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10 CFR 50.90
10 CFR 50.91

August 1, 2024

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Oyster Creek Nuclear Generating Station
Renewed Facility Operating License No. DPR-16
Docket No. 50-219 and 72-15

Subject: License Amendment Request to Revise Oyster Creek Nuclear Generating Station Renewed Facility Operating License to Add License Condition 2.C.(18) to Include License Termination Plan Requirements

Pursuant to the provisions of 10 CFR Part 50.90, Holtec Decommissioning International, LLC (HDI) hereby requests approval of the proposed amendment to the Renewed Facility Operating License DPR-16 for Oyster Creek Nuclear Generating Station (OCNGS).

The enclosed License Amendment Request proposes approving the License Termination Plan (LTP) and adding License Condition 2.C.(18) that establishes the criteria for determining when changes to the LTP require prior NRC approval. The LTP demonstrates that the remaining decommissioning activities will be performed in accordance with 10 CFR 50, 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 adverse effect on the quality of the environment.

Enclosure 1 to this letter provides a description and evaluation of the proposed change that includes the no significant hazards consideration determination and environmental considerations, along with a proposed markup of the Operating License pages and the retyped Operating License.

Enclosure 2 is the complete LTP.

The following technical documents and reports will be submitted separately to aid in the Staff's review of the LTP:

Enclosure 3, OCNGS Historical Site Assessment, Revision 2, November 2021

Enclosure 4, Radionuclide Selection for DCGL Development Oyster Creek Station Site Characterization Project, Revision 1, January 17, 2022

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Enclosure 5, Oyster Creek Generating Station Radiological Characterization Report Revision 1, April 24, 2023

Enclosure 6, Oyster Creek Nuclear Generating Station Below Grade Structures Radiological Characterization Report Revision 1, March 2024

Enclosure 7, ENG-OCS-002 Revision 1, RESRAD-Build Input Parameter Sensitivity Analysis – OCS, March 6, 2024

Enclosure 8, ENG-OCS-004 Revision 0, RESRAD Building Surface DCGL Values Oyster Creek, April 12, 2022

Enclosure 9, ENG-OCS-006 Revision: 1, Area Factors for Use with Oyster Creek DCGL Values for Buildings/Structures, April 14, 2022

Enclosure 10, ENG-OCS-007 Revision 0, RESRAD-Onsite Probabilistic Analysis - Industrial Use Scenario Oyster Creek Station, July 25, 2023

Enclosure 11, ENG-OCS-008 Revision: 0, Derived Concentration Guideline Levels Values for Soil – Industrial Use Scenario Oyster Creek, July 26, 2023

Enclosure 12, ENG-OCS-009 Revision: 0, Area Factors for Soil – Industrial Use Scenario, August 4, 2022

Enclosure 13, ENG-OCS-012 Revision: 0, Basement Fill Model Probabilistic Analysis for Instantaneous Release Scenario Assuming Industrial Use Exposure Pathways Oyster Creek, November 1, 2023

Enclosure 14, ENG-OCS-013 Revision: 1, Basement Fill Model: Calculation of DCGLW/F Values Assuming Industrial Use Scenario Exposure Pathways Oyster Creek Station, March 6, 2024

Enclosure 15, ENG-OCS-014 Revision: 0, Basement Fill Model: Probabilistic Analysis for Embedded Pipes Scenario Oyster Creek Station, January 2024

Enclosure 16, ENG-OCS-015 Revision: 1, Basement Fill Model: Calculation of Embedded Pipe DCGL Values Oyster Creek Station, March 6, 2024

Enclosure 17, ENG-OCS-016 Revision: 0, Calculation of Buried Pipe DCGL Values Oyster Creek Station, February 20, 2024

Enclosure 18, Technical Basis Document No. 24-01-12-2888 Revision 1, “Dose Contribution from Insignificant Radionuclides in the Oyster Creek Site-Specific Suite of Radiological Nuclides”, February 14, 2024

Enclosure 19, Technical Basis Document, “Instrument Efficiency Determination for Use in Minimum Detectable Concentration Calculations in Support of the Final Status Surveys at OCNGS” Revision 0, February 14, 2024

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Enclosure 20, Oyster Creek 100 Year Land Use Outlook – Categorization and Justification, GHD, February 9, 2024

Enclosure 21, Oyster Creek Hydrogeologic Investigation Report, September 8, 2022

Enclosure 22, TSD 24-055, “Basement Fill Model: Probabilistic Analysis for Instantaneous Release Scenario Assuming Industrial Use Exposure Pathways”, Revision 0

Enclosure 23, TSD 24-063, “Basement Fill Model: Calculation of DCGLW/F Values Assuming Industrial Use Scenario Exposure Pathways”, Revision 0

In accordance with 10 CFR 50.91, a copy of this License Amendment Request is being provided to the State of New Jersey Department of Environmental Protection.

