9.72	0.9	0.001	0.999	6.0E-05
Fe-55*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-8.11	0.7	0.001	0.999	3.0E-04
Gd-152	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-9.72	0.9	0.001	0.999	6.0E-05
H-3*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-4.6	0.9	0.001	0.999	1.0E-02
Mn-54*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-8.11	0.7	0.001	0.999	3.0E-04
Na-22*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-3.22	0.5	0.001	0.999	4.0E-02

Table 6G-1: Input Parameter Values for Sensitivity Analysis Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Nb-94*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-13.12	0.7	0.001	0.999	2.0E-06
Ni-59*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-3.91	0.7	0.001	0.999	2.0E-02
Ni-63*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-3.91	0.7	0.001	0.999	2.0E-02
Np-237	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-11.51	0.7	0.001	0.999	1.0E-05
Pa-231	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-12.21	0.9	0.001	0.999	5.0E-06
Pb-210	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-8.11	0.9	0.001	0.999	3.0E-04
Po-210	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-7.82	0.7	0.001	0.999	4.0E-04
Pu-238*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-13.82	0.5	0.001	0.999	1.0E-06
Pu-239*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-13.82	0.5	0.001	0.999	1.0E-06
Pu-240*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-13.82	0.5	0.001	0.999	1.0E-06
Pu-241*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-13.82	0.5	0.001	0.999	1.0E-06
Ra-226	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-6.91	0.5	0.001	0.999	1.0E-03
Ra-228	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-6.91	0.5	0.001	0.999	1.0E-03
Sb-125*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-9.72	0.9	0.001	0.999	6.0E-05
Sr-90*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-6.21	0.5	0.001	0.999	2.0E-03
Tc-99*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C, p. 6-11.	-6.91	0.7	0.001	0.999	1.0E-03
Te-125m	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C p. 6-11.	-7.60	0.6	0.001	0.999	5.0E-04
Th-228	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C p. 6-11.	-12.21	0.9	0.001	0.999	5.0E-06
Th-229	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C p. 6-11.	-12.21	0.9	0.001	0.999	5.0E-06
Th-230	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C p. 6-11.	-12.21	0.9	0.001	0.999	5.0E-06
Th-232	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C p. 6-11.	-12.21	0.9	0.001	0.999	5.0E-06
U-233	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C p. 6-11.	-7.82	0.6	0.001	0.999	4.0E-04
U-234	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C p. 6-11.	-7.82	0.6	0.001	0.999	4.0E-04
U-235	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C p. 6-11.	-7.82	0.6	0.001	0.999	4.0E-04
U-236	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C p. 6-11.	-7.82	0.6	0.001	0.999	4.0E-04
Bioaccumulation Factors for Fish ((pCi/kg)/(pCi/L))										
Ac-227	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	2.7	1.1			1.5E+01
Ag-108m*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	1.6	1.1			5.0E+00
Am-241*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.4	1.1			3.0E+01

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Am-243	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.4	1.1			3.0E+01
C-14*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	10.8	1.1			4.9E+04
Cm-242*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.4	1.1			3.0E+01
Cm-243*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.4	1.1			3.0E+01
Co-60*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	5.7	1.1			3.0E+02
Cs-134*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	7.6	0.7			2.0E+03
Cs-137*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	7.6	0.7			2.0E+03
Eu-152*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.9	1.1			4.9E+01
Eu-154*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.9	1.1			4.9E+01
Eu-155*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.9	1.1			4.9E+01
Fe-55*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	5.3	1.1			2.0E+02
Gd-152	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.2	1.1			2.5E+01
H-3*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	0	0.1			1.0E+00
Mn-54*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	6	1.1			4.0E+02
Na-22*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3	1.1			2.0E+01
Nb-94*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	5.7	1.1			3.0E+02
Ni-59*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	4.6	1.1			9.9E+01
Ni-63*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	4.6	1.1			9.9E+01
Np-237	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.4	1.1			3.0E+01
Pa-231	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	2.3	1.1			1.0E+01
Pb-210	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	5.7	1.1			3.0E+02
Po-210	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	4.6	1.1			9.9E+-01
Pu-238*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.4	1.1			3.0E+01
Pu-239*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.4	1.1			3.0E+01
Pu-240*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.4	1.1			3.0E+01
Pu-241*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.4	1.1			3.0E+01
Ra-226	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.9	1.1			4.9E+01
Ra-228	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3.9	1.1			4.9E+01
Sb-125*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	4.6	1.1			9.9E+01

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Sr-90*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	4.1	1.1			6.0E+01
Tc-99*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	3	1.1			2.0E+01
Te-125m	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	6.0	1.1			4.0E+02
Th-228	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	4.6	1.1			9.9E+01
Th-229	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	4.6	1.1			9.9E+01
Th-230	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	4.6	1.1			9.9E+01
Th-232	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	4.6	1.1			9.9E+01
U-233	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	2.3	1.1			1.0E+01
U-234	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	2.3	1.1			1.0E+01
U-235	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	2.3	1.1			1.0E+01
U-236	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C , p. 6-21.	2.3	1.1			1.0E+01
Bioaccumulation Factors for Crustacea/Mollusks ((pCi/kg)/(pCi/L))										
Ac-227	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Ag-108m*	P	3	D	7.70E+02	RESRAD Default	NR	NR	NR	NR	
Am-241*	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Am-243	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
C-14*	P	3	D	9.10E+03	RESRAD Default	NR	NR	NR	NR	
Cm-242*	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Cm-243*	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Co-60*	P	3	D	2.00E+02	RESRAD Default	NR	NR	NR	NR	
Cs-134*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Cs-137*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Eu-152*	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Eu-154*	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Eu-155*	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Fe-55*	P	3	D	3.20E+03	RESRAD Default	NR	NR	NR	NR	
Gd-152	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
H-3*	P	3	D	1.00E+00	RESRAD Default	NR	NR	NR	NR	
Mn-54*	P	3	D	9.00E+04	RESRAD Default	NR	NR	NR	NR	

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Na-22*	P	3	D	2.00E+02	RESRAD Default	NR	NR	NR	NR	
Nb-94*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Ni-59*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Ni-63*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Np-237	P	3	D	4.00E+02	RESRAD Default	NR	NR	NR	NR	
Pa-231	P	3	D	1.10E+02	RESRAD Default	NR	NR	NR	NR	
Pb-210	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Po-210	P	3	D	2.00E+04	RESRAD Default	NR	NR	NR	NR	
Pu-238*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Pu-239*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Pu-240*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Pu-241*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Ra-226	P	3	D	2.50E+02	RESRAD Default	NR	NR	NR	NR	
Ra-228	P	3	D	2.50E+02	RESRAD Default	NR	NR	NR	NR	
Sb-125*	P	3	D	1.00E+01	RESRAD Default	NR	NR	NR	NR	
Sr-90*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Tc-99*	P	3	D	5.00E+00	RESRAD Default	NR	NR	NR	NR	
Te-125m	P	3	D	5.00E+00	RESRAD Default	NR	NR	NR	NR	
Th-228	P	3	D	5.00E+02	RESRAD Default	NR	NR	NR	NR	
Th-229	P	3	D	5.00E+02	RESRAD Default	NR	NR	NR	NR	
Th-230	P	3	D	5.00E+02	RESRAD Default	NR	NR	NR	NR	
Th-232	P	3	D	5.00E+02	RESRAD Default	NR	NR	NR	NR	
U-233	P	3	D	6.00E+01	RESRAD Default	NR	NR	NR	NR	
U-234	P	3	D	6.00E+01	RESRAD Default	NR	NR	NR	NR	
U-235	P	3	D	6.00E+01	RESRAD Default	NR	NR	NR	NR	
U-236	P	3	D	6.00E+01	RESRAD Default	NR	NR	NR	NR	
Graphics Parameters										
Number of points				32	RESRAD Default	NR	NR	NR	NR	
Spacing				log	RESRAD Default	NR	NR	NR	NR	

Table 6G-1: Input Parameter Values for Sensitivity Analysis
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Time integration parameters										
Maximum number of points for dose				17	RESRAD Default	NR	NR	NR	NR	

Footnotes:

[a] P = physical, B = behavioral, M = metabolic; (see NUREG/CR-6697, Attachment B, Table 4.)
[b] 1 = high-priority parameter, 2 = medium-priority parameter, 3 = low-priority parameter (see NUREG/CR-6697, Attachment B, Table 4.1)
[c] D = deterministic, S = stochastic
[d] Distributions Statistical Parameters:
Lognormal-n: 1= mean, 2 = standard deviation
Bounded lognormal-n: 1= mean, 2 = standard deviation, 3 = minimum, 4 = maximum
Truncated lognormal-n: 1= mean, 2 = standard deviation, 3 = lower quantile, 4 = upper quantile
Bounded normal: 1 = mean, 2 = standard deviation, 3 = minimum, 4 = maximum
Triangular: 1 = minimum, 2 = most likely, 3 = maximum
Uniform: 1 = minimum, 2 = maximum

Note: values listed in columns 1 and 2 of the Distributions Statistical Parameters represent the exponent of the base (e) for Lognormal-n, Bounded lognormal-n, and Truncated lognormal-n distributions.
* Designates principal radionuclide-of-concern; undesignated radionuclides are included as daughter products.

Additional Sensitivity Analysis Data:
Sampling technique = Latin Hypercube
Number of observations =2000
Number of repetitions = 1

Input Rank Correlation Coefficients (NUREG/CR-6697):
Total porosity and bulk density = - 0.99 (contaminated zone, unsaturated and saturated zones)
Total porosity and effective porosity = 0.96 (unsaturated and saturated zones)
Well Pumping rate and irrigation = 0.96

Appendix 6H

Results of Sensitivity Analysis: Soil

(Extracted from Reference 6-12)

Table 6H-1: Sensitivity Analysis Results: Soil
(Based on the Partial Rank Correlation Coefficient (PRCC))

Radionuclide	Sensitive Parameter	Units	PRCC
H-3	Depth of roots	m	-0.93
	Saturated Zone Hydraulic Conductivity	m/y	0.48
	Kd of H in unsaturated zone	cm^3/g	-0.28
C-14	Depth of roots	m	-0.97
	Thickness of evasion layer of C-14	m	0.82
	Kd of C in contaminated zone	cm^3/g	0.44
Na-22	External gamma shielding factor	Unit-less	0.89
	Kd of Na in contaminated zone	cm^3/g	0.59
Mn-54	External gamma shielding factor	Unit-less	0.96
	Kd of Mn in contaminated zone	cm^3/g	0.50
Fe-55	Meat transfer factor for Fe	pCi/kg per pCi/d	0.88
	Kd of Fe in contaminated zone	cm^3/g	0.35
	Depth of Soil Mixing Layer	m	-0.90
Ni-59	Milk transfer factor for Ni	pCi/l per pCi/d	0.89
	Plant transfer factor for Ni	pCi/g plant per pCi/g soil	0.85
	Depth of roots	m	-0.77
	Depth of Soil Mixing Layer	m	-0.58
Ni-63	Milk transfer factor for Ni	pCi/l per pCi/d	0.89
	Plant transfer factor for Ni	pCi/g plant per pCi/g soil	0.85
	Depth of Soil Mixing Layer	m	-0.58
	Depth of roots	m	-0.77
Co-60	External gamma shielding factor	Unit-less	0.95
	Kd of Co in contaminated zone	cm^3/g	0.48
Sr-90	Plant transfer factor for Sr	pCi/g plant per pCi/g soil	0.94
	Depth of roots	m	-0.85
	Kd of Sr-90 in contaminated zone	cm^3/g	0.45
	Milk Transfer Factor for Sr	m	0.27
Nb-94	External gamma shielding factor	Unit-less	0.93
	Kd of Nb in contaminated zone	cm^3/g	0.52
Tc-99	Kd of Tc in contaminated zone	cm^3/g	0.92

Table 6H-1: Sensitivity Analysis Results: Soil (Based on the Partial Rank Correlation Coefficient (PRCC))			
Radionuclide	Sensitive Parameter	Units	PRCC
	Plant transfer factor for Tc	pCi/g plant per pCi/g soil	0.90
	Depth of roots	m	-0.81
	Evapotranspiration Coefficient	Unit-less	0.26
Ag-108m	External gamma shielding factor	Unit-less	0.98
	Kd of Ag in contaminated zone	cm^3/g	0.47
Sb-125	External gamma shielding factor	Unit-less	0.93
	Kd of Sb in contaminated zone	cm3 /g	0.52
Cs-134	External gamma shielding factor	Unit-less	0.95
	Plant transfer factor for Cs	pCi/g plant per pCi/g soil	0.50
	Depth of roots	m	-0.39
	Kd of Cs in contaminated zone	cm^3/g	0.27
Cs-137	External gamma shielding factor	Unit-less	0.92
	Plant transfer factor for Cs	pCi/g plant per pCi/g soil	0.59
	Depth of roots	m	-0.47
	Milk transfer factor for Cs	pCi/l per pCi/d	0.30
	Depth of Soil Mixing Layer	m	-0.28
	Meat transfer factor for Cs	pCi/kg per pCi/d	0.26
Eu-152	External gamma shielding factor	Unit-less	0.95
	Kd of Eu in contaminated zone	cm^3/g	0.44
Eu-154	External gamma shielding factor	Unit-less	0.95
	Kd of Eu in contaminated zone	cm^3/g	0.44
Eu-155	External gamma shielding factor	Unit-less	0.95
	Kd of Eu in contaminated zone	cm^3/g	0.44
Pu-238	Plant transfer factor for Pu	pCi/g plant per pCi/g soil	0.90
	Depth of roots	m	-0.83
	Depth of Soil Mixing Layer	m	-0.76
Pu-239	Plant transfer factor for Pu	pCi/g plant per pCi/g soil	0.89
	Depth of roots	m	-0.83
	Depth of Soil Mixing Layer	m	-0.76
Pu-240	Plant transfer factor for Pu	pCi/g plant per pCi/g soil	0.89

Table 6H-1: Sensitivity Analysis Results: Soil (Based on the Partial Rank Correlation Coefficient (PRCC))			
Radionuclide	Sensitive Parameter	Units	PRCC
	Depth of roots	m	-0.83
	Depth of Soil Mixing Layer	m	-0.76
Pu-241	Plant transfer factor for Am	pCi/g plant per pCi/g soil	0.64
	Depth of roots	m	-0.67
	Depth of Soil Mixing Layer	m	-0.52
	Kd of Am in contaminated zone	Cm^3/g	0.47
	Plant transfer factor for Pu	pCi/g plant per pCi/g soil	0.39
	Kd of Pu in contaminated zone	cm^3/g	0.35
Am-241	External gamma shielding factor	Unit-less	0.26
	Depth of roots	m	-0.79
	Depth of Soil Mixing Layer	m	-0.68
	Plant Transfer Factor for Am	pCi/g plant per pCi/g soil	0.88
Cm-242	Plant transfer factor for Cm	pCi/g plant per pCi/g soil	0.88
	Depth of roots	m	-0.85
	Depth of soil in mixing layer	m	-0.74
	Plant transfer factor for Pu	pCi/g plant per pCi/g soil	0.30
Cm-243	External gamma shielding factor	Unit-less	0.89
	Plant transfer factor for Cm	pCi/g plant per pCi/g soil	0.75
	Depth of roots	m	-0.66
	Depth of soil in mixing layer	m	-0.37

Appendix 6I

RESRAD Parameter Values for Soil DCGL Determination

(Extracted from Reference 6-14)

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Soil Concentrations										
Basic radiation dose limit (mrem/y)		3	D	25	10 CFR 20.1402	NR	NR	NR	NR	
Initial principal radionuclide concentration in soil (pCi/g)	P	2	D	1	Unit Value	NR	NR	NR	NR	
Distribution Coefficients for Contaminated, Unsaturated, and Saturated Zones (cm^3/g)										
Ac-227	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	6.72	3.22	0.001	0.999	825
Ag-108m*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	5.38	2.1	0.001	0.999	216
			D	888.945	75[th] percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Am-241*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	7.28	3.15	0.001	0.999	1445
Am-243	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	7.28	3.15	0.001	0.999	1445
C-14*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	2.4	3.22	0.001	0.999	11
			D	95.7876	75[th] percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Cm-242*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	8.82	1.82	0.001	0.999	6761
Cm-243*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	8.82	1.82	0.001	0.999	6761
Co-60*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	5.46	2.53	0.001	0.999	235
			D	1289.53	75[th] percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Cs-134*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	6.1	2.33	0.001	0.999	446
			D	2131.38	75[th] percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Cs-137*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	6.1	2.33	0.001	0.999	446
Eu-152*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	6.72	3.22	0.001	0.999	825
			D	7211	75[th] percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Eu-154*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	6.72	3.22	0.001	0.999	825
			D	7201.14	75[th] percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Eu-155*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	6.72	3.22	0.001	0.999	825
			D	7201.14	75[th] percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Fe-55*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	5.34	2.67	0.001	0.999	209
			D	1252.41	75[th] percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Gd-152	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	6.72	3.22	0.001	0.999	825
H-3*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to contaminated and saturated zones	-2.81	0.5	0.001	0.999	0.06
			D	0.0429964	25[th] percentile value determined in sensitivity analysis – applicable to unsaturated zone	---	---	---	---	

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Mn-54*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	5.06	2.29	0.001	0.999	158
			D	733.382	75th percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Na-22*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	5.04	3.22	0.001	0.999	154
			D	1342.29	75th percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Nb-94*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	5.94	3.22	0.001	0.999	380
			D	3301.51	75th percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Ni-59*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	6.05	1.46	0.001	0.999	424
Ni-63*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	6.05	1.46	0.001	0.999	424
Np-237	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	2.84	2.25	0.001	0.999	17
Pa-231	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	5.94	3.22	0.001	0.999	380
Pb-210	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	7.78	2.76	0.001	0.999	2392
Po-210	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	5.20	1.68	0.001	0.999	181
Pu-238*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	6.86	1.89	0.001	0.999	953
Pu-239*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	6.86	1.89	0.001	0.999	953
Pu-240*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	6.86	1.89	0.001	0.999	953
Pu-241*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	6.86	1.89	0.001	0.999	953
			D	3400.37	75th percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Ra-226	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	8.17	1.7	0.001	0.999	3533
Ra-228	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	8.17	1.7	0.001	0.999	3533

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Sb-125*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	5.94	3.22	0.001	0.999	380
			D	3322.31	75th percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Sr-90*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	3.45	2.12	0.001	0.999	32
			D	130.78	75th percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Tc-99*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C - applicable to unsaturated and saturated zones	-0.67	3.16	0.001	0.999	0.51
			D	4.27099	75th percentile value determined in sensitivity analysis – applicable to contaminated zone	---	---	---	---	
Te-125m	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	3.64	3.22	0.001	0.999	38.1
Th-228	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	8.68	3.62	0.001	0.999	5884
Th-229	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	8.68	3.62	0.001	0.999	5884
Th-230	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	8.68	3.62	0.001	0.999	5884
Th-232	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	8.68	3.62	0.001	0.999	5884
U-233	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	4.84	3.13	0.001	0.999	126
U-234	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	4.84	3.13	0.001	0.999	126
U-235	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	4.84	3.13	0.001	0.999	126
U-236	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	4.84	3.13	0.001	0.999	126
Initial concentration of radionuclides present in groundwater (pCi/l)	P	3	D	0	Ground water uncontaminated	NR	NR	NR	NR	
Calculation Times										
Time since placement of material (y)	P	3	D	0		NR	NR	NR	NR	
Time for calculations (y)	P	3	D	0, 1, 3, 10, 30, 100, 300, 1000	RESRAD Defaults	NR	NR	NR	NR	
Contaminated Zone										
Area of contaminated zone (m^2)	P	2	D	7,855.06	Site-specific Value – contaminated zone area set equivalent to size of EF-1 PA.	NR	NR	NR	NR	

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Thickness of contaminated zone (m)	P	2	D	0.1524	Assumed thickness of contaminated zone.	NR	NR	NR	NR	
Length parallel to aquifer flow (m)	P	2	D	100	Site-specific Value - Diameter of circle with an area = EF-1 Protected Area.	NR	NR	NR	NR	
Cover and Contaminated Zone Hydrological Data										
Cover depth (m)	P	2	D	0	Site-specific Value - no cover assumed	NR	NR	NR	NR	
Density of contaminated zone (g/cm^3)	P	1	S	Bounded Normal	NUREG 6697 distribution for site soil type - sandy loam	1.5635	0.2385	0.827	2.3	1.5635
Contaminated zone erosion rate (m/y)	P	2	D	6.00E-04	Site-specific Value - Calculated value based on site-specific slope of dx/dz and interpolated value in Figure 3.8-11 from NUREG/CR-6697.	NR	NR	NR	NR	
Contaminated zone total porosity	P	2	S	Bounded Normal	NUREG 6697 distribution for site soil type - sandy loam	0.41	0.0899	0.1322	0.6878	0.41
Contaminated zone field capacity	P	3	D	0.064	Site-specific Value - Calculated value using Equation 4.4 for the Field Capacity (from the RESRAD Data Collection Handbook).	NR	NR	NR	NR	
Contaminated zone hydraulic conductivity (m/y)	P	2	S	Bounded Log Normal -n	Site-specific Value - Used distribution from NUREG/CR-6697 Table 3.4-1 for site soil type - sandy loam.	5.022	1.33	2.49	9,250	5.022
Contaminated zone b parameter	P	2	S	Bounded Lognormal-n	NUREG 6697 distribution for site soil type - sandy loam	0.632	0.282	0.786	4.50	0.632
Humidity in air (g/m^3)	P	3	D	4.6	Regional value from Health Physics, Vol. 39.	NR	NR	NR	NR	
Evapotranspiration coefficient	P	2	S	Uniform	Site-specific Value - NUREG/CR-6697 Att. C, (Median = midpoint).	0.5	0.75	NR	NR	0.625
			D	0.687414	75th percentile value determined in sensitivity analysis – applicable for Tc-99	---	---	---	---	
Average annual wind speed (m/s)	P	2	D	2.91	Site-specific Value – DECo site meteorological data (10 m) Tables: 2003 – 2007.	NR	NR	NR	NR	
Precipitation (m/y)	P	2	D	0.84	Regional value for Detroit, MI (1971 -2000). Calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Irrigation (m/y)	B	3	S	Uniform	Site-specific Value – calculated using NUREG/CR-6697, Att C methodology. Calc. ENG-002 Section 6.1.	0.344	0.852	NR	NR	0.598
Irrigation mode	B	3	D	Overhead	Site-specific Value - overhead irrigation is standard practice in Midwest.	NR	NR	NR	NR	

Table 6I-1: Input Parameter Values for DCGL Calculations Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Runoff coefficient	P	2	D	0.2	Site-specific Value - Calculated value using Equation 10.1 for Runoff Coefficient. Calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Watershed area for nearby stream or pond (m^2)	P	3	D	2.82E8	Site-specific Value- drainage area listed in EF2 FSAR.	NR	NR	NR	NR	
Accuracy for water/soil computations	-	3	D	1.00E-03	RESRAD Default	NR	NR	NR	NR	
Saturated Zone Hydrological Data										
Density of saturated zone (g/cm^3)	P	1	S	Bounded Normal	NUREG 6697 distribution for site soil type - sandy loam	1.5635	0.2385	0.827	2.3	1.5635
Saturated zone total porosity	P	1	S	Bounded Normal	NUREG 6697 distribution for site soil type - sandy loam	0.41	0.0899	0.1322	0.6878	0.41
Saturated zone effective porosity	P	1	S	Bounded Normal	NUREG 6697 distribution for site soil type - sandy loam	0.346	0.0915	0.0629	0.628	0.346
Saturated zone field capacity	P	3	D	0.064	Site-specific Value - Calculated value using Equation 4.4 for the Field Capacity (from the RESRAD Data Collection Handbook). Calc ENG-002 section 6.1.	NR	NR	NR	NR	
Saturated zone hydraulic conductivity (m/y)	P	1	S	Bounded Log Normal-n	NUREG 6697 distribution for site soil type - sandy loam	5.022	1.33	2.49	9,250	5.022
			D	370.578	75th percentile value – applicable to H-3 RESRAD run	---	---	---	---	
Saturated zone hydraulic gradient	P	2	D	0.002	Site-specific Value - Golder Associates Report on Groundwater Charecterization	NR	NR	NR	NR	
Saturated zone b parameter	P	2	S	Bounded Lognormal-n	NUREG 6697 distribution for site soil type - sandy loam	0.632	0.282	0.786	4.50	0.632
Water table drop rate (m/y)	P	3	D	1.00E-03	RESRAD Default	NR	NR	NR	NR	
Well pump intake depth (m below water table)	P	2	S	Triangular	NUREG/CR-6697, Att. C.	6	30	10		10
Model: Nondispersion (ND) or Mass-Balance (MB)	P	3	D	ND	ND model recommended for contaminant areas > 1,000 m^2	NR	NR	NR	NR	

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Well pumping rate (m^3/y)	P	2	S	Uniform	Site-specific Value - Min, Max, and Median value based on NUREG/CR-6697, Att. C section 3.10 method using site irrigation method and area.	1141	2157			1649
Unsaturated Zone Hydrological Data										
Number of unsaturated zone strata	P	3	D	1	Site-specific Value - Golder Associates Report on Groundwater Charecterization (Table 1 and Appendix B)	NR	NR	NR	NR	
Unsat. zone 1, thickness (m)	P	1	D	1.8	Site-specific Value - Golder Associates Report on Groundwater Charecterization - Calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Unsat. zone 1, soil density (g/cm^3)	P	2	S	Bounded Normal	NUREG 6697 distribution for site soil type - sandy loam	1.5635	0.2385	0.827	2.3	1.5635
Unsat. zone 1, total porosity	P	2	S	Bounded Normal	NUREG 6697 distribution for site soil type - sandy loam	0.41	0.0899	0.1322	0.6878	0.41
Unsat. zone 1, effective porosity	P	2	D	Bounded Normal	NUREG 6697 distribution for site soil type - sandy loam	0.346	0.0915	0.0629	0.628	0.346
Unsat. zone 1, field capacity	P	3	D	0.064	Site-specific Value - Calculated value using Equation 4.4 for the Field Capacity (from the RESRAD Data Collection Handbook) - Calc ENG-002 section 6.1.	NR	NR	NR	NR	
Unsat. zone 1, hydraulic conductivity (m/y)	P	2	S	Bounded Log Normal-n	NUREG 6697 distribution for site soil type - sandy loam	5.022	1.33	2.49	9,250	5.022
Unsat. zone 1, soil-specific b parameter	P	2	S	Bounded Lognormal-n	NUREG 6697 distribution for site soil type - sandy loam	0.632	0.282	0.786	4.50	0.632
Occupancy										
Inhalation rate (m^3/y)	B	3	D	8,400	NUREG/CR-6697, Att. C	NR	NR	NR	NR	
Mass loading for inhalation (g/m^3)	P	2	S	Continuous linear	NUREG/CR-6697, Att. C					2.33E-05
Exposure duration	B	3	D	30	RESRAD default	NR	NR	NR	NR	
Indoor dust filtration factor	P	2	S	Uniform	NUREG/CR-6697, Att. C	0.15	0.95			0.58

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Shielding factor, external gamma	P	2	S	Bounded Lognormal-n	Distribution values from NUREG/CR-6697, Att. C.	-1.3	0.59	0.044	1	0.273
			D	0.3982	75th percentile value determined in sensitivity analysis – applicable in RESRAD runs for Na-22, Mn-54, Co-60, Nb-94, Ag-108m, Sb-125, Cs-134, Cs-137, Eu-152, Eu-154, Eu-155, Am-241, Cm-243	---	---	---	---	---
Fraction of time spent indoors	B	3	D	0.6571	NUREG/CR-5512, Vol. 3, Table 6.87; Calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Fraction of time spent outdoors (on site)	B	3	D	0.118	NUREG/CR-5512, Vol. 3, Table 6.87 - Calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Shape factor flag, external gamma	P	3	D	Circular	RESRAD Default - Circular contaminated zone assumed for EF-1 Protected area, ANL/EAIS-8, Table 1.3	NR	NR	NR	NR	
Ingestion Dietary										
Fruits, vegetables, grain consumption (kg/y)	B	2	D	112	NUREG/CR-5512, Vol. 3, (other vegetables + fruit + grain), Table 6.87	NR	NR	NR	NR	
Leafy vegetables consumption (kg/y)	B	3	D	21.4	NUREG/CR-5512, Vol. 3, Table 6.87	NR	NR	NR	NR	
Milk consumption (L/y)	B	2	D	233	NUREG/CR-5512, Vol. 3, Table 6.87	NR	NR	NR	NR	
Meat and poultry consumption (kg/y)	B	3	D	65.1	NUREG/CR-5512, Vol. 3 (beef + poultry), Table 6.87.	NR	NR	NR	NR	
Fish consumption (kg/y)	B	3	D	20.6	NUREG/CR-5512, Vol. 3, Table 6.87.	NR	NR	NR	NR	
Other seafood consumption (kg/y)	B	3	D	0.9	RESRAD Default.	NR	NR	NR	NR	
Soil ingestion rate (g/y)	B	2	D	18.26	NUREG/CR-5512, Vol. 3, Table 6.87.	NR	NR	NR	NR	
Drinking water intake (L/y)	B	2	D	478.5	NUREG/CR-5512, Vol. 3, Table 6.87.	NR	NR	NR	NR	
Contamination fraction of drinking water	P	3	D	1	Model assumption – drinking water from site.	NR	NR	NR	NR	
Contamination fraction of livestock	P	3	D	1	Model assumption – livestock water assumed contaminated.	NR	NR	NR	NR	
Contamination fraction of irrigation	P	3	D	1	Model assumption – irrigation water assumed contaminated.	NR	NR	NR	NR	
Contamination fraction of aquatic food	P	3	D	1	NUREG/CR-5512, Vol. 3.	NR	NR	NR	NR	

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Contamination fraction of plant food	P	3	D	1	NUREG/CR-5512, Vol. 3.	NR	NR	NR	NR	
Contamination fraction of meat	P	3	D	1	RESRAD Default -- ANL/EAD-4, Table 2.3.	NR	NR	NR	NR	
Contamination fraction of milk	P	3	D	1	RESRAD Default -- ANL/EAD-4, Table 2.3.	NR	NR	NR	NR	
Ingestion, Non- Dietary										
Livestock fodder intake for meat (kg/day)	M	3	D	27.1	NUREG/CR5512, Vol. 3 Table 6.87 (beef cattle + poultry + layer hen)					
Livestock fodder intake for milk (kg/day)	M	3	D	63.2	NUREG/CR5512, Vol. 3 Table 6.87 (forage + grain + hay)					
Livestock water intake for meat (L/day)	M	3	D	50	NUREG/CR5512, Vol. 3 Table 6.87 (beef cattle + poultry + layer hen)					
Livestock water intake for milk (L/day)	M	3	D	60	NUREG/CR5512, Vol. 3 Table 6.87.					
Livestock soil intake (kg/day)	M	3	D	0.5	RESRAD Default, ANL/AED-4.	NR	NR	NR	NR	
Mass loading for foliar deposition (g/m**3)	P	3	D	4.00E-04	NUREG/CR-5512, Vol. 3 Table 6.87, gardening.	NR	NR	NR	NR	
Depth of soil mixing layer (m)	P	2	S D	Triangular 0.149928	NUREG/CR-6697, Att. C 25th percentile value determined in sensitivity analysis – applicable for Fe-55, Ni-59, Ni-63, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cm-242, Cm-243	0 ---	0.6 ---	0.15 ---		0.15 ---
Depth of roots (m)	P	1	S D	Uniform 1.225	NUREG/CR-6697, Att C 25th percentile value determined in sensitivity analysis – applicable for H-3, C-14, Ni-59, Ni-63, Sr-90, Tc-99, Cs-134, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cm-242, Cm-243	0.3 ---	4.0 ---			2.15 ---
Drinking water fraction from ground water	P	3	D	1	RESRAD Default - all water assumed to be supplied from groundwater, ANL/EAIS-8 Table 1.3.	NR	NR	NR	NR	
Livestock water fraction from ground water	P	3	D	1	RESRAD Default - all water assumed to be supplied from groundwater, ANL/EAIS-8 Table 1.3 p. 12 .	NR	NR	NR	NR	

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Irrigation fraction from ground water	P	3	D	1	RESRAD Default - all water assumed to be supplied from groundwater, ANL/EAIS-8 Table 1.3	NR	NR	NR	NR	
Wet weight crop yield for Non-Leafy (kg/m**2)	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	0.56	0.48	0.001	0.999	0.56
Wet weight crop yield for Leafy (kg/m**2)	P	3	D	2.88921	NUREG/CR-5512, Vol. 3 Table 6.87	NR	NR	NR	NR	
Wet weight crop yield for Fodder (kg/m**2)	P	3	D	1.8868	NUREG/CR-5512, Vol. 3 Table 6.87	NR	NR	NR	NR	
Growing Season for Non-Leafy (years)	P	3	D	0.246	NUREG/CR-5512, Vol. 3 Table 6.87	NR	NR	NR	NR	
Growing Season for Leafy (years)	P	3	D	0.123	NUREG/CR-5512, Vol. 3 Table 6.87	NR	NR	NR	NR	
Growing Season for Fodder (years)	P	3	D	0.082	NUREG/CR-5512, Vol. 3 Table 6.87	NR	NR	NR	NR	
Translocation Factor for Fodder	P	3	D	1	NUREG/CR-5512, Vol. 3 Table 6.87	NR	NR	NR	NR	
Weathering Removal Constant for Vegetation (1/yr)	P	2	S	Triangular	NUREG/CR-6697, Att. C	5.1	84	18		18
Wet Foliar Interception Fraction for Non-Leafy	P	3	D	0.35	NUREG/CR-5512, Vol. 3 Table 6.87	NR	NR	NR	NR	
Wet Foliar Interception Fraction for Leafy	P	2	S	Triangular	NUREG/CR-6697, Att. C	0.06	0.95	0.67		0.67
Wet Foliar Interception Fraction for Fodder	P	3	D	0.35	NUREG/CR-5512, Vol. 3 Table 6.87	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Non-Leafy	P	3	D	0.35	NUREG/CR-5512, Vol. 3 Table 6.87	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Leafy	P	3	D	0.35	NUREG/CR-5512, Vol. 3	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Fodder	P	3	D	0.35	NUREG/CR-5512, Vol. 3	NR	NR	NR	NR	
Storage Times of Contaminated Foodstuffs (days)										
Fruits, non-leafy vegetables, and grain	B	3	D	14	NUREG/CR-5512, Vol. 3 Table 6.87	NR	NR	NR	NR	
Leafy vegetables	B	3	D	1	NUREG/CR-5512, Vol. 3 Table 6.87	NR	NR	NR	NR	
Milk	B	3	D	1	NUREG/CR-5512, Vol. 3 Table 6.87	NR	NR	NR	NR	
Meat and poultry	B	3	D	20	NUREG/CR-5512, Vol. 3 Table 6.87 (holdup period for beef)	NR	NR	NR	NR	
Fish	B	3	D	7	RESRAD Default, ANL/EAD-4, Table D.6	NR	NR	NR	NR	

Table 6I-1: Input Parameter Values for DCGL Calculations Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Crustacea and Mollusk	B	3	D	7	RESRAD Default, ANL/EAD-4 , Table D.6	NR	NR	NR	NR	
Well water	B	3	D	1	RESRAD Default, ANL/EAD-4 , Table D.6	NR	NR	NR	NR	
Surface water	B	3	D	1	RESRAD Default, ANL/EAD-4 , Table D.6	NR	NR	NR	NR	
Livestock fodder	B	3	D	45	RESRAD Default, ANL/EAD-4 , Table D.6	NR	NR	NR	NR	
Special Radionuclides (C-14)										
C-12 concentration in water (g/cm^3)	P	3	D	2.00E-05	RESRAD Default, ANL/EAD-4	NR	NR	NR	NR	
C-12 concentration in contaminated soil (g/g)	P	3	D	3.00E-02	RESRAD Default, ANL/EAD-4	NR	NR	NR	NR	
C-14 evasion layer thickness in soil (m)	P	2	D	0.426683	75th percentile value determined in sensitivity analysis					
C-14 evasion flux rate from soil (1/s)	P	3	D	7.00E-07	RESRAD Default, ANL/EAD-4	NR	NR	NR	NR	
C-12 evasion flux rate from soil (1/s)	P	3	D	1.01E-10	RESRAD Default, ANL/EAD-4, p. L-16. See calc. ENG-002 Section 6.1.	NR	NR	NR	NR	
Fraction of grain in beef cattle feed	B	3	D	0.8	NUREG/CR-6697, Table 3.2	NR	NR	NR	NR	
Fraction of grain in milk cow feed	B	3	D	0.2	NUREG/CR-6697, Table 3.2	NR	NR	NR	NR	
Fraction of vegetation carbon from soil	P	3	D	2.00E-02	RESRAD Default, ANL/EAD-4	NR	NR	NR	NR	
Fraction of vegetation carbon from air	P	3	D	9.80E-01	RESRAD Default, ANL/EAD-4	NR	NR	NR	NR	
Inhalation Dose Conversion Factors (mrem/pCi)										
Ac-227	M	3	D	6.72E+00	FGR11 (RESRAD Dose Conversion Library)	NR	NR	NR	NR	
Ag-108m*	M	3	D	2.83E-04	FGR11	NR	NR	NR	NR	
Am-241*	M	3	D	4.44E-01	FGR11	NR	NR	NR	NR	
Am-243	M	3	D	4.40E-01	FGR11	NR	NR	NR	NR	
C-14*	M	3	D	2.09E-06	FGR11	NR	NR	NR	NR	
Cm-242*	M	3	D	1.73E-02	FGR11	NR	NR	NR	NR	
Cm-243*	M	3	D	3.07E-01	FGR11	NR	NR	NR	NR	
Co-60*	M	3	D	2.19E-04	FGR11	NR	NR	NR	NR	
Cs-134*	M	3	D	4.63E-05	FGR11	NR	NR	NR	NR	
Cs-137*	M	3	D	3.19E-05	FGR11	NR	NR	NR	NR	
Eu-152*	M	3	D	2.21E-04	FGR11	NR	NR	NR	NR	
Eu-154*	M	3	D	2.86E-04	FGR11	NR	NR	NR	NR	

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Eu-155*	M	3	D	4.14E-05	FGR11	NR	NR	NR	NR	
Fe-55*	M	3	D	2.69E-06	FGR11	NR	NR	NR	NR	
Gd-152	M	3	D	2.43E-01	FGR11	NR	NR	NR	NR	
H-3*	M	3	D	6.40E-08	FGR11	NR	NR	NR	NR	
Mn-54*	M	3	D	6.70E-06	FGR11	NR	NR	NR	NR	
Na-22*	M	3	D	7.66E-06	FGR11	NR	NR	NR	NR	
Nb-94*	M	3	D	4.14E-04	FGR11	NR	NR	NR	NR	
Ni-59*	M	3	D	2.70E-06	FGR11	NR	NR	NR	NR	
Ni-63*	M	3	D	6.29E-06	FGR11	NR	NR	NR	NR	
Np-237	M	3	D	5.40E-01	FGR11	NR	NR	NR	NR	
Pa-231	M	3	D	1.28E+00	FGR11	NR	NR	NR	NR	
Pb-210	M	3	D	1.38E-02	FGR11	NR	NR	NR	NR	
Po-210	M	3	D	9.40E-03	FGR11	NR	NR	NR	NR	
Pu-238*	M	3	D	3.92E-01	FGR11	NR	NR	NR	NR	
Pu-239*	M	3	D	4.29E-01	FGR11	NR	NR	NR	NR	
Pu-240*	M	3	D	4.29E-01	FGR11	NR	NR	NR	NR	
Pu-241*	M	3	D	8.25E-03	FGR11	NR	NR	NR	NR	
Ra-226	M	3	D	8.60E-03	FGR11	NR	NR	NR	NR	
Ra-228	M	3	D	4.77E-03	FGR11	NR	NR	NR	NR	
Sb-125*	M	3	D	1.22E-05	FGR11	NR	NR	NR	NR	
Sr-90*	M	3	D	1.31E-03	FGR11	NR	NR	NR	NR	
Tc-99*	M	3	D	8.33E-06	FGR11	NR	NR	NR	NR	
Te-125m	M	3	D	7.29E-06	FGR11	NR	NR	NR	NR	
Th-228	M	3	D	3.42E-01	FGR11	NR	NR	NR	NR	
Th-229	M	3	D	2.16E+00	FGR11	NR	NR	NR	NR	
Th-230	M	3	D	3.26E-01	FGR11	NR	NR	NR	NR	
Th-232	M	3	D	1.64E+00	FGR11	NR	NR	NR	NR	
U-233	M	3	D	1.35E-01	FGR11	NR	NR	NR	NR	
U-234	M	3	D	1.32E-01	FGR11	NR	NR	NR	NR	

Table 6I-1: Input Parameter Values for DCGL Calculations Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
U-235	M	3	D	1.23E-01	FGR11	NR	NR	NR	NR	
U-236	M	3	D	1.25e-01	FGR11	NR	NR	NR	NR	
Ingestion Dose Conversion Factors (mrem/pCi)										
Ac-227	M	3	D	1.48E-02	FGR11	NR	NR	NR	NR	
Ag-108m*	M	3	D	7.62E-06	FGR11	NR	NR	NR	NR	
Am-241*	M	3	D	3.64E-03	FGR11	NR	NR	NR	NR	
Am-243	M	3	D	3.63E-03	FGR11	NR	NR	NR	NR	
C-14*	M	3	D	2.09E-06	FGR11	NR	NR	NR	NR	
Cm-242*	M	3	D	2.51E-03	FGR11	NR	NR	NR	NR	
Cm-243*	M	3	D	2.69E-05	FGR11	NR	NR	NR	NR	
Co-60*	M	3	D	7.33E-05	FGR11	NR	NR	NR	NR	
Cs-134*	M	3	D	5.00E-05	FGR11	NR	NR	NR	NR	
Cs-137*	M	3	D	6.48E-06	FGR11	NR	NR	NR	NR	
Eu-152*	M	3	D	9.55E-06	FGR11	NR	NR	NR	NR	
Eu-154*	M	3	D	1.53E-06	FGR11	NR	NR	NR	NR	
Eu-155*	M	3	D	6.07E-07	FGR11	NR	NR	NR	NR	
Fe-55*	M	3	D	1.61E-04	FGR11	NR	NR	NR	NR	
Gd-152	M	3	D	6.40E-08	FGR11	NR	NR	NR	NR	
H-3*	M	3	D	2.51E-03	FGR11	NR	NR	NR	NR	
Mn-54*	M	3	D	2.77E-06	FGR11	NR	NR	NR	NR	
Na-22*	M	3	D	1.15E-05	FGR11	NR	NR	NR	NR	
Nb-94*	M	3	D	7.14E-06	FGR11	NR	NR	NR	NR	
Ni-59*	M	3	D	2.10E-07	FGR11	NR	NR	NR	NR	
Ni-63*	M	3	D	5.77E-07	FGR11	NR	NR	NR	NR	
Np-237	M	3	D	4.44E-03	FGR11	NR	NR	NR	NR	
Pa-231	M	3	D	1.06E-02	FGR11	NR	NR	NR	NR	
Pb-210	M	3	D	5.37E-03	FGR11	NR	NR	NR	NR	
Po-210	M	3	D	1.90E-03	FGR11	NR	NR	NR	NR	
Pu-238*	M	3	D	3.20E-03	FGR11	NR	NR	NR	NR	