The following Technical Support Documents are currently under development and will be submitted for review on or before October 31, 2024

- TSD for the “Application of In Situ Object Counting System (ISOCS) and Advanced Radiological Survey Instruments at Oyster Creek”
- TSD 24-062, “OCNGS Structure Nuclide Fractions and Gross Activity DCGLs ($DCGL_{GA}$)”

Should you have any questions or require any further information, please contact me at (856) 797-0900 x 3578.

Sincerely,

Jean A. Fleming

Digitally signed by Jean A. Fleming
DN: cn=Jean A. Fleming, c=US, o=Holtec Decommissioning International, LLC, ou=Regulatory and Environmental Affairs, email=J.Fleming@Holtec.com
Date: 2024.08.01 07:05:46 -04'00'

Jean A. Fleming
Vice President, Licensing and Regulatory Affairs
Holtec International

Enclosure 1: Description and Evaluation of Proposed Changes
Attachment 1 Markup of the Facility License
Attachment 2 Retyped Facility License

Enclosure 2: Oyster Creek Nuclear Generating Station License Termination Plan

cc:
USNRC Regional Administrator, Region I
USNRC Project Manager, NMSS - Oyster Creek Nuclear Generating Station
USNRC Region I, Lead Inspector - Oyster Creek Nuclear Generating Station
Assistant Commissioner, Air Quality, Energy and Sustainability, NJ DEP
Principal Engineer, American Nuclear Insurers
Assistant Director Radiation Protection Element, NJ Bureau of Nuclear Engineering

HDI-OC-24-018

Enclosure 1

Description and Evaluation of

Proposed Changes

Description and Evaluation of Proposed Changes

License Amendment to Revise the Oyster Creek Nuclear Generating Station 10 CFR Part 50 License to Reflect the Requirements for Control of the License Termination Plan (LTP)

1. INTRODUCTION
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1 Markup of the 10 CFR Part 50 License

2 Retyped 10 CFR Part 50 License

1. INTRODUCTION

Holtec Decommissioning International (HDI) hereby requests an amendment to Oyster Creek Nuclear Generating Station (OCNGS) Renewed Facility License No. DPR-16. The proposed amendment would revise the license to reflect the requirements for control of the License Termination Plan (LTP) by adding License Condition 2.C.(18).

By letter dated February 14, 2018, (Reference 7.1) Exelon Generation notified the NRC that it would permanently cease operations at Oyster Creek no later than October 31, 2018. By letter on September 25, 2018 (Reference 7.2), Exelon Generation Company, LLC, provided certification of the permanent removal of fuel from the Reactor Vessel to the NRC in accordance with 10 CFR Part 50.82(a)(1)(a) and (ii). Therefore, as specified in 10CFR 50.82(a)(2), the 10 CFR Part 50 license for OCNGS no longer authorizes operation of the reactor or emplacement or retention of fuel in the reactor vessel.

Following the cessation of operation, HDI began planning to decommission OCNGS. On September 28, 2018 (Reference 7.3), HDI submitted a Post-Shutdown Decommissioning Activities Report (PSDAR) for OCNGS, pursuant to 10 CFR 50.82(a)(4)(i). On October 13, 2023 (Reference 7.4), HDI submitted a Notification of Revised PSDAR.

2. SUMMARY DESCRIPTION

HDI proposes to amend the OCNGS Renewed Facility Operating License to include a provision to allow changes to the approved LTP without prior NRC approval, similar to the flexibility afforded to licensees in making changes to the facilities or procedures, as described in the DSAR.

The OCNGS LTP describes the process used to meet the requirements for release of 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 OCNGS DSAR. 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 LTP addresses each of the criteria from 10 CFR 50.82(a)(9) and 10 CFR 50.82(a)(10), and the related radiological criteria from Subpart E of 10 CFR Part 20 for unrestricted or restricted release of the site. The LTP provides supporting information necessary to address the criteria, including the following:

- A 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 OCNGS will meet the release criteria in 10 CFR 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 DSAR and the Final Generic Environmental Impact Statement describing any new information or significant environmental change associated with proposed license termination activities.