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Pu-239*	M	3	D	3.54E-03	FGR11	NR	NR	NR	NR	
Pu-240*	M	3	D	3.54E-03	FGR11	NR	NR	NR	NR	
Pu-241*	M	3	D	6.85E-05	FGR11	NR	NR	NR	NR	
Ra-226	M	3	D	1.33E-03	FGR11	NR	NR	NR	NR	
Ra-228	M	3	D	1.44E-03	FGR11	NR	NR	NR	NR	
Sb-125*	M	3	D	2.81E-06	FGR11	NR	NR	NR	NR	
Sr-90*	M	3	D	1.53E-04	FGR11	NR	NR	NR	NR	
Tc-99*	M	3	D	1.46E-06	FGR11	NR	NR	NR	NR	
Te-125m	M	3	D	3.67E-06	FGR11	NR	NR	NR	NR	
Th-228	M	3	D	4.03E-03	FGR11	NR	NR	NR	NR	
Th-229	M	3	D	5.48E-04	FGR11	NR	NR	NR	NR	
Th-230	M	3	D	5.48E-04	FGR11	NR	NR	NR	NR	
Th-232	M	3	D	2.73E-03	FGR11	NR	NR	NR	NR	
U-233	M	3	D	2.89E-04	FGR11	NR	NR	NR	NR	
U-234	M	3	D	2.83E-04	FGR11	NR	NR	NR	NR	
U-235	M	3	D	2.67E-04	FGR11	NR	NR	NR	NR	
U-236	M	3	D	2.69E-04	FGR11	NR	NR	NR	NR	
Plant Transfer Factors ((pCi/g plant)/(pCi/g soil))										
Ac-227	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	1.1	0.001	0.999	1.0E-03
Ag-108m*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-5.52	0.9	0.001	0.999	4.0E-03
Am-241*	P	1	S	Truncated lognormal-n	Truncated lognormal-n	-6.91	0.9	0.001	0.999	1.0E-03
			D	0.00182659	75th percentile value determined in sensitivity analysis – value applicable to Am-241 from Pu-241	---	---	---	---	
Am-243	P	1	D	Truncated lognormal-n	Truncated lognormal-n	-6.91	0.9	0.001	0.999	1.0E-03
C-14*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-0.36	0.9	0.001	0.999	7.0E-01
Cm-242*	P	1	D	0.00182659	75th percentile value determined in sensitivity analysis					
Cm-243*	P	1	D	0.00182659	75th percentile value determined in sensitivity analysis					

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Co-60*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-2.53	0.9	0.001	0.999	8.0E-02
Cs-134*	P	1	D	0.078229	75th percentile value determined in sensitivity analysis					
Cs-137*	P	1	D	0.078229	75th percentile value determined in sensitivity analysis					
Eu-152*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	1.1	0.001	0.999	2.0E-03
Eu-154*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	1.1	0.001	0.999	2.0E-03
Eu-155*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	1.1	0.001	0.999	2.0E-03
Fe-55*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.9	0.001	0.999	1.0E-03
Gd-152	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	1.1	0.001	0.999	2.0E-03
H-3*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	1.57	1.1	0.001	0.999	4.8E+00
Mn-54*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-1.20	0.9	0.001	0.999	3.0E-01
Na-22*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-3.00	1.0	0.001	0.999	5.0E-02
Nb-94*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-4.61	1.1	0.001	0.999	1.0E-02
Ni-59*	P	1	D	0.091145	75th percentile value determined in sensitivity analysis					
Ni-63*	P	1	D	0.091145	75th percentile value determined in sensitivity analysis					
Np-237	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-3.91	0.9	0.001	0.999	2.0E-02
Pa-231	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-4.61	1.1	0.001	0.999	1.0E-02
Pb-210	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-5.52	0.9	0.001	0.999	4.0E-03
Po-210	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.90	0.9	0.001	0.999	1.0E-03
Pu-238*	P	1	D	0.00182691	75th percentile value determined in sensitivity analysis – value applicable for Pu-238 from Cm-242					
Pu-239*	P	1	D	0.00182691	75th percentile value determined in sensitivity analysis					
Pu-240*	P	1	D	0.00182691	75th percentile value determined in sensitivity analysis					
Pu-241*	P	1	D	0.00182691	75th percentile value determined in sensitivity analysis					
Ra-226	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-3.22	0.9	0.001	0.999	4.0E-02

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Ra-228	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-3.22	0.9	0.001	0.999	4.0E-02
Sb-125*	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-4.61	1.0	0.001	0.999	1.0E-02
Sr-90*	P	1	D	0.589716	75th percentile value determined in sensitivity analysis					
Tc-99*	P	1	D	9.15863	75th percentile value determined in sensitivity analysis					
Te-125m	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-2.30	1.0	0.001	0.999	1.0E-01
Th-228	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.9	0.001	0.999	1.0E-03
Th-229	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.9	0.001	0.999	1.0E-03
Th-230	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.9	0.001	0.999	1.0E-03
Th-232	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.9	0.001	0.999	1.0E-03
U-233	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	0.9	0.001	0.999	2.0E-03
U-234	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	0.9	0.001	0.999	2.0E-03
U-235	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	0.9	0.001	0.999	2.0E-03
U-236	P	1	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	0.9	0.001	0.999	2.0E-03
Meat Transfer Factors ((pCi/L)/(pCi/d))										
Ac-227	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-10.82	1.0	0.001	0.999	2.0E-05
Ag-108m*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	0.7	0.001	0.999	2.0E-03
Am-241*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.90	0.2	0.001	0.999	5.0E-05
Am-243	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.90	0.2	0.001	0.999	5.0E-05
C-14*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-3.47	1.0	0.001	0.999	3.1E-02
Cm-242*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-10.82	1.0	0.001	0.999	2.0E-05
Cm-243*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-10.82	1.0	0.001	0.999	2.0E-05
Co-60*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-3.51	1.0	0.001	0.999	3.0E-02
Cs-134*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-3.00	0.4	0.001	0.999	5.0E-02
Cs-137*	P	2	D	0.0651616	75th percentile value determined in sensitivity analysis					
Eu-152*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	1.0	0.001	0.999	2.0E-03
Eu-154*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	1.0	0.001	0.999	2.0E-03
Eu-155*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	1.0	0.001	0.999	2.0E-03

Table 6I-1: Input Parameter Values for DCGL Calculations Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Fe-55*	P	2	D	0.0391293	75[th] percentile value determined in sensitivity analysis					
Gd-152	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	1.0	0.001	0.999	2.0E-03
H-3*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-4.42	1.0	0.001	0.999	1.2E-02
Mn-54*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.7	0.001	0.999	1.0E-03
Na-22*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-2.53	0.2	0.001	0.999	8.0E-02
Nb-94*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-13.82	0.9	0.001	0.999	1.0E-06
Ni-59*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-5.30	0.9	0.001	0.999	5.0E-03
Ni-63*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-5.30	0.9	0.001	0.999	5.0E-03
Np-237	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.7	0.001	0.999	1.0E-03
Pa-231	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-12.21	1.0	0.001	0.999	5.0E-06
Pb-210	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-7.13	0.7	0.001	0.999	8.0E-04
Po-210	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-5.30	0.7	0.001	0.999	5.0E-03
Pu-238*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.21	0.2	0.001	0.999	1.0E-04
Pu-239*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.21	0.2	0.001	0.999	1.0E-04
Pu-240*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.21	0.2	0.001	0.999	1.0E-04
Pu-241*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.21	0.2	0.001	0.999	1.0E-04
Ra-226	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.7	0.001	0.999	1.0E-03
Ra-228	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.7	0.001	0.999	1.0E-03
Sb-125*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.9	0.001	0.999	1.0E-03
Sr-90*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-4.61	0.4	0.001	0.999	1.0E-02
Tc-99*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.21	0.7	0.001	0.999	1.0E-04
Te-125m	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-4.96	0.9	0.001	0.999	7.0E-03
Th-228	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.21	1.0	0.001	0.999	1.0E-04
Th-229	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.21	1.0	0.001	0.999	1.0E-04
Th-230	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.21	1.0	0.001	0.999	1.0E-04
Th-232	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.21	1.0	0.001	0.999	1.0E-04
U-233	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-7.13	0.7	0.001	0.999	8.0E-04
U-234	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-7.13	0.7	0.001	0.999	8.0E-04

Table 6I-1: Input Parameter Values for DCGL Calculations Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
U-235	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-7.13	0.7	0.001	0.999	8.0E-04
U-236	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-7.13	0.7	0.001	0.999	8.0E-04
Milk Transfer Factors ((pCi/L)/(pCi/d))										
Ac-227	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-13.12	0.9	0.001	0.999	2.0E-06
Ag-108m*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-5.12	0.7	0.001	0.999	6.0E-03
Am-241*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-13.12	0.7	0.001	0.999	2.0E-06
Am-243	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-13.12	0.7	0.001	0.999	2.0E-06
C-14*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-4.4	0.9	0.001	0.999	1.2E-02
Cm-242*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-13.12	0.9	0.001	0.999	2.0E-06
Cm-243*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-13.12	0.9	0.001	0.999	2.0E-06
Co-60*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.21	0.7	0.001	0.999	2.0E-03
Cs-134*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-4.61	0.5	0.001	0.999	1.0E-02
Cs-137*	P	2	D	0.0139265	75th percentile value determined in sensitivity analysis					
Eu-152*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.72	0.9	0.001	0.999	6.0E-05
Eu-154*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.72	0.9	0.001	0.999	6.0E-05
Eu-155*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.72	0.9	0.001	0.999	6.0E-05
Fe-55*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-8.11	0.7	0.001	0.999	3.0E-04
Gd-152	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.72	0.9	0.001	0.999	6.0E-05
H-3*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-4.6	0.9	0.001	0.999	1.0E-02
Mn-54*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-8.11	0.7	0.001	0.999	3.0E-04
Na-22*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-3.22	0.5	0.001	0.999	4.0E-02
Nb-94*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-13.12	0.7	0.001	0.999	2.0E-06
Ni-59*	P	2	D	0.0320793	75th percentile value determined in sensitivity analysis					
Ni-63*	P	2	D	0.0320793	75th percentile value determined in sensitivity analysis					
Np-237	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-11.51	0.7	0.001	0.999	1.0E-05
Pa-231	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-12.21	0.9	0.001	0.999	5.0E-06
Pb-210	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-8.11	0.9	0.001	0.999	3.0E-04

Table 6I-1: Input Parameter Values for DCGL Calculations Resident Farmer Scenario - Soil										
Parameter	*Type*[a]	*Priority*[b]	*Treatment*[c]	*Value/Distribution*	*Value/Distribution Reference Source*	*Distribution's Statistical Parameters*[d]				
						1	2	3	4	Median or Mean
Po-210	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-7.82	0.7	0.001	0.999	4.0E-04
Pu-238*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-13.82	0.5	0.001	0.999	1.0E-06
Pu-239*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-13.82	0.5	0.001	0.999	1.0E-06
Pu-240*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-13.82	0.5	0.001	0.999	1.0E-06
Pu-241*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-13.82	0.5	0.001	0.999	1.0E-06
Ra-226	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.5	0.001	0.999	1.0E-03
Ra-228	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.5	0.001	0.999	1.0E-03
Sb-125*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-9.72	0.9	0.001	0.999	6.0E-05
Sr-90*	P	2	D	0.00281171	75% percentile value determined in sensitivity analysis					
Tc-99*	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-6.91	0.7	0.001	0.999	1.0E-03
Te-125m	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-7.60	0.6	0.001	0.999	5.0E-04
Th-228	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-12.21	0.9	0.001	0.999	5.0E-06
Th-229	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-12.21	0.9	0.001	0.999	5.0E-06
Th-230	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-12.21	0.9	0.001	0.999	5.0E-06
Th-232	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-12.21	0.9	0.001	0.999	5.0E-06
U-233	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-7.82	0.6	0.001	0.999	4.0E-04
U-234	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-7.82	0.6	0.001	0.999	4.0E-04
U-235	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-7.82	0.6	0.001	0.999	4.0E-04
U-236	P	2	S	Truncated lognormal-n	NUREG/CR-6697, Att. C	-7.82	0.6	0.001	0.999	4.0E-04
Bioaccumulation Factors for Fish ((pCi/kg)/(pCi/L))										
Ac-227	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	2.7	1.1			1.5E+01
Ag-108m*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	1.6	1.1			5.0E+00
Am-241*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.4	1.1			3.0E+01
Am-243	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.4	1.1			3.0E+01
C-14*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	10.8	1.1			4.9E+04
Cm-242*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.4	1.1			3.0E+01
Cm-243*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.4	1.1			3.0E+01
Co-60*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	5.7	1.1			3.0E+02

Table 6I-1: Input Parameter Values for DCGL Calculations
Resident Farmer Scenario - Soil

Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Cs-134*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	7.6	0.7			2.0E+03
Cs-137*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	7.6	0.7			2.0E+03
Eu-152*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.9	1.1			4.9E+01
Eu-154*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.9	1.1			4.9E+01
Eu-155*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.9	1.1			4.9E+01
Fe-55*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	5.3	1.1			2.0E+02
Gd-152	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.2	1.1			2.5E+01
H-3*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	0	0.1			1.0E+00
Mn-54*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	6	1.1			4.0E+02
Na-22*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3	1.1			2.0E+01
Nb-94*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	5.7	1.1			3.0E+02
Ni-59*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	4.6	1.1			9.9E+01
Ni-63*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	4.6	1.1			9.9E+01
Np-237	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.4	1.1			3.0E+01
Pa-231	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	2.3	1.1			1.0E+01
Pb-210	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	5.7	1.1			3.0E+02
Po-210	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	4.6	1.1			9.9E+-01
Pu-238*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.4	1.1			3.0E+01
Pu-239*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.4	1.1			3.0E+01
Pu-240*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.4	1.1			3.0E+01
Pu-241*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.4	1.1			3.0E+01
Ra-226	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.9	1.1			4.9E+01
Ra-228	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3.9	1.1			4.9E+01
Sb-125*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	4.6	1.1			9.9E+01
Sr-90*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	4.1	1.1			6.0E+01
Tc-99*	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	3	1.1			2.0E+01
Te-125m	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	6.0	1.1			
Th-228	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	4.6	1.1			9.9E+01
Th-229	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	4.6	1.1			9.9E+01

Table 6I-1: Input Parameter Values for DCGL Calculations Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Th-230	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	4.6	1.1			9.9E+01
Th-232	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	4.6	1.1			9.9E+01
U-233	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	2.3	1.1			1.0E+01
U-234	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	2.3	1.1			1.0E+01
U-235	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	2.3	1.1			1.0E+01
U-236	P	2	S	Lognormal-n	NUREG/CR-6697, Att. C	2.3	1.1			1.0E+01
Bioaccumulation Factors for Crustacea/Mollusks ((pCi/kg)/(pCi/L))										
Ac-227	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Ag-108m*	P	3	D	7.70E+02	RESRAD Default	NR	NR	NR	NR	
Am-241*	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Am-243	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
C-14*	P	3	D	9.10E+03	RESRAD Default	NR	NR	NR	NR	
Cm-242*	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Cm-243*	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Co-60*	P	3	D	2.00E+02	RESRAD Default	NR	NR	NR	NR	
Cs-134*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Cs-137*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Eu-152*	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Eu-154*	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Eu-155*	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
Fe-55*	P	3	D	3.20E+03	RESRAD Default	NR	NR	NR	NR	
Gd-152	P	3	D	1.00E+03	RESRAD Default	NR	NR	NR	NR	
H-3*	P	3	D	1.00E+00	RESRAD Default	NR	NR	NR	NR	
Mn-54*	P	3	D	9.00E+04	RESRAD Default	NR	NR	NR	NR	
Na-22*	P	3	D	2.00E+02	RESRAD Default	NR	NR	NR	NR	
Nb-94*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Ni-59*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Ni-63*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Np-237	P	3	D	4.00E+02	RESRAD Default	NR	NR	NR	NR	

Table 6I-1: Input Parameter Values for DCGL Calculations Resident Farmer Scenario - Soil										
Parameter	Type[a]	Priority[b]	Treatment[c]	Value/Distribution	Value/Distribution Reference Source	Distribution's Statistical Parameters[d]				
						1	2	3	4	Median or Mean
Pa-231	P	3	D	1.10E+02	RESRAD Default	NR	NR	NR	NR	
Pb-210	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Po-210	P	3	D	2.00E+04	RESRAD Default	NR	NR	NR	NR	
Pu-238*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Pu-239*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Pu-240*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Pu-241*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Ra-226	P	3	D	2.50E+02	RESRAD Default	NR	NR	NR	NR	
Ra-228	P	3	D	2.50E+02	RESRAD Default	NR	NR	NR	NR	
Sb-125*	P	3	D	1.00E+01	RESRAD Default	NR	NR	NR	NR	
Sr-90*	P	3	D	1.00E+02	RESRAD Default	NR	NR	NR	NR	
Tc-99*	P	3	D	5.00E+00	RESRAD Default	NR	NR	NR	NR	
Te-125m	P	3	D	5.00E+00	RESRAD Default					
Th-228	P	3	D	5.00E+02	RESRAD Default	NR	NR	NR	NR	
Th-229	P	3	D	5.00E+02	RESRAD Default	NR	NR	NR	NR	
Th-230	P	3	D	5.00E+02	RESRAD Default	NR	NR	NR	NR	
Th-232	P	3	D	5.00E+02	RESRAD Default	NR	NR	NR	NR	
U-233	P	3	D	6.00E+01	RESRAD Default	NR	NR	NR	NR	
U-234	P	3	D	6.00E+01	RESRAD Default	NR	NR	NR	NR	
U-235	P	3	D	6.00E+01	RESRAD Default	NR	NR	NR	NR	
U-236	P	3	D	6.00E+01	RESRAD Default	NR	NR	NR	NR	
Graphics Parameters										
Number of points				32	RESRAD Default	NR	NR	NR	NR	
Spacing				log	RESRAD Default	NR	NR	NR	NR	
Time integration parameters										
Maximum number of points for dose				17	RESRAD Default	NR	NR	NR	NR	

[a] P = physical, B = behavioral, M = metabolic; (see NUREG/CR-6697, Attachment B, Table 4.)
[b] 1 = high-priority parameter, 2 = medium-priority parameter, 3 = low-priority parameter (see NUREG/CR-6697, Attachment B, Table 4.1)

[c] D = deterministic, S = stochastic
[d] Distributions Statistical Parameters:
Lognormal-n: 1= mean, 2 = standard deviation
Bounded lognormal-n: 1= mean, 2 = standard deviation, 3 = minimum, 4 = maximum
Truncated lognormal-n: 1= mean, 2 = standard deviation, 3 = lower quantile, 4 = upper quantile
Bounded normal: 1 = mean, 2 = standard deviation, 3 = minimum, 4 = maximum
Triangular: 1 = minimum, 2 = maximum, 3 = most likely
Uniform: 1 = minimum, 2 = maximum

Note: values listed in columns 1 and 2 of the Distributions Statistical Parameters represent the exponent of the base (e) for Lognormal-n, Bounded lognormal-n, and Truncated lognormal-n distributions.
* Designates principal radionuclide-of-concern; undesignated radionuclides are included as daughter products.

Appendix 6J

Soil DCGL Results

(Extracted from Reference 6-14)

Table 6J-1: Soil DCGL Results

Radionuclide	Peak of the Mean Dose (mrem/yr per pCi/g)	$DCGL_w$ (pCi/g)
H-3	7.95E-04	3.14E+04
C-14	5.53E-02	4.52E+02
Na-22	4.03E+00	6.20E+00
Mn-54	1.16E+00	2.15E+01
Fe-55	7.31E-04	3.42E+04
Ni-59	2.30E-03	1.09E+04
Ni-63	6.29E-03	3.97E+03
Co-60	4.89E+00	5.11E+00
Sr-90	2.14E+00	1.17E+01
Nb-94	2.14E-01	1.17E+02
Tc-99	2.13E-01	1.17E+02
Ag-108m	3.21E+00	7.78E+00
Sb-125	7.28E-01	3.44E+01
Cs-134	3.02E+00	8.27E+00
Cs-137	1.49E+00	1.67E+01
Eu-152	2.20E+00	1.14E+01
Eu-154	2.37E+00	1.05E+01
Eu-155	6.20E-02	4.03E+02
Pu-238	1.59E-01	1.57E+02
Pu-239	1.76E-01	1.42E+02
Pu-240	1.76E-01	1.42E+02
Pu-241	4.78E-03	5.23E+03
Am-241	1.88E-01	1.33E+02
Cm-242	3.24E-03	7.70E+03
Cm-243	3.22E-01	7.75E+01

Appendix K

Input Parameter Values for Area Factors: Building Surfaces

(Extracted from Reference 6-15)

Table 6K-1: Input Parameter Values for Building Surface Area Factors

Parameter	Type[a]	Nuclide	Treatment[b]	Value/Distribution	Value Reference Source
Exposure Duration (d)	B	All	D	365	NUREG/CR-5512, Vol.3,section 5.2.1
Indoor Fraction	B	All	D	0.267	NUREG/CR-5512, Vol.3,section 5.2.2.9
Evaluation Time (y)	P	All		1	Use of 1y provides doses at t=0y and t=1y.
Number of Rooms	P	All	D	1	NUREG/CR-5512
Deposition Velocity (m/s)	P	Cm-242 Pu-241 All Others	D D D	1.5179E-05 1.5179E-05 4.78217E-04	25th percentile value 25th percentile value 75th percentile value
Resuspension Rate (s^{-1})	P	Cm-242 Pu-241 All Others	D D D	4.87543E-07 4.87543E-07 6.70403E-10	75th percentile value 75th percentile value 25th percentile value
Air Exchange Rate for Room (h^{-1})	B	All	D	1.52	NUREG/CR-6697, Att. C, sec. 7.4 and NUREG/CR-6755, sec. 3.2
Room Area (m^2)	P	All	D	315.97	Site-specific data
Room Height (m)	P	All	D	3.66	Site-specific data
Time Fraction	B	All	D	1	NUREG/CR-5512
Inhalation Rate (m^3/d)	M	All	D	45.6	Inhalation rate for moderate to heavy activities - NUREG/CR-6697, Attachment C, section 5.1; NUREG/CR-5512, vol. 3, section 5.3.4
Indirect Ingestion Rate (m^2/h)	B	All	D	0.00011	NUREG/CR6755, A.3.3, Table A.12
Receptor Location	B	All	D	5.97, 13.23, 1	NUREG/CR-5512; site-specific room dimensions
Shielding Thickness (cm)	P	All	D	0	Site-specific model-no shielding assumed
Shielding Density (g/cm^3)	P	All	D	2.4	RESRAD-Build default value for concrete – not used in DCGL calculations
Shielding Material	P	All	D	concrete	Default input – not used in DCGL calculations
Number of Sources	P	All		1	Various size floor area sources
External Dose Conversion Factor, (mrem/y per pCi/cm^2)	M	All	D	RESRAD-Build default	FGR12
Air Submersion Dose Conversion Factor, (mrem/y per pCi/m^3)	M	All	D	RESRAD-Build default	FGR12
Inhalation Dose Conversion Factor, (mrem/pCi)	M	All	D	RESRAD-Build default	FGR11
Ingestionl Dose Conversion Factor, (mrem/pCi)	M	All	D	RESRAD-Build default	FGR11
Source 1: Floor					
Type	P	All		area	NUREG/CR-5512
Direction	P	All		Z	NUREG/CR-5512
Location of Center of Source: x,y,z (m)	P	All	D	5.97, 13.23, 0	Site-Specific Modeling
Source length X-axis (m)	P	All	D	11.94	Not used in calculations
Source length Y-axis (m)	P	All	D	26.47	Not used in calculations
Area (m^2)	P	All	D	100, 50, 25, 15, 10, 8, 6, 5, 4, 3, 2, 1	Recommended size for Class 1 structure [ref. 3.5] used as upper limit for area source size
Air Fraction	B	H-3 All others	D	1.0 0.07	NUREG/CR-6697, Att. C Section 8.6
Direct Ingestion (h^{-1})	B	All	D	1.2E-7	NUREG/CR6755, A.3.3
Removable Fraction	P	All	D	0.1	NUREG-1727, Table C.7.1; NUREG/CR-6755, section 3.5

Time for Source Removal (d)	P	Ag-108m	D	52,695.2	75th percentile value
		Am-241	D	18,249.3	25Th percentile value
		C-14	D	52,695.2	75Th percentile value
		Co-60	D	52,695.2	75Th percentile value
		Cm-242	D	18,249.3	25Th percentile value
		Cm-243	D	18,249.3	25Th percentile value
		Cs-134	D	52,695.2	75Th percentile value
		Cs-137	D	52,695.2	75Th percentile value
		Eu-152	D	52,695.2	75Th percentile value
		Eu-154	D	52,695.2	75Th percentile value
		Eu-155	D	52,695.2	75Th percentile value
		Fe-55	D	52,695.2	75Th percentile value
		H-3	D	18,249.3	25Th percentile value
		Mn-54	D	52,695.2	75Th percentile value
		Na_22	D	52,695.2	75Th percentile value
		Nb-94	D	52,695.2	75Th percentile value
		Ni-59	D	18,249.3	25Th percentile value
		Ni-63	D	18,249.3	25Th percentile value
		Pu-238	D	18,249.3	25Th percentile value
		Pu-239	D	18,249.3	25Th percentile value
		Pu-240	D	18,249.3	25Th percentile value
		Pu-241	D	18,249.3	25Th percentile value
		Sb-125	D	52,695.2	75Th percentile value
		Sr-90	D	52,695.2	75Th percentile value
		Tc-99	D	52,695.2	75Th percentile value
Radionuclide Concentration (pCi/m^2)	P	All	D	1.0	-

[a] P = physical, B = behavioral, M = metabolic; (see NUREG/CR-6697, Attachment B, Table 4.)
[b] D = deterministic

Appendix 6L

Area Factors for Building Surfaces
(Extracted from Reference 6-15)

Table 6L-1: Building Surface Area Factors by Radionuclide and Area Size

Area (m^2)	AF Value: Ag-108m	Am-241	C-14	Cm-242	Cm-243	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Eu-155	Fe-55	H-3
1	1.3E+01	8.1E+01	8.1E+01	9.9E+01	5.1E+01	1.3E+01	1.3E+01	1.3E+01	1.3E+01	1.3E+01	1.3E+01	1.0E+02	1.0E+02
2	7.1E+00	4.1E+01	4.1E+01	5.0E+01	2.7E+01	7.1E+00	7.1E+00	7.2E+00	7.1E+00	7.1E+00	7.4E+00	5.0E+01	5.0E+01
3	5.2E+00	2.8E+01	2.8E+01	3.3E+01	1.9E+01	5.2E+00	5.3E+00	5.3E+00	5.2E+00	5.2E+00	5.4E+00	3.3E+01	3.3E+01
4	4.2E+00	2.1E+01	2.1E+01	2.5E+01	1.5E+01	4.3E+00	4.3E+00	4.3E+00	4.3E+00	4.3E+00	4.4E+00	2.5E+01	2.5E+01
5	3.7E+00	1.7E+01	1.7E+01	2.0E+01	1.2E+01	3.7E+00	3.7E+00	3.7E+00	3.7E+00	3.7E+00	3.8E+00	2.0E+01	2.0E+01
6	3.3E+00	1.5E+01	1.5E+01	1.7E+01	1.1E+01	3.3E+00	3.3E+00	3.3E+00	3.3E+00	3.3E+00	3.4E+00	1.7E+01	1.7E+01
8	2.8E+00	1.1E+01	1.1E+01	1.2E+01	8.4E+00	2.8E+00	2.8E+00	2.8E+00	2.8E+00	2.8E+00	2.9E+00	1.3E+01	1.2E+01
10	2.4E+00	9.0E+00	9.0E+00	9.9E+00	7.0E+00	2.4E+00	2.5E+00	2.5E+00	2.5E+00	2.4E+00	2.5E+00	1.0E+01	1.0E+01
15	2.0E+00	6.2E+00	6.1E+00	6.6E+00	5.0E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00	2.1E+00	6.7E+00	6.7E+00
25	1.6E+00	3.8E+00	3.8E+00	4.0E+00	3.3E+00	1.6E+00	1.6E+00	1.6E+00	1.6E+00	1.6E+00	1.6E+00	4.0E+00	4.0E+00
50	1.2E+00	2.0E+00	2.0E+00	2.0E+00	1.8E+00	1.2E+00	1.2E+00	1.2E+00	1.2E+00	1.2E+00	1.3E+00	2.0E+00	2.0E+00
100	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00
Area (m^2)	**AF Value: Mn-54**	**Na-22**	**Nb-94**	**Ni-59**	**Ni-63**	**Pu-238**	**Pu-239**	**Pu-240**	**Pu-241**	**Sb-125**	**Sr-90**	**Tc-99**	
1	1.3E+01	1.3E+01	1.3E+01	1.0E+02	1.0E+02	9.8E+01	9.9E+01	9.8E+01	9.9E+01	1.3E+01	5.5E+01	4.8E+01	
2	7.1E+00	7.1E+00	7.1E+00	5.0E+01	5.0E+01	4.9E+01	5.0E+01	4.9E+01	4.9E+01	7.1E+00	2.9E+01	2.6E+01	
3	5.2E+00	5.2E+00	5.2E+00	3.3E+01	3.3E+01	3.3E+01	3.3E+01	3.3E+01	3.3E+01	5.2E+00	2.0E+01	1.8E+01	
4	4.3E+00	4.3E+00	4.3E+00	2.5E+01	2.5E+01	2.5E+01	2.5E+01	2.5E+01	2.5E+01	4.3E+00	1.6E+01	1.4E+01	
5	3.7E+00	3.7E+00	3.7E+00	2.0E+01	2.0E+01	2.0E+01	2.0E+01	2.0E+01	2.0E+01	3.7E+00	1.3E+01	1.2E+01	
6	3.3E+00	3.3E+00	3.4E+00	1.7E+01	1.7E+01	1.7E+01	1.7E+01	1.7E+01	1.7E+01	3.3E+00	1.1E+01	1.0E+01	
8	2.8E+00	2.8E+00	2.8E+00	1.2E+01	1.3E+01	1.2E+01	1.2E+01	1.2E+01	1.2E+01	2.8E+00	8.8E+00	8.0E+00	
10	2.4E+00	2.4E+00	2.4E+00	1.0E+01	1.0E+01	9.9E+00	1.0E+01	9.9E+00	1.0E+01	2.4E+00	7.3E+00	6.7E+00	
15	2.0E+00	2.0E+00	2.0E+00	6.7E+00	6.7E+00	6.6E+00	6.7E+00	6.6E+00	6.6E+00	2.0E+00	5.2E+00	4.9E+00	
25	1.6E+00	1.6E+00	1.6E+00	4.0E+00	4.0E+00	4.0E+00	4.0E+00	4.0E+00	4.0E+00	1.6E+00	3.4E+00	3.2E+00	
50	1.2E+00	1.2E+00	1.2E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00	2.0E+00	1.2E+00	1.9E+00	1.8E+00	
100	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	

Appendix 6M

Input Parameter Values for Area Factors: Soil

In general, the input parameters for the soil area factor (AF) calculations are the same as those in LTP Appendix 6I. The information presented below is documented in Reference 6-16.

The resident farmer scenario assumes a reasonably conservative scenario for establishing DCGL values for residual radioactivity in soil. The same scenario is assumed for the AF calculations.

The conceptual model used in the code is based on the site characteristics expected at the time of release of the site. The model is comprised of a contaminated zone underlain by an unsaturated zone underlain by a saturated zone. The contaminated zone is assumed to be at the ground surface with no cover material and the ground water is initially uncontaminated.

The potential pathways used to estimate human radiation exposure resulting from residual radioactivity in the soil for this scenario includes the following:

- Direct exposure to external radiation from soil containing residual radioactivity;
- Internal dose from inhalation of airborne radionuclides;
- Internal dose from ingestion of:
  - Plant foods grown in the soil material containing residual radioactivity;
  - Meat and milk from livestock fed with fodder grown in soil containing residual radioactivity and water containing residual radioactivity;
  - Drinking water containing residual radioactivity from a well;
  - Aquatic food from a pond containing residual radioactivity; and
  - Soil containing residual radioactivity.

Areas of difference in input values are explained in the following discussion.

1. Contaminated Fractions – Food Pathways

As the size of the contaminated area (A) varies, the fraction of the total food consumed by the receptor grown in the contaminated area will also vary. The fraction of the food supply grown in the contaminated is referred to as a "contaminated fraction." Accordingly, with the decrease in the size of the contaminated area, a decrease in the values for the contaminated fraction of plant food ingested (FPLANT), the contaminated fraction of meat ingested (FMEAT), and contaminated fraction of milk ingested (FMILK) will also result.

Adjustments to FPLANT, FMEAT, and FMILK are made using equations from the RESRAD User's Manual (Reference 6-10). Equation D.5 in the RESRAD User's Manual varies the contamination fraction (FA_3) for plants as follows:

$$\text{FPLANT} = A/1{,}000 \quad \text{when} \quad A \leq 1{,}000 \text{ m}^2$$

$$\text{FPLANT} = 1.0 \quad \text{when} \quad A > 1{,}000 \text{ m}^2$$

As applicable to meat and milk, Equation D.5 was adjusted for the size of the contaminated zone used in the calculation of the soil DCGLs, (i.e., FMEAT and FMILK = 1.0 when the contaminated area was 7,855 m^2).

Input values for FMEAT and FMILK used in this calculation are determined as follows:

$$\text{FMEAT or FMILK} = A/\,7{,}855 \quad \text{when} \quad A \leq 7{,}855 \text{ m}^2$$

$$\text{FMEAT or FMILK} = 1.0 \quad \text{when} \quad A > 7{,}855\text{m}^2$$

Table 6M-1 shows the values for FPLANT, FMEAT, and FMILK as a function of the size of the contaminated zone.

2. Contaminated Fraction - Water Pathways

Unlike the contaminated fractions of food described above, the contaminated fractions for drinking water (FDW), livestock water (FLW), irrigation water (FIRW), and aquatic food (FR9) are assumed not to decrease as the size of the contaminated zone decreases. Setting the values for these input parameters to 1.0 maintains the assumption that all water used by the resident farmer comes from a well on site, regardless of the size of the contaminated area.

3. Size of the Contaminated Zone

Another RESRAD input parameter that is influenced by changes in the size of the contaminated zone is the length parallel to aquifer flow (LCZPAQ). As the area of the contaminated zone decreases, the value of LCZPAQ will also decrease. Because the contaminated zone is assumed circular in shape, the value for LCZPAQ is equal to the diameter of the circle:

Area of a Circle, $A = \pi r^2$

Rearranging and substituting for $r = \frac{LCZPAQ}{2}$

$$\text{LCZPAQ (m)} = 2\sqrt{\frac{A}{\Pi}}$$

Table 6M-1 also shows the values for LCZPAQ as a function of the area of the contaminated zone.

Table 6M-1: Contaminated Fractions as a Function of the Size of the Contaminated Zone

	Input Value for Contaminated Zone with Area (m^2):			
RESRAD Parameter	2000	1000	500	250
LCZPAQ (m)	50	36	25	18
FPLANT	1.0	1.0	0.5	0.25
FMEAT	0.25	0.13	0.064	0.032
FMILK	0.25	0.13	0.064	0.032
	Input Value for Contaminated Zone with Area (m^2):			
RESRAD Parameter	100	50	25	10
LCZPAQ (m)	11	8.0	5.6	3.6
FPLANT	0.01	0.05	0.025	0.01
FMEAT	0.013	0.0064	0.0032	0.0013
FMILK	0.013	0.0064	0.0032	0.0013
	Input Value for Contaminated Zone with Area (m^2):			
RESRAD Parameter	5	2	1	
LCZPAQ (m)	2.5	1.6	1.1	
FPLANT	0.005	0.002	0.001	
FMEAT	0.00064	0.00025	0.00013	
FMILK	0.00064	0.00025	0.00013	

Appendix 6N

Soil Area Factors

(Extracted from Reference 6-16)

Table 6N-1: Soil Area Factors by Radionuclide and Area Size

Area (m^2)	AF value: Ag-108m	Am-241	C-14	Cm-242	Cm-243	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Eu-155	Fe-55	H-3
1	1.1E+01	3.9E+01	1.8E+04	5.1E+01	1.4E+01	1.2E+01	1.2E+01	1.2E+01	1.1E+01	1.1E+01	8.4E+00	1.6E+03	2.9E+02
2	6.2E+00	2.9E+01	8.1E+03	4.4E+01	8.4E+00	6.6E+00	6.6E+00	6.9E+00	6.4E+00	6.4E+00	5.1E+01	8.6E+02	1.3E+02
5	3.3E+00	1.9E+01	2.6E+03	3.4E+01	4.7E+00	3.5E+00	3.6E+00	3.7E+00	3.4E+00	3.5E+00	2.8E+00	3.5E+02	5.8E+01
10	2.2E+00	1.4E+01	1.1E+03	2.7E+01	3.1E+00	2.3E+00	2.4E+00	2.5E+00	2.3E+00	2.3E+00	1.9E+00	1.7E+02	3.8E+01
25	1.6E+00	1.0E+01	3.2E+02	1.8E+01	2.3E+00	1.7E+00	1.7E+00	1.8E+00	1.6E+00	1.6E+00	1.4E+00	7.1E+01	2.3E+01
50	1.3E+00	7.5E+00	1.2E+02	1.2E+01	1.9E+00	1.4E+00	1.4E+00	1.5E+00	1.3E+00	1.3E+00	1.2E+00	3.6E+01	1.6E+01
100	1.2E+00	5.4E+00	4.5E+01	7.6E+00	1.7E+00	1.2E+00	1.3E+00	1.3E+00	1.2E+00	1.2E+00	1.1E+00	1.8E+01	9.9E+00
250	1.1E+00	3.1E+00	1.2E+01	3.6E+00	1.5E+00	1.1E+00	1.1E+00	1.2E+00	1.1E+00	1.1E+00	1.1E+00	7.1E+00	4.4E+00
500	1.0E+00	1.8E+00	4.4E+00	1.9E+00	1.2E+00	1.1E+00	1.1E+00	1.1E+00	1.0E+00	1.0E+00	1.0E+00	3.6E+00	2.3E+00
1000	1.0E+00	1.0E+00	1.6E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.8E+00	1.2E+00
2000	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Area (m^2)	AF value: Mn-54	Na-22	Nb-94	Ni-59	Ni-63	Pu-238	Pu-239	Pu-240	Pu-241	Sb-125	Sr-90	Tc-99	
1	1.1E+01	1.1E+01	1.1E+01	1.4E+03	1.4E+03	6.4E+01	6.5E+01	6.5E+01	4.2E+01	1.1E+01	7.5E+02	1.0E+03	
2	6.4E+00	6.4E+00	6.3E+00	7.1E+02	7.1E+02	5.7E+01	5.7E+01	5.8E+01	3.1E+01	6.2E+00	3.9E+02	5.0E+02	
5	3.5E+00	3.5E+00	3.4E+00	2.8E+02	2.8E+02	4.5E+01	4.5E+01	4.5E+01	1.4E+01	3.3E+00	1.7E+02	2.0E+02	
10	2.3E+00	2.3E+00	2.2E+00	1.4E+02	1.4E+02	3.5E+01	3.5E+01	3.5E+01	1.5E+01	2.2E+00	8.8E+01	1.0E+02	
25	1.6E+00	1.6E+00	1.6E+00	5.7E+01	5.7E+01	2.2E+01	2.2E+01	2.2E+01	1.1E+01	1.6E+00	3.8E+01	4.1E+01	
50	1.3E+00	1.4E+00	1.3E+00	2.8E+01	2.8E+01	1.4E+01	1.4E+01	1.4E+01	8.0E+00	1.3E+00	2.0E+01	2.0E+01	
100	1.2E+00	1.2E+00	1.2E+00	1.4E+01	1.4E+01	8.3E+00	8.3E+00	8.4E+00	5.7E+00	1.2E+00	1.0E+01	1.0E+01	
250	1.1E+00	1.1E+00	1.1E+00	5.7E+00	5.7E+00	3.8E+00	3.8E+00	3.8E+00	3.2E+00	1.1E+00	4.2E+00	4.1E+00	
500	1.0E+00	1.0E+00	1.0E+00	2.8E+00	2.8E+00	2.0E+00	2.0E+01	2.0E+00	1.8E+00	1.0E+00	2.1E+00	2.0E+00	
1000	1.0E+00	1.0E+00	1.0E+00	1.4E+00	1.4E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+01	1.0E+00	1.1E+00	1.0E+00	
2000	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	

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7.0 Update of Plant Specific Decommissioning Costs

Detroit Edison is submitting this update of remaining decommissioning costs for Fermi 1 per the requirement of 10CFR50.82(a)(9)(ii)(F). This chapter will cover the cost update and comparison of updated cost with the financial assurance requirement of 10CFR50.75.

7.1 Scope

Detroit Edison used the guidance in Regulatory Guide 1.179, "Standard Format and Content of License Termination Plans for Nuclear Power Reactors", NUREG-1713, "Standard Review Plan for Decommissioning Cost Estimates for Nuclear Power Reactors", and NUREG-1700, Rev. 1, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans".

This cost estimate update only includes those costs required for license termination. As addressed in earlier chapters, Detroit Edison's intent is to terminate the license with buildings standing. Therefore, this estimate does not include any cost for building demolition or site restoration.

Per NUREG-1713, this update may be in summary form provided the supporting information had been previously submitted and is referenced. Per NUREG-1700, the licensee will only be required to update the site-specific cost estimate to reflect any changes that occurred since it was initially submitted. For example, the licensee could be required to update the LTP cost estimate to reflect completed decommissioning activities, inflation and changes in radioactive waste disposal cost. NUREG-1700 also states that the NRC is not requiring the licensee to submit contractual documents. Section 7.2 will address the applicable previously submitted cost information. Section 7.3 will address the update to the previous submittals. Section 7.4 will compare Detroit Edison's financial assurance with the estimated remaining decommissioning costs.

7.2 History of Fermi 1's Decommissioning Cost

Per Reference 7.5.1, the initial decommissioning performed from 1972 – 1975 cost approximately $7M, with an additional estimated $540K set aside for long term surveillance costs. Note that the money set aside was depleted in the late 1990's.

In response to 10CFR50.75, Detroit Edison had Nuclear Energy Services perform a site specific cost study which was completed in November 1989, and submitted to the NRC in Reference 7.5.2. Unit cost factors were used to determine the cost of each work activity. Also, period dependent costs, such as staff, small tools and supplies, were assumed. As addressed in that submittal, the cost estimate was $10.5M in 1989 dollars, but the study was to be updated to include three tanks not included in the cost estimate. A prepayment was made into an external trust fund which was estimated to grow to match the decommissioning estimate in 2025. The detailed cost estimate was submitted in Reference 7.5.2. Reference 7.5.3 discussed that additional equipment was added to the cost study, increasing the cost to $12.2M in 1989 dollars. An additional payment was made into the external trust fund to allow the predicted fund with earnings to match the escalated cost in 2025. The facility was in SAFSTOR at the time, with final decommissioning planned to start in 2025.

A plant specific cost estimate was required for Fermi 1, in part, because of it being a liquid metal cooled fast breeder reactor, to which none of the funding assurance formulas applied. Additionally, it was a small reactor already partly decommissioned at the time of the cost estimate.

Detroit Edison decided to enter the last stage of SAFSTOR following an evaluation performed in 2000. The NRC was notified of that decision in Reference 7.5.4. At the time, the cost estimate was revised based on engineering judgment, yielding a forecasted remaining cost of $34M.

Financial assurance reports have been submitted to the NRC annually starting in 1999 per 10CFR50.75. The combination of withdrawals in support of decommissioning activities and market declines revealed a shortfall between the fund and cost estimate. Subsequently, DTE Energy provided a parent company guarantee in 2004 to cover the shortfall.

In 2007, Detroit Edison notified the NRC (Reference 7.5.5) that the project cost estimate had further increased after bids were received for the reactor vessel and large component removal. The cost remaining at the beginning of 2007 was projected to be $43M. Again, the parent company guarantee was increased as a result.

An engineering judgment review and update of the remaining cost estimate has been performed internally at least annually since the final decommissioning project began. The March 2008 decommissioning funding status report (Reference 7.5.6) reported a remaining cost in 2007 dollars of $34M and $37M in nominal dollars.

7.3 Cost Estimate Update

As of the end of 2008, the remaining project cost is estimated to be $28M spread over the following remaining years:

2009 - $19.6M
2010 - $4.8M
2011 - $3.1M
2012 - <u>$0.3M</u>
$27.8M

Some contingency is included in the estimate for the reactor vessel and large component project while the balance of the project has a potential for $1M - $3M of risk that is within the bounds of the current financial assurance, as discussed in Section 7.4.

A breakdown of the remaining costs by year is contained in Table 7-1. The activity descriptions match those in the original plant specific cost estimate submitted in

Reference 7.5.2. Activities not included have been completed. Some new activities have been added during updates and are noted as such.

Figure 7-1 shows the decommissioning cost estimate broken down by the following categories:

- Reactor vessel and large components
- Other component removals
- Other waste
- Staff
- License Termination / Final Status Survey
- Decontamination and Maintenance
- NRC fees
- Overheads

The cost of the activities associated with the reactor vessel and large component removal have been combined. A fixed price contract was awarded for most of the activity and its value is proprietary. The estimated costs of the remaining reactor vessel and large component removal project have been combined so that the proprietary contract value is not specified, and this chapter can be a public document. A contingency of approximately 5% was originally assigned to the reactor vessel and large component project. The contract covers removal, shipping and disposal. The risk of cost increases for the reactor vessel and large component removal project has been limited via use of a fixed price contract.

Excluding the estimate for the reactor vessel and large components line item (C15 in Table 7.1), the remaining project cost is estimated to be $12.2M. The $1M - $3M assigned risk correlates to 8 – 25% of the $12.2M. The 25% matches the contingency factor contained in NUREG-1700, and therefore, is felt to be appropriate for the activities not associated with the reactor vessel and large component removal portion of this project. The fixed price waste disposal contract minimizes the usually significant risk from waste cost escalation. Excluding the reactor vessel and large component disposal, the estimated remaining disposal cost is $1M. The fixed price contracts help ensure certainty of cost, while the unknowns remaining could increase cost.

In 2008, a cost estimate was independently developed for removal of the liquid waste system piping and tanks and fuel pools walls. An experienced decommissioning supervisor performed the estimate based on planning the work, estimating the manhours to be used for each type of labor and unit cost rate. The labor estimate was $719K. This correlates to the $719K in line items C26 and C27 in Table 7.1 for 2009. The independent cost estimate did not include the hot sump itself or the embedded piping, which are included in C26 and C27. Line item C27 includes an additional $117K for 2010. As the work requests for these activities are developed, the adequacy of the $117K will be determined for these additional activities. The $719K in the labor cost estimate matching the cost estimate for the liquid waste system and fuel pools showed that the estimate was not sufficient to include all labor and waste costs. However, a separate line item had been added to the cost estimate in 2000 to include additional waste costs under line item D11, since the review at the time identified the individual activities did not include sufficient cost for labor and waste in some cases. The amounts captured in D11 for 2009 – 2010 are adequate to cover ~$400K from these activities.

NUREG-1713 (Reference 7.5.7) addresses that the cost estimate should be in current year dollars. That criteria is not mentioned in Regulatory Guide 1.179 (Reference 7.5.9), or NUREG-1700 (Reference 7.5.8). The estimated cost presented here is in nominal dollars, not current year dollars. Detroit Edison uses nominal dollars (dollars in year spent) for large project budgets. Detroit Edison considers it appropriate to report the cost estimate in nominal dollars for the following reasons:

- Approximately 70% of remaining costs are forecast to be spent in 2009, the year the LTP is being submitted. For 2009 activities, nominal dollars equals current year dollars.
- A fixed price contract covers the majority of the reactor vessel and large component removal expenses.
- Detroit Edison has a fixed price contract for waste disposal with escalation based on an economic statistic, not historical waste cost escalation. All radioactive waste is expected to be disposed of at Energy Solution's Clive, Utah facility.
- The current economic environment in Michigan is not inflationary.
- Appropriate parameters to use for discounting nominal dollars to current year dollars are problematic in the current economy. The 2008 labor factor increase was less than the annual increase in the previous 5 years. Energy costs have decreased over the past 6 months.
- The remaining project duration is short, so the difference between nominal dollars and current year dollars is small.
- If an inflation factor of 2% is used for 2009 and 4% each year for 2010 and 2011, then the total remaining cost of the project in 2009 dollars is $27.5M vs. the $27.8M in nominal dollars. These inflation factors are used strictly for illustrative purposes to show there is little difference between nominal dollars and current year dollars for the balance of this project.

The regulatory guidance in References 7.5.8 and 7.5.9 refer to NUREG 1307 for estimating waste disposal costs. All remaining waste is expected to be Class A waste, which can be disposed of at Energy Solutions' disposal site in Clive, Utah. Detroit Edison used the contractual costing values numbers for the reactor vessel, large components and other low level radwaste for disposal costs since they are specific to this project, rather than the generic site costs in NUREG 1307, Rev. 13.

Table 7.1 is based on the current schedule and forecast. Schedule reviews will continue as the project progresses. If the schedule is revised, forecasted costs may shift between years. Cost forecasting is also an ongoing activity, with monthly expenditures being compared to forecast. The updated cost estimate contained in Table 7.1 is a current snapshot. Updated forecasts will be available for NRC inspection upon request. Detroit

Edison will continue submitting the annual financial assurance report per 10CFR50.75 until the license is terminated.

7.4 Adequacy of Financial Assurance.

As of the end of 2008, the Fermi 1 Decommissioning Trust Fund contains approximately $2M. The parent company guarantee was increased to $30M in March 2008. A copy of the parent company guarantee document was submitted to the NRC in Reference 7.5.6. Together the fund and parent company guarantee provide financial assurance in accordance with 10CFR50.75. The amount of financial assurance currently provided is greater than necessary to cover the estimated decommissioning cost.

The amount of financial assurance needed to cover the estimated remaining project costs is $28M. Even if the risk of $1M - $3M was added, the sum would be bounded by the $32M of financial assurance currently provided.

Detroit Edison expects to withdraw approximately $1M from the trust fund in 2009 after additional work is complete. Based on the condition of the present facility, Detroit Edison considers a balance of $1M will be sufficient to place and maintain the reactor in a safe storage condition if unforeseen conditions or expenses arise per 10CFR50.82(a)(8)(i)(B). At that time, the remaining sodium work will be completed for components removed from the reactor and/or primary system and the majority of processing liquid dispositioned.

A rough estimate was conducted of the current cost to place the facility in monitored safe storage. The cost is dependent on the activity status. The cost of maintaining non-contaminated buildings was not included. If the facility were to be placed in passive safe storage, periodic monitoring would be accomplished by Fermi 2 personnel on a part-time basis; no dedicated Fermi 1 staff would be needed. The rough estimate for placing the facility in a safe storage condition if unforeseen conditions arise as of the end of 2008 was $1.5M. Approximately half the estimate is for dispositioning the processing liquid and disposing of waste in preparation for another passive SAFSTOR period.

Further withdrawal of funds will occur as project activities near final completion and as less funds are needed to meet the requirement of 10CFR50.82(a)(8)(i)(B).

The amount of the parent company guarantee may also be decreased if appropriate as the decommissioning project progresses and fewer costs remain.

Per NUREG-1700, the financial assurance instrument required under 10CFR50.75 must be funded to the amount of the cost estimate. Regulatory Guide 1.179 states that if the LTP indicates the assurance of funding is to be provided by a surety method, insurance or other guarantee, the financial assurance instrument must remain in effect until the NRC has terminated the license. No monetary or percentage limitation is set for use of a specific financial assurance method, as long as it meets 10CFR50.75.

Detroit Edison plans to maintain financial assurance such that the combination of the parent company guarantee and Fermi 1 Decommissioning Trust Fund covers the remaining cost estimate.

7.5 References

7.5.1 Supplement to Retirement of the Enrico Fermi Atomic Power Plant, Power Reactor Development Company, October 1975

7.5.2 Detroit Edison letter, NRC-90-0104, dated July 26, 1990

7.5.3 Detroit Edison letter, NRC-91-0022, dated March 4, 1991

7.5.4 Detroit Edison letter, NRC-00-0092, dated November 6, 2000

7.5.5 Detroit Edison letter, NRC-07-0046, dated August 27, 2007

7.5.6 Detroit Edison letter, NRC-08-0026, dated March 31, 2008

7.5.7 NUREG-1713, "Standard Review Plan for Decommissioning Cost Estimates for Nuclear Power Reactors", dated December 2004

7.5.8 NUREG-1700, Rev. 1, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans", dated April 2003

7.5.9 Regulatory Guide 1.179, "Standard Format and Content of License Termination Plans for Nuclear Power Reactors", dated January 1999.

Table 7.1
Updated Cost Estimate – Nominal Dollars

Activity	Description	2009$K	2010$K	2011$K	2012$K	TOTAL
A9	Prepare the Decommissioning Plan (License Termination Plan)	59				59
A11	Prepare integrated work sequence and schedule	20				20
A12	Design, specify and procure special equipment and materials	52	22			
A13	Prepare detailed work procedures	50				50
A14	Specify and procure standard equipment	31	22			
A16	Respond to NRC questions on plan	52	22			74
C3	Refurbish Polar Crane & decon FARB cranes/*maintain craines*	45	47			92
C6	Select shipping containers; obtain shipping permits	2				2
C9	Remove, segment and package Offset Handling Mechanism**					0
C10	Remove, segment and package Hold Down/Control Mechanism**					0
C11	Remove, segment and package Transfer Rotor and Container**					0
C12	Remove, segment and package Rotating Shield Plug ***	97				97
C14	Remove and package Graphite Shielding Blocks**					0
C15	Remove, segment and package Reactor Vessel, Thermal Shield and Reactor Vessel Internals**	14855	791			15646
C16	Segment and Package Primary Shield Tank (Rx project portion incl in C14)**					0
C17	Decontaminate service platform**					0
C18	Segment and package Primary Coolant Pumps**					0
C19	Segment and package Intermediate Heat Exchangers**					0
C20	Segment and package Primary Piping and Components **					0
C21	Remove/decon contaminated concrete surfaces in Reactor Building, and all auxiliary structures; Package and ship as LLW		108	191		299
C24	Remove, segment and package Recirculating Inert Gas System	20				20
C25	Remove, segment and package Fission Product Detector System	23				23
C26	Remove, segment and package Fuel Pool Liners, Steam Cleaning Machine, Fuel Transfer and Liquid Waste Tanks and "Hot" Sump	465				465
C27	Decontaminate Liquid Waste Piping in FARB/Remove Dispose	254	117			371

Activity	Description	2009$K	2010$K	2011$K	2012$K	TOTAL
C28	Remove, segment and package Health Physics Laboratory Building Liquid Waste Discharge System and HP Slab		80			80
C29	Removal of Primary Sodium Tanks and Pipes in Sodium Tunnel	171				171
C30	Remove, segment and package Primary Sodium Overflow Tank, Pumps and Piping		234			234
C31	Remove, segment and package Fuel Transfer Tank, Steam Cleaning Chamber Equipment	97				97
C33	HP Building Slab (included with Item C28)					0
C34	Decon cutting equipment; package and remove from site			25		25
C35	Perform final site radiation survey (incl. planning)	216	585	1045		1846
C36	Prepare Final Report and terminate license			169	58	227
D1	Utility Staff Costs (Undistributed elsewhere)	333	391	225	50	999
D2	Decom General Manager/ Contract Staff	966	807	350	20	2143
D3	Permits/Licenses (NRC Fees)	286	216	225	117	844
D4	Environmental Survey Analyses	1	1			2
D5	Health Physics Supplies and Equipment	33	35			68
D6	Small Tools	2	2			4
D7	Nuclear Insurance (no specific charge to Fermi 1)					0
D8*	Building Maintenance	33	35	25		93
D9*	Phone Bill, Travel, Administration	16	12	18	5	51
D10*	Cost Study/Cost Monitoring Tool	5	5			10
D11*	LLW (Additional cost based on eval of original estimate)	255	350	182		787
D13*	Asbestos** (part is in C15, part here)	50	29			79
D17*	Review Committee & other review/support	19	16	6		41
D18	Severance Pay - not budgeted or forecasted					
D19*	Decommissioning Support Activities	600	500	311	68	1479
D20*	Utility Benefits & Overhead	514	351	315		1180
	TOTALS	19622	4778	3087	318	27805
	TOTALS					

A = Planning Activity Costs

12/08 est

B = Planning Undistributed Costs

C = Decommissioning Activity Costs

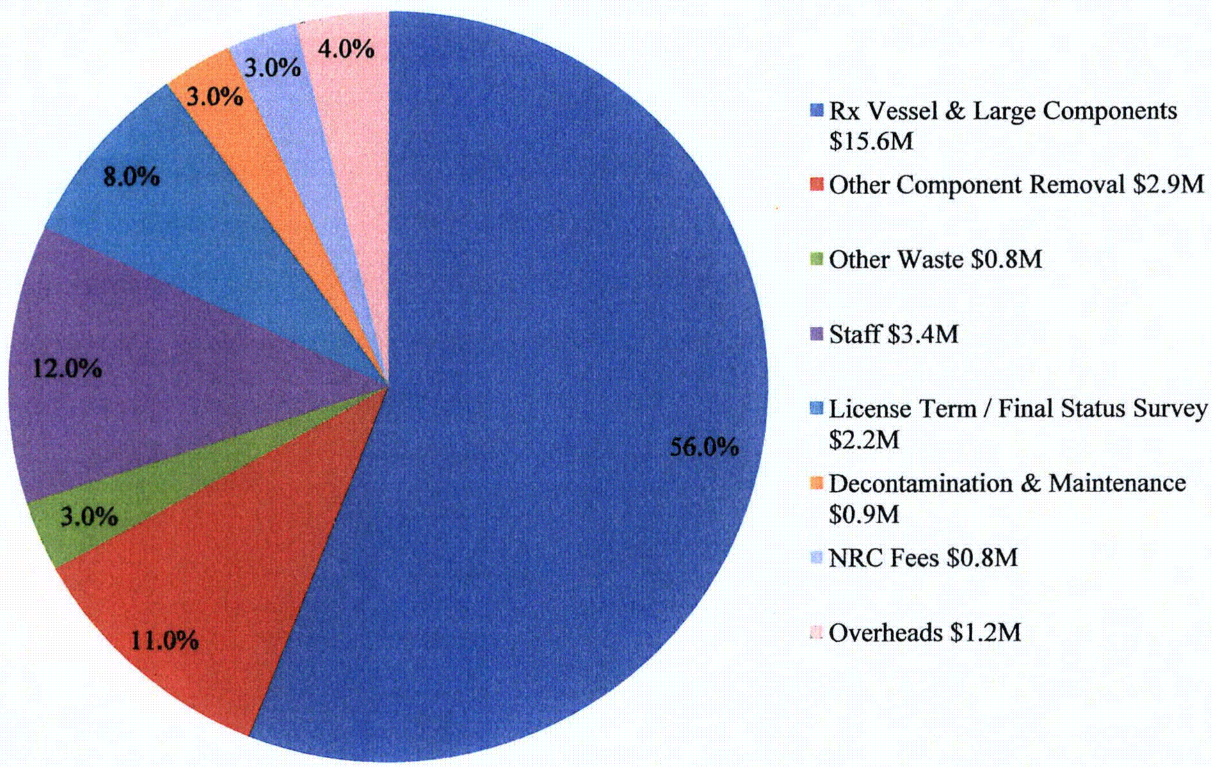
D = Decommissioning Undistributed Costs

*Added or modified activity

** Included in Line C15 as part of Reactor Vessel & Large Component Removal Project

*** Part is included in Line C15, completion of graphite block handling from rotating plug is here

Figure 1 - Decommissioning Cost Categories



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8.0 Purpose

This chapter addresses new information and any significant environmental changes associated with the site-specific termination activities.

8.1 Scope

Each of the potential environmental impacts identified in the NRC General Environmental Impact Statement (GEIS) for Decommissioning, NUREG-0586, Supplement 1 (Reference 8.51) will be addressed. For impacts that are identified in the GEIS as generic, this chapter will confirm the generic review applies. This section will provide site-specific information for the impacts the GEIS identifies as site specific. The discussion will refer to the most recent Environmental Assessment performed for Fermi 1 (Reference 8.5.2) and address applicable changes. Per NUREG-1700, Rev. 1 (Reference 8.5.7) the scope will cover activities to be performed from time of submittal of this License Termination Plan (LTP) until the license is terminated.

8.2 Background

Detroit Edison submitted a supplemental environmental letter (Reference 8.5.2) in response to an NRC request during the review of Detroit Edison's application to extend the Fermi 1 Possession Only License for 40 years through 2025.

Detroit Edison prepared an Environmental Assessment for extending SAFSTOR for 40 years (from 1985) to 2025. The NRC approved the 40 year extension of the license and documented its evaluation of the environmental assessment via Amendment No. 9 to the Fermi 1 license (Reference 8.5.3). At the time, Detroit Edison was anticipating completing the decommissioning of Fermi 1 after Fermi 2's license termination in 2025.

Environmental regulations have changed significantly from the time of Fermi 1 original licensing in the late 1950's – early 1960's. Additionally, Fermi 2 was licensed and built after Fermi 1's original licensing, modifying the site. Reference 8.5.2 was based on environmental assessments for requesting an operating license for Fermi 2 and Fermi 2's Updated Final Safety Analysis Report (Fermi 2 UFSAR, Reference 8.5.5). Detroit Edison has determined the Environmental Assessment in Reference 8.5.2 provides a better base document to use for comparison in the scope of this chapter, than the original licensing environmental reports.

Some major changes have occurred since the previous Environmental Assessment. First, Detroit Edison commenced the final state of SAFSTOR, delayed decontamination and dismantlement. One advantage this provided was the availability of personnel who worked at Fermi 1 during plant operation for contact. These personnel provided firsthand accounts for the historical site assessment, information on how systems were left and how they operated. They helped identify hazards and determine safe ways to access some areas. The information they provided significantly augmented the written documents.

While the SAFSTOR period will be less than evaluated in Reference 8.5.2, it will be almost 40 years from permanent shutdown in 1972 until the license is terminated. Note that much of the Environmental Assessment was incorporated into the Fermi 1 Safety Analysis Report (F1SAR, Reference 8.5.4), which is updated biennially. The F1SAR was prepared in response to the 1996 Decommissioning Rule.

The second major change is that regulations and regulatory guidance have changed since 1985-88 when the Fermi 1 license extension was requested and approved. The license termination rule, 10CFR20, Subpart E was subsequently issued, changing the criteria for license termination. This chapter will be based on current criteria, while Reference 8.5.2 addressed as-left dose rates needing to meet unrestricted dose rate criteria, which is no longer sufficient for eliminating controls.

Third, the GEIS has been published. The GEIS, per Section 3.1.1.3 is applicable to Fermi 1. Section 6.2 of the GEIS states in part: "For those issues that have been determined to be generic, licensees may proceed with the decommissioning activity without further analysis provided the impacts resulting from those activities fall within the range of impacts as described in Chapter 4."

Based on current requirements, two issues have been identified that require a site specific analysis. They are 1) threatened and endangered species, and 2) environmental justice.

The GEIS, Table 3-2, did specifically recognize that Fermi 1 is currently performing the decontamination and dismantlement phase of SAFSTOR.

The Fermi site, in total, has been ISO 14001 certified. This certification is based on performance and management controls in place to address and control significant aspects of both Fermi 1 and Fermi 2 activities. The site environmental program applies to the conduct of decommissioning activities.

A portion of the Fermi site is part of the Detroit River International Wildlife Refuge as discussed in Chapter 1, Section 1.3.2. The areas that will be impacted by Fermi 1 decommissioning activities are outside the wildlife refuge.

8.3 Environmental Assessment

This section is organized to address each of the environmental impacts covered by Chapter 4 of the GEIS.

8.3.1 Onsite/Offsite Land Use

Fermi 1 is located on the same site as Fermi 2 as discussed in Chapter 1, Section 1.3.2. The Fermi 1 license termination boundary is the inside edge of the road around

Fermi 1's perimeter. This area is wholly within the Fermi 2 owner controlled area.

The Fermi 1 decommissioning will mainly affect the Fermi 1 operational area. No roads, barge slips, or rail lines are being constructed or modified. Some activities such as shipping, transportation and disposal are offsite, and not considered in this section. A few activities will occur within the owner controlled area but outside the license termination boundary. These activities are parking, laydown, storage, and staging, including loading waste onto rail cars. The rail was originally installed for Fermi 1 and so was part of its original operational area. However, usable track no longer reaches into the Fermi 1 license termination boundary. Containers will be unloaded and loaded onsite, within the Fermi 2 operational area. Per the GEIS, Appendix M, the operational area is the portion of the plant site where most or all of the site activities occur, such as reactor operations, material and equipment storage, parking, substation operation, facility service and maintenance. Per the definition, this includes all areas within the protected area fence, the intake and discharge structures, the cooling system, and other site structures as well as associated paved, graveled, and maintained landscaped areas.

The activities of parking, laydown, storage, staging and loading are similar to activities at Fermi 2 supporting plant operation, as well as activities that occurred during Fermi 1 operation. Therefore, there is no change in general land use on the Fermi 2 site by the decommissioning project. Per the GEIS, the potential impacts to land use onsite are small. If new land uses occur beyond the site boundary, then the magnitude of the impact needs to be evaluated and depends on the nature, size and permanence of the disturbance to existing land.

Note that a boilerhouse containing an oil-fired boiler unit used to produce steam for generating electricity via the Fermi 1 turbine generator was demolished during the Industrial Safety Improvement Project, which preceded the current decommissioning project. Additionally, the Health Physics and Chemistry Building was demolished in 1980 due to deterioration. Both of these buildings were within the Fermi 1 license termination boundary.

The Environmental Assessment in Reference 8.5.2 addressed that the SAFSTOR status would not affect land use onsite or offsite and that there were no plans for construction or dismantling any portion of the facility over the next 40 years. The final decommissioning project, as discussed earlier, has started, which is different than that specified by the previous Environmental Assessment. Also, there is a potential for construction of Fermi 3, but the environmental impacts of Fermi 3 are outside the scope of this evaluation and are addressed by the Fermi 3 Combined Operating License Application Environmental Report (Reference 8.5.6).

For Fermi 1, since no changes in land use are anticipated beyond the owner controlled area site boundary, and the temporary use of the Fermi 2 site area for parking, storing, laydown, staging and loading are similar to uses of the land to support the operation of Fermi 2, the magnitude of the potential impact on land use of the Fermi 1 project is small.

8.3.2 Water Use

The GEIS concludes that the potential impacts on water use are small. The evaluation is applicable to Fermi 1 decommissioning. The Environmental Assessment states that while in the SAFSTOR status, Fermi 1 has no requirement for water, thus the use on site is attributable to Fermi 2. At the time of the assessment, Fermi 2 personnel were using the Fermi 1 Control Building and Office Building. Currently, some potable water is used for rest rooms and locker rooms supporting the Fermi 1 decommissioning staff. Some water is used to support decommissioning activities, but this is much less than during plant operations and its use is minimized. The potable water system was originally installed for Fermi 1, but is now considered a site support system. Water is currently obtained from the Frenchtown Township water supply, rather than onsite wells. The potable water tower and its supporting systems are operated by Fermi 2 personnel. They are located outside the Fermi 1 license termination boundary.

The only impact of the Fermi 1 decommissioning project on water use is a small increase of the overall Fermi site's use of water. This increased usage will decrease after license termination. At peak, the decommissioning staff is expected to account for <10% of the Fermi site workers. Therefore, the potential impacts of the Fermi 1 decommissioning and license termination on water use is small.

8.3.3 Water Quality

The Environmental Assessment in Reference 8.5.2 specifies that non-contaminated liquid waste collected in sump systems is essentially the intrusion of underground and rain water. The sumps discharge to the site drain system which is covered by the site NPDES permit. Sanitary facilities in the Fermi 1 building discharge into the site sanitary drain system, which is also covered by the site NPDES permit. This will continue to be the case during decommissioning and license termination.

Since little change will be made in the landscape as part of the Fermi 1 decommissioning, minimal or no changes will occur in storm water flow.

Note that the oily waste basin and oily waste system located within the Fermi 1 license termination boundary are not addressed in this assessment. It is part of a Fermi 2 site system and its use is not impacted by Fermi 1 decommissioning.

The GEIS evaluation and conclusion that the impact of decommissioning on water quality is small applies to Fermi 1.

8.3.4 Air Quality

The Environmental Assessment in Reference 8.5.2 did not address air quality. The GEIS made the generic conclusion that the impacts of decommissioning on air quality are small. This conclusion is applicable to Fermi 1. Temporary effluent systems were installed to minimize radiological releases. Local filtration is used for some activities to minimize airborne contamination. In general, the impacts of Fermi 1's decommissioning on air quality will be less than what was generically reviewed, since the decommissioning work force is smaller than most, no concrete batch plant is being constructed, and buildings are not being demolished as part of decommissioning.

8.3.5 Aquatic Ecology

The Environmental Assessment in Reference 8.5.2 stated that since there is no water requirement for the facility and no construction or dismantling activities are anticipated, there will be no impact on aquatic resources.

Section 8.3.2 of the LTP discusses water usage during decommissioning. This section covers aquatic ecology. There have been and will be dismantling activities during Fermi 1 decommissioning. However, no shoreline or in-water structures or systems are being removed during license termination activities.

Section 8.3.1 discussed that land outside the current Fermi 1 operational area, but inside the Fermi 2 operational area, and typically within the original Fermi 1 operational area will be used for parking, laydown, storage, loading and similar activities. These activities will have minimal impact on the aquatic environment and are not being conducted on the shoreline.

There is one state listed aquatic threatened species that has been positively identified as currently located in the Fermi 2 owner controlled area – the American lotus. No lotuses are found within the Fermi 1 license termination boundary. Areas to be used for parking, laydown, storage and loading are not aquatic areas and do not contain the American lotus.

Excavation is expected only within the operational area. The GEIS concludes that activities within operational areas, including the removal of shoreline or in-water structures, will have minimal impact on aquatic resources provided all applicable best measure practices are employed and required permits are obtained. Therefore, the NRC made a generic conclusion that for such activities, the potential impacts to aquatic ecology are small. However, if disturbance beyond operational areas is anticipated, impacts must be considered on a site specific basis.

Since all activities at Fermi 1 are anticipated to be within the Fermi 1 operational area, except for activities such as parking, laydown, loading and storage, which are within the Fermi 2 operational area and are similar to operational activities, the conclusion of the GEIS that the aquatic impact will be small applies to Fermi 1 decommissioning. Since shoreline and in-water facilities are not being removed, the aquatic ecology impact of Fermi 1's decommissioning is well within the scope of activities evaluated in the GEIS.

8.3.6 Terrestrial Ecology

The Environmental Assessment in Reference 8.5.2 addressed that since there are no construction or dismantling activities anticipated there will be no impact on terrestrial resources. The Fermi 1 decommissioning project does involve dismantling activities, but not building demolition. Land use was discussed in Section 8.3.1. Disturbance will be limited to Fermi 1 or Fermi 2 operational areas.

There are two other state threatened species positively identified in addition to the American lotus discussed in Section 8.3.5 onsite, the bald eagle and the eastern fox snake. The bald eagle has not been observed nesting at Fermi 1 or in the site areas expected to be used for Fermi 1 parking, laydown, storage, loading, etc. The specific site areas where the eastern fox snake has been observed have not been identified.

The GEIS, Section 4.3.6.4, concludes that for facilities where habitat disturbance is limited to operational areas, the impacts on terrestrial ecology are not detectable or destabilizing. Therefore, the NRC staff makes a generic conclusion that for such facilities the potential impacts to terrestrial ecology are small.

This conclusion applies to Fermi 1 since disturbances are anticipated only to Fermi 1 and Fermi 2 operational areas. Additionally, leaving the buildings standing will not create impacts on migratory birds that are detectable, since more numerous and larger buildings are onsite in the Fermi 2 operational areas.

8.3.7 Threatened and Endangered Species

Threatened or endangered species were not specifically addressed by the Environmental Assessment in Reference 8.5.2. The GEIS requires this topic be considered on a site specific basis.

There are no federally listed endangered species on the Fermi site (Reference 8.5.6), but there are three state listed threatened species positively identified onsite during recent reviews of the site and literature. They are the American lotus, the bald eagle, and the eastern fox snake. The American lotus is found on site wetland areas. There are no such areas in the Fermi 1 license termination boundary, nor in the areas anticipated being used for parking, storage, loading, etc. The road and rail line pass next to wetland areas, but the increased transportation from the Fermi 1 project will be insignificant compared to transportation onsite due to Fermi 2 operations and outages. While there will be several more rail shipments than typical, the rail line is not being modified or extended into wetland areas to support such shipments.

Bald eagles have been observed nesting on the Fermi 2 site, but not within the Fermi 1 license termination boundary. There are few trees within the license termination boundary; most of the open land is gravel, blacktop, weeds, concrete, and some grass. No nests have been observed in the areas anticipated to be used for parking, storage, loading, etc.

The areas where the American lotus and bald eagle nest are located are within the Detroit River International Wildlife Refuge, which is jointly maintained by the U.S. Fish and Wildlife Service and DTE Energy.

The eastern fox snake has been spotted in multiple areas on the Fermi site. The snake has not been observed inside any systems being removed. The eastern fox snake inhabits emergent wetlands along the Great Lake shorelines and similar areas. They can and have been found in buildings but prefer habitats with herbaceous vegetation, such as cattails.

There will be no changes made to near-shore or in-water structures and little land will be disturbed during the decommissioning. The current buildings will remain standing. Based on the nature of the terrestrial impacts and that no lotuses have been observed growing or bald eagles nesting within the Fermi 1 license termination boundary, the impacts to the American lotus and bald eagle from Fermi 1 decommissioning are expected to be non-existent or minor. Since the Fermi 1 buildings will remain during this project, and little land will be disturbed, the impact to the eastern fox snake is expected to be small.

In reference 8.5.9 the State of Michigan Department of Natural Resources listed the following endangered or threatened species that are known to occur in or near the potential Fermi 3 project site.

Barn owl – state endangered
Common tern – state threatened
Eastern fox snake – state threatened
Bald eagle – state threatened
American lotus – state threatened
Arrowhead – (sagittaria montevidensis) – state threatened
Frank's sedge – state threatened

The bald eagle, American lotus and eastern fox snake have been discussed above as being positively observed onsite and are addressed separately in this section. The other species mentioned were not positively identified onsite during recent reviews. Per the Michigan State University Extension Michigan Natural Features Inventory website, the last observation of the barn owl in Monroe County was in 1982, the last observation of the common tern in Monroe County was in 1985 and the last observation of Frank's sedge in Monroe County was in 1983. The habitat for the barn owl is a variety of natural community types and agricultural land. The common tern habitat is sand and gravel beach. The arrowhead, which was observed in Monroe County in 2001, habitat is wet to shallowly inundated mud flats and banks, lagoons and estuaries. The habitat for Frank's sedge is floodplain forests with moist soil and disturbed lakeland prairies.

These species, which have not been positively identified on the Fermi site, are being mentioned in this section, since site surveys for the potential Fermi 3 project will be continuing through the summer of 2009. It is possible that additional species may be identified. However, the types of habitats these species live in are not going to be disturbed by the Fermi 1 decommissioning project, so any potential impact is minimal.

8.3.8 Radiological

The Environmental Assessment in Reference 8.5.2 discussed controls and procedures, including the ALARA program, carried out to control radiation exposure and release of radioactive material. Periodic surveillances were also discussed. The assessment addressed the radiation exposure received since plant shutdown, radionuclide inventory, radiation survey results and waste management.

Many of the controls, such as the ALARA program, dosimetry and some surveillances continue, though electronic dosimetry is now used instead of the direct reading dosimeters previously used. License amendments have been requested and issued changing access control, removing the water intrusion system, cover gas testing, liquid waste tank level checks and environmental sampling previously required. The Fermi 2 dosimeter calibration facility described in the Environmental Assessment has been removed from Fermi 1.

The assessment estimated maintenance, repair and surveillance operations over the next 40 years would average 0.034 person-rem per year. The final dismantling and decontamination dose was not addressed.

The activation analysis for the reactor vessel was summarized in a table, including reductions in activity in 2026 and 2086. The assessment estimated an 85% reduction in activity during the 40 year SAFSTOR period.

An updated activation analysis was performed in preparation for the current decommissioning project. Its results and other updated information on radionuclide inventory and surveys at Fermi 1 are contained in the F1SAR (Reference 8.5.4).

The Reference 8.5.2 assessment addressed that there will be no radioactive gaseous wastes released from Fermi 1 over the SAFSTOR period and that if there is a need liquid wastes would be processed until acceptable for discharge in accordance with the Technical Specifications. Updated Technical Specifications were issued via license amendment for gaseous and liquid radioactive effluents since the assessment. There have been and will be gaseous effluents during the decommissioning project. They have been well under the Technical Specification limits and are expected to continue to be. So far, there have been no liquid radioactive effluent releases during the current decommissioning project. Site policy is to minimize liquid radioactive effluents.

The GEIS concluded that the radiological impacts of decommissioning will remain within regulatory limits and will be small. The impact being small was a generic conclusion, though any onsite disposal of slightly contaminated material, such as rubblization, would require a site specific analysis.

Chapter 3 of the LTP addresses that the estimated occupational exposure from decommissioning Fermi 1 is expected to be approximately 50 person-rem. The expected occupational exposure from the Fermi 1 decommissioning project is expected to be well below the range of 308-664 person-rem estimate in the GEIS for decommissioning a Pressurized Water Reactor (PWR) following SAFSTOR and considerably below the 1215 person-rem estimate for immediate dismantling of a PWR. The estimate for a Boiling Water Reactor was higher. The GEIS also listed the range of estimates for High Temperature Gas Reactors and Fast Breeder Reactors actually decommissioning as 430 person-rem, which was based on Fort St. Vrain.

The removal of the reactor and primary shield tank including graphite blocks and asbestos are expected to be responsible for the majority of project exposure. The estimated exposure for these activities of 35 – 44 person-rem are within the range of 14 – 180 person-rem listed in the GEIS for reactor vessel removal.

8.3.9 Radiological Accidents

The Environmental Assessment in Reference 8.5.2 addressed three postulated accidents that could occur during SAFSTOR. These were a liquid release, a gaseous release following a liquid spill, and a fire or other catastrophic event releasing the residual sodium activity to the environment. These scenarios were updated when incorporated into the F1SAR to also account for information obtained from more recent analyses. The scenarios continued to be updated during decommissioning to include release of neutralized liquid produced during sodium processing and release of some contamination on the internal surfaces of the reactor. The most recent F1SAR update at the time of the LTP submittal will be the biennial update submitted in November 2008.

The GEIS made the generic conclusion that the impacts of non-spent-fuel-related radiological accidents during decommissioning are small. The consequences of the accidents postulated in the F1SAR fall within the bounds of the accidents addressed in the GEIS, and Fermi 1 is specifically mentioned in Appendix I of the GEIS. Therefore, the GEIS conclusion that the impact of radiological accidents during decommissioning is small is applicable to Fermi 1.

Fermi 1's fuel was shipped offsite in the 1970's and so is not a contributor to any accident analysis during decommissioning.

8.3.10 Occupational Issues

The Environmental Assessment contained in Reference 8.5.2 did not address occupational issues other than radiation exposure, which is addressed in Section 8.3.8 of the LTP.

The GEIS addresses the physical, chemical, ergonomic, and biological hazards of decommissioning, including removal of sodium and NaK, which are the hazards unique to Fermi 1. The NRC makes a generic conclusion that for all plants, the potential impacts on occupational issues are small.

8.3.11 Cost

The Environmental Assessment in Reference 8.5.2 did not address decommissioning cost. The updated decommissioning cost estimate is being supplied in Chapter 7 of the LTP. As discussed in Chapter 7, the cost estimate is dynamic in that it is being reviewed and updated as decommissioning progresses. The GEIS addresses that the cost of decommissioning results in impacts on the price of electricity. Detroit Edison is paying for decommissioning without the cost being included in the rate structure. Therefore, decommissioning Fermi 1 is not specifically impacting the cost of electricity.

The GEIS provides ranges of decommissioning cost estimates. The Fermi 1 cost estimate falls within the range in the GEIS.

8.3.12 Socioeconomics

The Environmental Assessment in Reference 8.5.2 addressed that there is a small number of individuals required for maintenance of the facility in SAFSTOR and all were employed by Detroit Edison in other capacities. Therefore, there was virtually no impact on the community and traffic patterns.

The GEIS addresses changes in the work force and population due to facility closure, potential increased demand for housing and public services if the decommissioning work force is substantially larger than the operational work force, changes in tax revenue and decreases in need for public services and housing due to plant closure.

Since Fermi 1 closed more than 30 years ago, impacts of plant closure are immaterial to completing the decommissioning. Detroit Edison pays taxes based on Fermi 2 and the Fermi site, with no taxes attributable to the shutdown Fermi 1 facility. Therefore, completing the decommissioning will not impact property taxes. The work force at Fermi 1 has increased and fluctuated during decommissioning, depending on the specific activities being performed. The number of temporary decommissioning workers is expected to peak in 2009 during the reactor vessel and large component project, and then decrease. At peak, the decommissioning work force is expected to be no more than 10% of the Fermi site work force. Many of the workers are from the southeast Michigan area.

The GEIS concludes generically that the impacts on socioeconomics of decommissioning are small. The impacts of Fermi 1's decommissioning will be even smaller than the generic impact since any closure impacts have previously occurred, property taxes will not be affected, and the change in overall site work force is small.

8.3.13 Environmental Justice

Environmental justice was not addressed in the Environmental Assessment in Reference 8.5.2. Section 6.1 of the GEIS addressed that for the 19 reactors permanently shutdown (listed in Table F-1 of the GEIS) since decommissioning is substantially underway, the impacts for the issue of environmental justice have already occurred and an evaluation would provide little value and opportunity for mitigation. However, should a licensee choose a different decommissioning option from its current choice, then site specific issues would need to be addressed.

Fermi 1 is one of the 19 reactors listed in Table F-1 of the GEIS, where its status is listed as SAFSTOR. Fermi 1 is currently performing the last stage of SAFSTOR prior to license termination. Therefore, there is no need to further evaluate the issue of environmental justice.

8.3.14 Cultural, Historic and Archeological Resources

The impact of Fermi 1 decommissioning on cultural, historic and archeological resources was not specifically addressed in Reference 8.5.2. The GEIS discusses that decommissioning activities that have a potential to adversely impact cultural resources include stabilization, decontamination, dismantlement and large component removal, primarily through land disturbance, which could damage or destroy the resource, or alter the contextual setting of the resource. The GEIS mentions that in a few situations, the nuclear facility itself could be potentially eligible for inclusion in the National Register of Historic Places or the Historic American Engineering Record.

Impacts to cultural, historical or archeological resources are considered detectable if the activity has a potential to have a discernable adverse effect. The impacts are destabilizing if the activity would degrade the resource to the point that it would be of significantly reduced value to future generations, such as physically damaging structures or artifacts or destroying the physical context of the resource in its environment.

The GEIS addresses that for plants where disturbance of lands beyond operational areas is not anticipated, the impacts on cultural, historic and archeological resources are not considered to be detectable or destabilizing. Therefore, the GEIS makes a generic conclusion that for such plants, the potential impacts to cultural, historic and archeological resources are small. As addressed in Section 8.3.1, the Fermi 1 decommissioning activities will only impact the Fermi 1 and Fermi 2 operational areas, so the generic conclusion applies, with the exception that the historic significance of Fermi 1, itself, and impact of decommissioning on it need to be addressed.

Reference 8.5.6, the Fermi 3 COLA Environmental Report, was checked to ensure that the recent survey of cultural, historic and archeological resources did not identify any such resources that would invalidate the above conclusion. The results of that review did not identify any issues that would invalidate the above conclusion.

Since Fermi 1, itself, needs to be addressed on a site specific basis, a specific review of its historic significance has been performed.

An evaluation has been performed of the eligibility of Fermi 1 for the National Register of Historic Places, applying the National Register Criteria (Reference 8.5.8). The assessment concluded that the plant possesses significance under National Register Criteria A for its role in the development of the nuclear power industry in the United States and under Criteria C for the engineering design of the reactor and its associated components. Although components of the plant were removed during initial decommissioning and recent remediation efforts to remove residual sodium and radiologically contaminated materials, the facility retains sufficient physical integrity, supported by archival evidence to adequately convey the significance of the plant. The study concluded that Fermi 1 retains those characteristics of significance and integrity for National Register consideration.

Fermi 1 was the nation's first and only commercial sized liquid-metal cooled fast breeder reactor that produced electricity. It was the world's largest breeder reactor at the time of its completion.

The other similarly sized US sodium-cooled fast breeder reactor, the Fast Flux Test Facility, did not have a steam cycle or generate electricity. While Fermi 1 was not a commercial success, and operated for only a short time period at its first core design full power, its operation increased knowledge of fast breeder reactors and sodium systems. Personnel from around the world visited Fermi 1 and some learned the technology to further develop other fast breeder reactor programs. Unique systems were designed and operated at Fermi 1.

Technology was developed further in response to the partial fuel melt event in 1966. Actions taken during the event showed a fast breeder reactor can be safely shutdown during a core melt event, without environmental releases. Actions following the event demonstrated a fast breeder reactor can be restarted safely following a partial fuel melt event.

The conclusions of the review will be discussed with Michigan State Historical Preservation Office (SHPO). If the Michigan SHPO concurs with the eligibility of Fermi 1 for the National Register, consultation will be conducted on minimization or mitigation of the adverse effect decommissioning will have on Fermi 1 from a historical perspective.

Neither preservation of the plant nor objects from the plant is feasible. Without completing the planned decommissioning activities to achieve license termination, radiation and contamination levels are too high for public access.

The site of Fermi 1 also includes Fermi 2, an operating nuclear power plant. Physically keeping the plant achieves no preservation purpose as access to the site is severely restricted, and the public would gain no interpretive understanding of the plant. Displaying unique objects from within the plant is also problematic due to the size of the hardware, the difficulties of radiological decontamination, and that some of the components themselves are radioactive due to exposure to the reactor.

Additionally, the significance of the plant is the overall process of using atomic power to generate electricity, not isolated components. As a result, alternative mitigation strategies will need development.

Upon conclusion of license termination activities, the facility will still retain integrity of location, setting, exterior materials and association, since license termination will be conducted with current buildings remaining. The already diminished interior and process integrity will be further diminished as radioactive and radiologically contaminated components are removed from the facility. The removal is necessary due to the radiation and contamination levels. Since license termination decommissioning activities will mainly adversely affect the already diminished interior and process integrity, and the equipment that will be removed has too high of radiation or contamination levels to allow public access, the adverse effect will be small from a historical perspective.

The other potential adverse effect of license termination would be reduction in availability of documentary evidence regarding Fermi 1's operation and significance. Detroit Edison will consult with the Michigan SHPO on measures to minimize or mitigate the adverse effects of the license termination, if the state office concurs the facility is eligible for the National Register.

8.3.15 Aesthetic Issues

Aesthetic issues were not addressed in the Environmental Assessment in Reference 8.5.2. The GEIS makes a generic conclusion that for all plants, the potential impacts on aesthetics are small. The evaluation included the situation of retention of structures onsite at the time of license termination. This was determined to be a continuation of the visual impact analyzed for facility construction or operations. The review performed in the GEIS is applicable to Fermi 1 decommissioning, so the conclusion of a small impact on aesthetics applies.

8.3.16 Noise

Noise was not specifically addressed in the Environmental Assessment in Reference 8.5.2. The GEIS concluded the noise impacts are small generically. The types of activities which will create noise during Fermi 1's decommissioning were addressed in the GEIS evaluation, so its conclusion is applicable to Fermi 1.

8.3.17 Transportation

The Environmental Assessment in Reference 8.5.2 only addressed transportation to the extent that there was virtually no impact on traffic patterns due to individuals maintaining Fermi 1 in SAFSTOR, since all were employed by Detroit Edison in other capacities.

The GEIS made a generic conclusion that for all plants, the potential transportation impacts are low. Fermi 1 decommissioning waste will be transported by truck and rail, both of which are covered by the GEIS evaluation. The majority of radioactive waste is shipped directly to Clive, Utah, a distance of approximately 1800 miles, which is within the distance evaluated. The number of low level waste shipments is expected to be considerably less than the 671 shipments evaluated in the GEIS. Therefore, the GEIS evaluation applies to Fermi 1 decommissioning transportation and the potential impact is low.

8.3.18 Irreversible and Irretrievable Commitment of Resources

The Environmental Assessment in Reference 8.5.2 stated that 40 years of SAFSTOR will not involve commitment of a significant amount of resources. It addressed that there will be less waste volume at the end of SAFSTOR due to additional period of decay and so less burial site volume will be needed. It also implies that fewer offsite shipments of radioactive material may be required compared to immediate dismantling. In practice, some materials removed during Fermi 1's decommissioning to date have not had detectable contamination and other materials need to be disposed of as low level radioactive waste.

The Environmental Assessment also addressed that the site is being used for production of electricity by Fermi 2 and there were no plans for the site for the next 40 years other than electrical production. It mentioned that some Fermi 1 facilities are used to support Fermi 2.

Per the GEIS, land devoted to low level waste disposal sites or industrial landfills are not within its scope and are addressed in licensing documents for the disposal sites.

The GEIS addressed the use of the land and if the license is terminated for unrestricted use then the land would be available for other uses, whether or not the decommissioning process returned the land to Greenfield or an industrial complex. Detroit Edison intends to terminate Fermi 1's license for unrestricted use, though the land will remain part of an industrial complex, namely part of the Fermi 2 site. It will be potentially available for other uses compatible with the Fermi site.

The GEIS considered use of irretrievable resources during the decommissioning process, such as rags, gases, tools, and transportation of materials to and from the site. It concluded the resources used during decommissioning are minor. The

GEIS concluded generically that the impacts of decommissioning on irreversible and irretrievable commitments are small. This conclusion applies to Fermi 1.

8.4 Conclusion

Each of the potential environmental impacts identified in the GEIS were evaluated. The conclusions in the GEIS that the impacts from activities generically evaluated will be small due to decommissioning were determined to apply to Fermi 1's decommissioning. Site specific potential impacts were addressed and impacts were concluded to be non-existent or small. The one area requiring follow-up is consultation with the State of Michigan Historic Preservation Office regarding measures to minimize or mitigate the adverse effects of the license termination activities if the state office agrees Fermi 1 is eligible for the National Register.

Overall, the potential environmental impacts due to decommissioning Fermi 1 of all areas addressed were determined to be small.

8.5 References

8.5.1 NUREG-0586, Supplement 1, "Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities", dated November 2002.

8.5.2 Detroit Edison letter, NRC-87-0174, "Transmittal of Supplemental Environmental Information Enrico Fermi Atomic Power Plant, Unit 1", dated September 25, 1987.

8.5.3 NRC letter, "Issuance of Amendment No. 9 to Renew Possession-Only License No. DPR-9 for Fermi Unit 1 (TAC Nos 57716 and 61665)", dated April 28, 1989.

8.5.4 Fermi 1 Safety Analysis Report.

8.5.5 Fermi 2 Updated Final Safety Analysis Report

8.5.6 DTE Energy letter, "Detroit Edison Fermi 3 COLA Environmental Report", dated September 2008

8.5.7 NUREG-1700, Rev. 1, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans", dated April 2003

8.5.8 "Preliminary National Register of Historic Places Evaluation for the Enrico Fermi Atomic Power Plant, Monroe County, Lagoona Beach, Michigan", Commonwealth Cultural Resources Group, authored by R. Christopher Goodwin & Associates, Inc. dated March, 2009

8.5.9 State of Michigan, Department of Natural Resources letter from L. Sargent to Dr. Ralph E. Brooks, Black and Veatch, dated November 28, 2007

Access Control Measures – Application of programs and/or policies designed to assure that survey areas are not contaminated by personnel or decommissioning activities in the adjacent areas.

Action level – The numerical value that will cause the decision maker to choose one of the alternative actions. It may be a regulatory threshold standard (*e.g.*, Maximum Contaminant Level for drinking water), a dose- or risk-based concentration level (*e.g.*, *DCGL*), or a reference-based standard.

Activation – The process of making a radioisotope by bombarding a stable element with neutrons or protons.

Activity – The rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (*Ci*) and the Becquerel (*Bq*).

ALARA – Acronym for "as low as reasonably achievable," which means making every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical.

alpha (α) – The specified maximum probability of a Type I error. This means the maximum probability of rejecting the null hypothesis when it is true. Alpha is also referred to as the size of the test. Alpha reflects the amount of evidence the decision maker would like to see before abandoning the null hypothesis.

alpha particle – A positively charged particle emitted by some radioactive materials undergoing radioactive decay.

Ambient – An encompassing atmosphere or environment.

Area of elevated activity – An area over which residual radioactivity exceeds a specified value $DCGL_{EMC}$.

Assessment – The evaluation process used to measure the performance or effectiveness of a system and its elements. As used in MARSSIM, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation, management systems review, peer review, inspection, or surveillance.

Atomic Energy Commission (AEC) – Federal agency created in 1946 to manage the development, use, and control of nuclear energy for military and civilian applications. Abolished by the Energy Reorganization Act of 1974 and succeeded by the Energy Research and Development Administration (now part of the U.S. Department of Energy) and the U.S. Nuclear Regulatory Commission.

Audit (quality) – A systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

Background Radiation – Radiation from cosmic sources, naturally occurring radioactive material and global fallout, which contributes to the background radiation.

beta (β) – The probability of a Type II error, i.e., the probability of accepting the null hypothesis when it is false. The complement of beta (1-β) is referred to as the power of the test.

beta particle – An electron emitted from the nucleus during radioactive decay.

Bias – The systematic or persistent distortion of a measurement process which causes errors in one direction (*i.e.*, the expected sample measurement is different from the sample's true value).

Biased sample or measurement – See *judgmental measurement.*

Biological half-life – The time required for a biological system, such as that of a human, to eliminate, by natural processes, half of the amount of a substance (such as a radioactive material) that has entered it.

Byproduct material – Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.

Calibration – Comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments.

Cation – A positively charged ion.

Chain of Custody – Refers to an unbroken trail of accountability to ensure the physical security of samples, data, and records.

Characterization Survey – Type of survey that includes facility or site sampling, monitoring, and analysis activities to determine the extent and nature of residual radioactivity. Characterization surveys provide the basis for acquiring necessary technical information to develop, analyze and select appropriate cleanup techniques.

Class 1 Area – An area that is projected to require a Class 1 final status survey. Impacted areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiological surveys) above the DCGL. Size limitations (per survey unit) are ≤100 sq. m. for structures and ≤2000 sq. m. for open land areas.

Class 2 Area – Impacted areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are <u>not</u> expected to exceed the DCGL. Size limitations (per survey unit) are >100 sq. m. and ≤1,000 sq. m. for structures and >2,000 sq. m. and ≤10,000 sq. m. for open land areas.

Class 3 Area – Impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual activity at a small fraction of the DCGL, based on site operating history and previous radiological surveys. There are no size limitations for Class 3 areas.

Classification – The act or result of separating areas or survey units into one of three designated classes: Class 1 area, Class 2 area, or Class 3 area.

Collective dose – The sum of the individual doses received in a given period by a specified population from exposure to a specified source of radiation.

Committed Dose Equivalent (CDE) – This is the dose to some specific organ or tissue that is received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed Effective Dose Equivalent (CEDE) – The committed dose equivalent for a given organ multiplied by a weighting factor.

Conceptual site model – A description of a site and its environs and presentation of hypotheses regarding the contaminants present, their routes of migration, and their potential impact on sensitive receptors.

Condensate – Water that has been produced by the cooling of steam in a condenser.

Condenser – A large heat exchanger designed to cool exhaust steam from a turbine below the boiling point so that it can be returned to the heat source as water. In a pressurized water reactor, the water is returned to the steam generator. In a boiling water reactor, it returns to the reactor core. The heat removed from the steam by the condenser is transferred to a circulating water system and is exhausted to the environment, either through a cooling tower or directly into a body of water.

Confirmatory Survey – A survey conducted by NRC, or its contractor, to verify the results of the licensee's final status survey. Typically, confirmatory surveys consist of measurements at a fraction of the locations previously surveyed by the licensee, to determine whether the licensee's results are valid and reproducible.

Containment – A shell or other enclosure around a nuclear reactor to confine fission products that otherwise might be released to the atmosphere in the event of an accident.

Contamination – Deposition of reactor-generated radioactive material.

Control charts – A plot of the results of a quality control action that demonstrates control is being maintained within expected statistical variation or to indicate when control is or may be lost unless intervention occurs.

Controlled Area – At a nuclear facility, an area outside a restricted area but within the site boundary, access to which the licensee can limit for any reason.

Core – The central portion of a nuclear reactor containing the fuel elements, moderator, neutron poisons, and support structures.

Corrective action – An action taken to eliminate the causes of an existing nonconformance, deficiency, or other undesirable situation in order to prevent recurrence.

Critical Group – The group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

Data Quality Assessment (DQA) – The scientific and statistical evaluation of data used to determine if the data are of the right type, quality and quantity to support their intended use.

Data Quality Objective (DQO) – Qualitative and quantitative statements derived from the DQO process that clarify technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

Data Quality Objective Process – A systematic strategic planning tool based on the scientific method that identifies and defines the type, quality and quantity of data needed to satisfy a specific use. The key elements of the DQO process are discussed in the LTP.

Data usability – The process of ensuring or determining whether the quality of the data produced meets the intended use of the data.

Decision maker – The person, team, board, or committee responsible for the final decision regarding disposition of the survey unit.

Decision rule – A statement that describes a logical basis for choosing among alternative actions.

Decommission – To remove a facility or site safely from service and reduce residual radioactivity to a level that permits (1) release of the property for unrestricted use and termination of the license or (2) release of the property under restricted conditions and termination of the license.

Decontamination – The removal of undesired residual radioactivity from facilities, soils or equipment prior to the release of a site or facility and termination of a license. Decontamination is also known as remediation, remediation action and cleanup.

delta (δ) – The amount that the distribution of measurements for a survey unit is shifted to the right of the distribution of measurements of the reference area.

delta (Δ) – The width of the gray region. Δ divided by σ, the arithmetic standard deviation of the measurements, is the relative shift expressed in multiples of standard deviations.

Depleted uranium – Uranium having a percentage of uranium-235 smaller than the 0.7 percent found in natural uranium. It is obtained from spent (used) fuel elements or as byproduct tails, or residues, from uranium isotope separation.

Design specification process – The process of determining the sampling and analysis procedures that are needed to demonstrate that the attainment objectives are achieved.

Detection limit – The net response level that can be expected to be seen with a detector with a fixed level of certainty.

Detection sensitivity – The minimum level of ability to identify the presence of radiation or radioactivity.

Direct measurement – Radioactivity measurement obtained by placing the detector near the surface or media being surveyed. An indication of the resulting radioactivity level is read out directly.

Disturbed soil – Disturbed soil is soil that is known to have been moved by earth-moving equipment since 1945.

Dose (or radiation dose) – A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent.

Derived Concentration Guideline Levels (DCGLs) – Derived radionuclide-specific activity concentration that corresponds to the release criterion (25 mrem/y) within a survey unit.

$DCGL_{EMC}$ – A DCGL scaled, through the use of area factors, to obtain a DCGL that represents the same dose to an individual for residual radioactivity in a smaller area within a survey unit.

$DCGL_W$ – A DCGL for the average residual radioactivity in a survey unit.

Effective half-life – The time required for the amount of a radioactive element deposited in a living organism to be diminished 50 percent as a result of the combined action of radioactive decay and biological elimination.

Effective probe area – The physical probe area corrected for the amount of the probe area covered by a protective screen.

Effluent – Material discharged into the environment from licensed operations.

Elevated measurement – A measurement that exceeds a specified value $DCGL_{EMC}$.

Elevated Measurement Comparison (EMC) – This comparison is used in conjunction with the Wilcoxon test to determine if there are any measurements that exceed a specified value $DCGL_{EMC}$.

Exposure – Being exposed to ionizing radiation or to radioactive material.

Exposure Pathway – The route by which radioactivity travels through the environment to eventually cause radiation exposure to a person or group.

Exposure Scenario – A description of the future land uses, human activities, and behavior of the natural system as related to a future human receptor's interaction with (and therefore exposure to) residual radioactivity. In particular, the exposure scenario describes where humans may be exposed to residual radioactivity in the environment, what exposure group habits determine exposure, and how residual radioactivity moves through the environment.

External Dose – That portion of the dose equivalent received from radiation sources outside the body.

False negative decision error – The error that occurs when the null hypothesis (H_0) is not rejected when it is false. For example, the false negative decision error occurs when the decision maker concludes that the waste is hazardous when it truly is not hazardous. A statistician usually refers to a false negative error as a *Type II decision error.* The measure of the size of this error is called *beta*, and is also known as the complement of the power of a hypothesis test.

False positive decision error – A false positive decision error occurs when the null hypothesis (H_0) is rejected when it is true. Consider an example where the decision maker presumes that a certain waste is hazardous (*i.e.*, the null hypothesis or baseline condition is "the waste is hazardous"). If the decision maker concludes that there is insufficient evidence to classify the waste as hazardous when it truly is hazardous, the decision maker would make a false positive decision error. A statistician usually refers to the false positive error as a *Type I decision error.* The measure of the size of this error is called *alpha*, the level of significance, or the size of the critical region.

Feedwater – Water supplied to the reactor pressure vessel or the steam generator that removes heat from the reactor fuel rods by boiling and becoming steam. The steam becomes the driving force for the plant turbine generator.

Final Status Survey (FSS) – Measurements and sampling to describe the radiological conditions of a site or facility, following completion of decontamination activities (if any) and in preparation for release of the site or facility.

Final Status Survey Plan (FSSP) – The description of the final status survey design.

Final Status Survey Report (FSSR) – The results of the final status survey conducted by a licensee to demonstrate the radiological status of its facility. The FSSR is submitted to NRC for review and approval.

Floodplain – The lowland and relatively flat areas adjoining inland and coastal waters including flood-prone areas of offshore islands. Areas subject to a one percent or greater chance of flooding in any given year are included.

gamma (γ) radiation – Penetrating high-energy, short-wavelength electromagnetic radiation (similar to X-rays) emitted during radioactive decay. Gamma rays are very penetrating and require dense materials (such as lead or steel) for shielding.

Geiger-Mueller counter – Radiation detection and measuring instrument. It consists of a gas-filled tube containing electrodes, between which an electrical voltage, but no current, is flowing. When ionizing radiation passes through the tube, a short, intense pulse of current passes from the negative electrode to the positive electrode and is measured or counted. The number of pulses per second measures the intensity of the radiation field. It was named for Hans Geiger and W. Mueller, who invented it in the 1920s. It is sometimes called simply a Geiger counter or a G-M counter and is the most commonly used portable radiation instrument.

Graphite – A form of carbon, similar to that used in pencils, used as a moderator in some nuclear reactors.

Grid – A network of parallel horizontal and vertical lines forming squares on a map that may be overlaid on a property parcel for the purpose of identification of exact locations.

Gross Activity DCGLs – DCGLs established, based on the representative radionuclide mix, for gross (non-radionuclide-specific) alpha/beta surface radioactivity measurements. Field assessments will typically consist of these gross radioactivity measurements.

Ground Water – Water contained in pores or fractures in either the unsaturated or saturated zones below ground level.

Half-life ($t_{1/2}$) – The time required for one-half of the atoms of a particular radionuclide present to disintegrate.

Hard-to-Detect – Hard to detect (for this purpose, nuclides that are not detectable by gamma analysis or by liquid scintillation for H-3); Examples: Sr-90, Ni-63, Fe-55, C-14 or transuranics. Sometimes referred to as difficult to measure or DTM (see EPRI NP-3840, Project 1560-3, Environmental Radiation Doses for Difficult-to-Measure Nuclides).

Historical Site Assessment (HSA) – The identification of potential, likely, or known sources of radioactive material and radioactive contamination based on existing or derived information for the purpose of classifying a facility or site, or parts thereof, as impacted or non-impacted.

Hydrology – Study of the properties, distribution, and circulation of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere.

Hypothesis – An assumption about a property or characteristic of a set of data under study. The goal of statistical inference is to decide which of two complementary hypotheses is likely to be true. The *null hypothesis* (H_0) describes what is assumed to be the true state of nature and the *alternative hypothesis* (H_a) describes the opposite situation.

Impact – The positive or negative effect of an action (past, present, or future) on the natural environment (land use, air quality, water resources, geological resources, ecological resources, aesthetic and scenic resources) and the human environment (infrastructure, economics, social, and cultural).

Impacted Area – This is any area that is not classified as non-impacted. Impacted describes any area with a reasonable possibility of containing residual radioactivity in excess of natural background or fallout levels.

Independent assessment – An assessment performed by a qualified individual, group, or organization that is not part of the organization directly performing and accountable for the work being assessed.

Industrial Area – The land area of potential radiological and non-radiological impact is that portion of the site where licensed activities took place.

Investigation level – A derived media-specific, radionuclide-specific concentration or activity level of radioactivity that: 1) is based on the release criterion, and 2) triggers a response, such as further investigation or cleanup, if exceeded.

Judgmental measurement – A measurement performed at locations selected using professional judgment based on unusual appearance, location relative to known contaminated areas, high potential for residual radioactivity, general supplemental information, etc. Judgmental measurements are not included in the statistical evaluation of the survey unit data because they violate the assumption of randomly selected, independent measurements. Instead, judgmental measurements are individually compared to the DCGL.

Karst terrain – A kind of terrain with characteristics of relief and drainage arising from a high degree of rock solubility. The majority of karst conditions occur in limestone areas, but karst may also occur in areas of dolomite, gypsum, or salt deposits. Features associated with karst terrain may include irregular topography, abrupt ridges, sink holes, caverns, abundant springs, and disappearing streams. Well developed or well integrated drainage systems of streams and tributaries are generally not present.

Less-than data – These are measurements that are less than the minimum detectable concentration (MDC).

License Termination Plan (LTP) – A detailed description of the activities a reactor license intends to use to assess the radiological status of its facility, to remove radioactivity attributable to licensed operations at its facility to levels that permit release of the site in accordance with the NRC's regulations and termination of the license, and to demonstrate that the facility meets NRC's requirements for release. An LTP consists of several interrelated components including: (1) a site characterization; (2) identification of remaining dismantlement activities; (3) plans for site remediation; (4) detailed plans for the final radiation survey; (5) a description of the end use of the facility, if restricted; (6) an updated site-specific estimate of remaining decommissioning costs; and (7) a supplement to the environmental report, pursuant to 10 CFR 51.33, describing any new information or significant environmental change associated with the licensee's proposed termination activities.

Licensed Material – Source material, special nuclear material, or byproduct material received, possessed, used, transferred or disposed of under a general or specific license issued by the NRC.

Licensee – A person who possesses a license or a person who possesses licensable material, who the NRC could require to obtain a license.

Lower Bound of the Gray Region (LBGR) – Refers to the minimum value of the gray region. The width of the gray region (*DCGL-LBGR*) is also referred to as the shift, *Δ*.

Low-level waste – A general term for a wide range of wastes having low levels of radioactivity. Industries; hospitals and medical, educational, or research institutions; private or government laboratories; and nuclear fuel cycle facilities (e.g., nuclear power reactors and fuel fabrication plants) that use radioactive materials generate low-level wastes as part of their normal operations. These wastes are generated in many physical and chemical forms and levels of contamination. Low-level radioactive wastes containing source, special nuclear, or byproduct material are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level waste has the same meaning as in the Low-Level Radioactive Waste Policy Act, that is, radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste).

Material Background – This refers to naturally occurring and non-licensed radiation in the human environment. It includes cosmic rays, radiation from the naturally occurring radioactive elements, and man-made radiation from global fallout. Since all material contains some level of natural radioactivity or background, it may be necessary to establish background values for materials expected to be encountered when performing final status surveys.

MARSSIM – The *Multi-Agency Radiation Site Survey and Investigation Manual (NUREG–1575)* is a multi-agency consensus manual that provides information on planning, conducting, evaluating, and documenting building surface and surface soil final status radiological surveys for demonstrating compliance with dose- or risk-based regulations or standards.

Measurement – For the purpose of MARSSIM, the term is used interchangeably to mean: 1) the act of using a detector to determine the level or quantity of radioactivity on a surface or in a sample of material removed from a media being evaluated or, 2) the quantity obtained by the act of measuring.

Minimum Detectable Concentration (MDC) – This term means the *a priori* radioactivity concentration level that specific instrument or technique can be expected to detect 95% of the time; the value that should be used when stating the detection capability of an instrument for a given measurement technique. The MDC is the detection limit, L_D, multiplied by an appropriate conversion factor to give units of radioactivity concentration.

Minimum detectable count rate (MDCR) – The minimum detectable count rate (MDCR) is the *a priori* count rate that a specific instrument and technique can be expected to detect.

Missing or unusable data – Data (measurements) mislabeled, lost, or do not meet quality control standards. Less-than data are not considered to be missing or unusable data.

Model – A simplified representation of an object or natural phenomenon. The model can be in many possible forms, such as a set of equations or a physical, miniature version of an object or system constructed to allow estimates of the behavior of the actual object or phenomenon when the values of certain variables are changed. Important environmental models include those estimating the transport, dispersion, and fate of chemicals in the environment.

Monitoring – Monitoring (radiation monitoring, radiation protection monitoring) is the measurement of radiation levels, concentrations, surface area concentrations, or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

mrem/y (millirem per year) – One one-thousandth (0.001) of a rem per year.

Naturally Occurring Radioactive Material (NORM) – This refers to the natural radioactivity in rocks, soils, air and water. NORM generally refers to materials in which the radionuclide concentrations have not been enhanced by or as a result of human practices. NORM does not include uranium or thorium in source material.

Non-blind measurement – Non-blind measurements are measurements that have a concentration and origin that are known to the individual performing the measurement.

Nonconformance – A deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate; non-fulfillment of specified requirements.

Non-impacted Area – An area where there is no reasonable possibility (extremely low probability) for residual radioactivity to exist.

Nonparametric test – A test based on relatively few assumptions about the exact form of the underlying probability distributions of the measurements. As a consequence, nonparametric tests are generally valid for a fairly broad class of distributions. The Wilcoxon Rank Sum test and the Sign test are examples of nonparametric tests.

Nuclide – A general term referring to all known isotopes, both stable (279) and unstable (about 2,700), of the chemical elements.

Null Hypothesis (H_0) - A statistical scenario set up to be nullified, refuted or rejected ('disproved statistically') in order to demonstrate compliance with the release criteria.

Occupational dose – The dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation or to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include dose received from background radiation, from any medical administration the individual has received, from voluntary participation in medical research programs, or as a member of the general public.

Outlier – Measurements that are unusually large or small relative to the rest and therefore are suspected of misrepresenting the population from which they were collected.

pCi/g – Picocurie per gram, a concentration scale typically used in the measurement of radioactivity in soil.

Peer review – A documented critical review of work generally beyond the state of the art or characterized by the existence of potential uncertainty. The peer review is conducted by qualified individuals (or organization) that are independent of those who performed the work, but are collectively equivalent in technical expertise (*i.e.*, peers) to those who performed the original work. The peer review is conducted to ensure that activities are technically adequate, competently performed, properly documented, and satisfy established technical and quality requirements. The peer review is an in-depth assessment of the assumptions, calculations, extrapolations, alternate interpretations, methodology, acceptance criteria, and conclusions pertaining to specific work and of the documentation that supports them. Peer reviews provide an evaluation of a subject where quantitative methods of analysis or measures of success are unavailable or undefined, such as in research and development.

Performance evaluation – A type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory.

Personnel monitoring – The use of portable survey meters to determine the amount of radioactive contamination on individuals, or the use of dosimetry to determine an individual's occupational radiation dose.

Physical probe area – The physical surface area assessed by a detector. The physical probe area is used to make probe area corrections in the activity calculations.

Possession-only license – This is a form of license that allows possession but not operation.

Power (1-β) – This term refers to the probability of rejecting the *null hypothesis* when it is false. The power is equal to one minus the *Type II* error rate, *i.e.* (1-β).

Precision – A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions, expressed generally in terms of the standard deviation.

Probabilistic – Refers to computer codes or analyses that use a random sampling method to select parameter values from a distribution. Results of the calculations are also in the form of a distribution of values. The results of the calculation do not typically include the probability of the scenario occurring.

Process – A combination of people, machine and equipment, methods, and the environment in which they operate to produce a given product or service.

Professional judgment – An expression of opinion, based on technical knowledge and professional experience, assumptions, algorithms, and definitions, as stated by an expert in response to technical problems.

Qualified data – Any data that have been modified or adjusted as part of statistical or mathematical evaluation, data validation, or data verification operations.

Quality – The totality of features and characteristics of a product or service that bear on its ability to meet the stated or implied needs and expectations of the user.

Quality indicators – Measurable attributes of the attainment of the necessary quality for a particular environmental decision. Indicators of quality include precision, bias, completeness, representativeness, reproducibility, comparability, and statistical confidence.

Radiation survey – Measurements of radiation levels associated with a site together with appropriate documentation and data evaluation.

Radioactive decay – This term refers to the spontaneous transformation of an unstable atom into one or more different nuclides accompanied by either the emission of energy and/or particles from the nucleus, nuclear capture or ejection of orbital electrons or fission. Unstable atoms decay into a more stable state, eventually reaching a form that does not decay further, or has a very long half-life.

Radioactivity – The mean number of nuclear transformations occurring in a given quantity of radioactive material per unit time. The International System (SI) unit of radioactivity is the *Becquerel (Bq)*. The customary unit is the *Curie (Ci)*.

Radiological survey – Measurements of radiation levels and radioactivity associated with a site together with appropriate documentation and data evaluation.

Radioluminescence – The light produced by the absorption of energy from ionizing radiation.

Radionuclide – An unstable nuclide that undergoes radioactive decay.

Random error – The deviation of an observed value from the true value is called the error of observation. If the error of observation behaves like a random variable (*i.e.*, its value occurs as though chosen at random from a probability distribution of such errors) it is called a random error.

Readily removable – A qualitative statement of the extent to which a radionuclide can be removed from a surface or medium using non-destructive, common, housekeeping techniques (*e.g.*, washing with moderate amounts of detergent and water) that do not generate large volumes of radioactive waste requiring subsequent disposal or produce chemical wastes that are expected to adversely affect public health or the environment.

Reasonable alternatives – Those alternatives that are practical or feasible from a technical and economic standpoint.

Reference area – Geographical area from which representative reference measurements are performed for comparison with measurements performed in specific survey units at remediation site. A site radiological reference area (background area) is defined as an area that has similar physical, chemical, radiological, and biological characteristics as the site area being remediated, but which has not been contaminated by site activities. The distribution and concentration of background radiation in the reference area should be the same as that which would be expected on the site if that site had never been contaminated. More than one reference area may be necessary for valid comparisons if a site exhibits considerable physical, chemical, radiological, or biological variability.

Reference coordinate system – A grid of intersecting lines referenced to a fixed site location or benchmark. Typically the lines are arranged in a perpendicular pattern dividing the survey location into squares or blocks of equal areas. Other patterns include three-dimensional and polar coordinate systems.

Relative shift (Δ/σ) – Δ divided by σ, the standard deviation of the measurements.

Release criterion – A regulatory limit expressed in terms of dose or risk.

rem – The special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem = 0.01 sievert).

Remedial action – Those actions that are consistent with a permanent remedy taken instead of, or in addition to, removal action in the event of a release or threatened release of a hazardous substance into the environment, to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health or welfare or the environment.

Removable activity – Surface activity that is readily removable by wiping the surface with moderate pressure and can be assessed with standard radiation detectors. It is usually expressed in units of dpm/100 cm^2.

Removal – The cleanup or removal of released hazardous substances, or pollutants or contaminants which may present an imminent and substantial danger; such actions as may be necessary taken in the event of the threat of release of hazardous substances into the environment; such actions as may be necessary to monitor, assess, and evaluate the threat of release of hazardous substances; the removal and disposal of material, or the taking of other such actions as may be necessary to prevent, minimize or mitigate damage to the public health or welfare or the environment.

Replicate – A repeated analysis of the same sample or repeated measurement at the same location.

Representativeness – A measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Reproducibility – The precision, usually expressed as a standard deviation, which measures the variability among the results of measurement of the same sample at different laboratories.

Residual Radioactivity – Radioactivity in structures, materials, soils, groundwater and other media at a site resulting from activities under a licensee's control. This includes radioactivity from all licensed and unlicensed sources used by the licensee. It also includes radioactive materials remaining at the site as a result of routine or accidental causes. Residual radioactivity does not include background radiation from naturally occurring isotopes or fallout from nuclear bomb testing.

RESRAD Code – A computer code developed by the U.S. Department of Energy and designed to estimate radiation doses and risks from RESidual RADioactive materials in soils.

RESRAD-BUILD Code – A computer code developed by the U.S. Department of Energy and designed to estimate radiation doses and risks from RESidual RADioactive materials in buildings.

Restricted Area – Any area to which access is limited by a licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

Restricted use – A designation following remediation requiring radiological controls.

SAFSTOR – The alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use.

Scanning – An evaluation technique performed by moving a detection device over a surface at a specified speed and distance above the surface to detect radiation.

Scoping Survey – An initial survey performed to evaluate: 1) radionuclide contaminants, 2) relative radionuclide ratios, and 3) general levels and extent of contamination.

Sign Test – A nonparametric statistical test used to demonstrate compliance with the release criterion when the radionuclide-of-interest is not present in background or present in a small fraction of the DCGL, and the distribution of data is not symmetric.

Single nuclide DCGL – A radionuclide-specific activity concentration that would result in an annual total effective dose equivalent (TEDE) of 25 mrem with no other radionuclides present.

Site – The area of land, along with structures and other facilities, as described in the original NRC license application, plus any property outside the originally licensed boundary added for the purpose of receiving, possessing, or using radioactive material at any time during the term of the license, as well as any property where radioactive material was used or possessed that has been released prior to license termination.

Site Characterization – Studies that enable the licensee to sufficiently describe the conditions of the site, separate building, or outdoor area to evaluate the acceptability of the decommissioning plan.

Smear – A radiation survey technique which is used to determine levels of removable surface contamination. A medium (typically filter paper) is rubbed over a surface (typically of area 100 cm^2), followed by a quantification of the activity on the medium. A smear is also known as a swipe.

Soil activity (soil concentration) – The level of radioactivity present in soil and expressed in units of activity per soil mass (typically pCi/g).

Source Term – Refers to a conceptual representation of the residual radioactivity at a site or facility.

Split Sample – A sample that has been homogenized and divided into two or more aliquots for subsequent analysis.

Standard normal distribution – A normal (Gaussian) distribution with mean zero and variance one.

Standard Review Plan – This is a document that provides guidance to the staff for reviewing an application to obtain an NRC license to construct or operate a nuclear facility or to possess or use nuclear materials.

Subsurface soil sample – A soil sample that reflects the modeling assumptions used to develop the *DCGL* for subsurface soil activity. An example would be soil taken deeper than 15 cm below the soil surface to support surveys performed to demonstrate compliance with release criterion.

Surface contamination – Residual radioactivity found on building or equipment surfaces and expressed in units of activity per surface area (dpm/100 cm^2).

Surface soil sample – A soil sample that reflects the modeling assumptions used to develop the *DCGL* for surface soil activity.

Surveillance (quality) – Continual or frequent monitoring and verification of the status of an entity and the analysis of records to ensure that specified requirements are being fulfilled.

Survey – An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Survey Area - An area established and classified based on a common radiological history, logical physical boundaries and site landmarks for the purpose of documenting and conveying radiological information.

Survey meter – Any portable radiation detection instrument especially adapted for inspecting an area or individual to establish the existence and amount of radioactive material present.

Survey plan – A plan for determining the radiological characteristics of a site.

Survey Unit – A geographical area consisting of structures or land areas of specified size and shape at a site for which a separate decision will be made as to whether or not the unit attains the site-specific reference-based cleanup standard for the designated pollution parameter. Survey units are generally formed by grouping contiguous site areas with similar use histories and having the same contamination potential (classification). Survey units are established to facilitate the survey process and the statistical analysis of survey data.

Systematic error – An error of observation based on system faults which are biased in one or more ways, *e.g.*, tending to be on one side of the true value more than the other.

Technical review – A documented critical review of work that has been performed within the state of the art. The review is accomplished by one or more qualified reviewers who are independent of those who performed the work, but are collectively equivalent in technical expertise to those who performed the original work. The review is an in-depth analysis and evaluation of documents, activities, material, data, or items that require technical verification or validation for applicability, correctness, adequacy, completeness, and assurance that established requirements are satisfied.

Technical Specifications – Part of an NRC license authorizing the operation of a nuclear production or utilization facility. A Technical Specification establishes requirements for items such as safety limits, limiting safety system settings, limiting control settings, limiting conditions for operation, surveillance requirements, design features, and administrative controls.

Total Effective Dose Equivalent (TEDE) – The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (CEDE) (for internal exposures).

Triangular sampling grid – A grid of sampling locations that is arranged in a triangular pattern.

Tritium – A radioactive isotope of hydrogen (one proton, two neutrons). Because it is chemically identical to natural hydrogen, tritium can easily be taken into the body by any ingestion path. It decays by beta emission. It has a radioactive half-life of about 12.5 years.

Turnover – Acknowledgment by all involved decommissioning project sections and station personnel that a system, structure or open land area meets the conditions identified in the prerequisites section of this procedure and can be released to the License Termination Project for FSS activity.

Turnover Survey – A final operational radiological survey performed by the Radiation Protection (RP) Department after the completion of decommissioning activities in an area to verify that the area is ready for Final Status Survey.

Type I error – A decision error that occurs when the null hypothesis is rejected when it is true. The probability of making a Type I decision error is called alpha (α).

Type II error – A decision error that occurs when the null hypothesis is accepted when it is false. The probability of making a Type II decision error is called beta (β).

Unity rule – A rule applied when more than one radionuclide is present at a concentration that is distinguishable from background and where a single concentration comparison does not apply. In this case, the mixture of radionuclides is compared against default concentrations by applying the unity rule. This is accomplished by determining: 1) the ratio between the concentration of each radionuclide in the mixture, and 2) the concentration for that radionuclide in an appropriate listing of default values. The sum of the ratios for all radionuclides in the mixture should not exceed 1.

Unrestricted Area – This refers to an area, where access is neither limited nor controlled by the licensee.

Uranium – A radioactive element with the atomic number 92 and, as found in natural ores, an atomic weight of approximately 238. The two principal natural isotopes are uranium-235 (0.7 percent of natural uranium), which is fissile, and uranium-238 (99.3 percent of natural uranium), which is fertile, converting to fissionable plutonium-239 by absorbing fast neutrons. Natural uranium also includes a minute amount of uranium-234.

Validation – Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. In design and development, validation concerns the process of examining a product or result to determine conformance to user needs.

Verification – Confirmation by examination and provision of objective evidence that the specified requirements have been fulfilled. In design and development, verification concerns the process of examining a result of given activity to determine conformance to the stated requirements for that activity.

W_r – This represents the sum of the ranks of the adjusted measurements from the reference area, used as the test statistic for the Wilcoxon Rank Sum test.

Wilcoxon Rank Sum (WRS) test – A nonparametric statistical test used to demonstrate compliance with the release criterion when the radionuclide-of-interest is present in background.

W_s – The sum of the ranks of the measurements from the survey unit, used with the Wilcoxon Rank Sum test.

Acronyms and Abbreviations

AEC	Atomic Energy Commission
AF	Area Factor
ALI	Annual Limit on Intake
AOC	Areas of Concern
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
BKG	Background
Bq	Becquerel
BRP	Big Rock Point
CAP	Corrective Action Program
CAR	Corrective Action Report
CARD	Condition Assessment Resolution Document
CDE	Committed Dose Equivalent
CEDE	Committed Effective Dose Equivalent
CFR	Code of Federal Regulations
CHAR	Characterization
Ci	curie
cm	centimeters
COC	Chain of Custody
CPM	counts per minute
DCGL	Derived Concentration Guideline Level
$DCGL_{EMC}$	DCGL for small areas of elevated activity, used with the EMC
$DCGL_{W}$	DCGL for average concentrations over a wide area, used with statistical tests
D and D	Decontamination and Decommissioning
DLC	Data Life Cycle
DOE	Department of Energy
DOT	Department of Transportation
DPM	disintegrations per minute
DPR	Department of Professional Regulation
DQA	Data Quality Assessment
DQO	Data Quality Objectives
DRIWR	Detroit River International Wildlife Refuge
DTE	Detroit Edison
EDCR	Engineering Design Change Requests
EF1	Enrico Fermi 1 Nuclear Power Plant
EMC	Elevated Measurement Comparison
EPA	Environmental Protection Agency
ESEC	Excavation Safety and Environmental Control

Acronyms and Abbreviations

ETD	Easy-to-Detect
FARB	Fuel and Repair Building
FGEIS	Final Generic Environmental Impact Statement
FPD	Fission Product Detector
FSS	Final Status Survey
FSSP	Final Status Survey Plan
FSSR	Final Status Survey Report
F1SAR	Fermi 1 Safety Analysis Report
GM	Geiger-Mueller
GPS	global positioning system
H_0	null hypothesis
H_a	alternative hypothesis
HEPA	High Efficiency Particulate Air Filter
HPGe	High Purity Germanium
HSA	Historical Site Assessment
HTD	Hard-to-Detect
IHX	Intermediate Heat Exchanger
ISO	International Organization for Standardization
ISOCS	*In Situ* Object Counting System
LBGR	Lower Bound [of the] Gray Region
LLD	Lower Limit of Detection
LLW	Low Level Waste
LMFBR	Liquid Metal Fast Breeder Reactor
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCA	Multi-Channel Analyzer
mCi	micro curie
MCL	Maximum Contaminant Level
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
MDCR	Minimum Detectable Count Rate
MSL	Mean Sea Level
mrem	millirem
MWt	Megawatt thermal
NaI	Sodium – Iodide
NEPA	National Environmental Policy Act
NIST	National Institute of Standards and Technology
NMMSS	Nuclear Materials Management and Safeguards System
NMSS	Office of Nuclear Material Safety and Safeguards (Nuclear Regulatory Commission)

Acronyms and Abbreviations

NORM	Naturally Occurring Radioactive Material
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
OCA	Owner Controlled Area
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
OSHA	U.S. Occupational Safety and Health Administration
PCBs	Polychlorinated Biphenyls
pCi	picocurie
POL	Possession-Only License
PRDC	Power Reactor Development Company
PSDAR	Post-Shutdown Decommissioning Activities Report
PSR	Partial Site Release
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
REM	Radiation Equivalent Man
REMP	Radiological Environmental Monitoring Program
RESRAD	RESidual RADioactivity (Computer Code)
RESRAD-BUILD	RESidual RADioactivity-BUILDing (Computer Code)
RRA	Radiologically Restricted Area
RP	Radiation Protection
RPV	Reactor Pressure Vessel
RSSI	Radiation Survey and Site Investigation [Process]
RWP	Radiation Work Permit
SAFSTOR	Safe storage of a nuclear facility
SARA	Superfund Amendments and Reauthorization Act
SOP	Step-Off Pad
SRP	[NMSS Decommissioning] Standard Review Plan (NUREG-1700, Revision 1)
TBD	Technical Based Document
TEDE	Total Effective Dose Equivalent
Tech Spec	Technical Specification (part of plant license)
TLD	thermoluminescent dosimeter
TODE	Total Organ Dose Equivalent
TRU	Transuranic(s) [radionuclides]
USGS	U. S. Geological Survey
UTL	Upper Tolerance Limit
VSP	Visual Sample Plan
WRS	Wilcoxon Rank Sum [test]

Acronyms and Abbreviations