3. PROPOSED CHANGE

HDI proposes to amend the OCNGS license to incorporate a new license condition, License Condition 2.C.(18) as follows:

(18) License Termination Plan (LTP)

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

1) Increases the derived concentration guideline levels and related minimum detectable concentrations for both scan and fixed measurement methods,
2) Increases the radioactivity level, relative to the applicable derived concentration guideline level, at which an investigation occurs,
3) Changes the statistical test applied to a test other than the Sign test or Wilcoxon Rank Sum test,
4) Results in significant environmental impacts not previously reviewed,
5) Increases the Type I decision error above the level stated in the approved LTP,
6) Changes the approach used to demonstrate compliance with the dose criteria, or
7) Changes parameter values or pathway dose conversion factors that would lead to a lower calculated dose than in the approved LTP.

Reclassification of survey areas, as described in MARSSIM, 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 (Class 1 to Class 2 area) will require NRC notification at least 14 days prior to implementation.

4. TECHNICAL EVALUATION

License Condition 3.D.; the proposed change adds the requirements to maintain the sites LTP program. Pursuant to 10 CFR 50.82(a)(9), nuclear power reactor licensees are required to submit an LTP prior to, or along with, their application for termination of a license. This LTP will become a supplement to the OCNGS DSAR. The LTP is required to be submitted at least two years before termination of the license.

HDI is submitting a proposed amendment to the OCNGS license to satisfy the requirements of 10 CFR 50.82(a)(10) for approval of the OCNGS LTP by license amendment. The change to the license will authorize the implementation of the LTP, allows the implementation of the method outlined in Chapter 5 of the LTP for site compliance with dose-based release criteria, and provides appropriate and necessary conditions for when changes can be made without prior NRC review and approval.

This proposal gives the NRC the opportunity to review the OCNGS LTP to ensure HDI's planned activities and processes meet the criteria in 10 CFR 50.82(a)(9) and NUREG-1700, “Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans” (Reference 7.5). In accordance with NUREG-1700, 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.

Since the LTP is based on NRC guidance and establishes the methodology HDI will use to meet license termination criteria, this proposed license amendment is appropriate to allow completion of the OCNGS decommissioning project and license termination.

HDI prepared the LTP using the guidance in:

- Regulatory Guide 1.179, “Standard Format and Contents for License Termination Plans for Nuclear Power Reactors,” (Reference 7.6),
- NUREG-1575, “Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),” (Reference 7.7),
- NUREG-1700, “Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans,” and
- NUREG-1757, “Consolidated NMSS Decommissioning Guidance” (Reference 7.8)

5. REGULATORY EVALUATION

5.1. Applicable Regulatory Requirements

5.1.1. 10 CFR Part 50.82, Termination of License

10 CFR Part 50.82(a)(9) states “All power reactor licensees must submit an application for termination of license. The application for termination of license must be accompanied or preceded by a license termination plan to be submitted for NRC approval.”

(i) The license termination plan must be a supplement to the FSAR or equivalent and must be submitted at least 2 years before termination of the license date.

(ii) The license termination plan must include—

(A) A site characterization,

(B) Identification of remaining dismantlement activities,

(C) Plans for site remediation,

(D) Detailed plans for the final radiation survey,

(E) A description of the end use of the site, if restricted,

(F) An updated site-specific estimate of remaining decommissioning costs,

(G) A supplement to the environmental report, pursuant to § 51.53, describing any new information or significant environmental change associated with the licensee's proposed termination activities, and

(H) Identification of parts, if any, of the facility or site that were released for use before approval of the license termination plan.

5.1.2. 10 CFR Part 50.82, Termination of License

10 CFR Part 50.82(a)(10) states “If the license termination plan demonstrates that the remainder of decommissioning activities will be performed in accordance with the regulations in this chapter, 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, the Commission shall approve the plan, by license amendment, subject to such conditions and limitations as it deems appropriate and necessary and authorize implementation of the license termination plan.”

5.1.3. 10 CFR Part 50.51, Continuation of License

10 CFR Part 50.51(b) states "Each license for a facility that has permanently ceased operations, continues in effect beyond the expiration date to authorize ownership and possession of the production or utilization facility, until the Commission notifies the licensee in writing that the license is terminated. During such period of continued effectiveness, the licensee shall:

(1) Take actions necessary to decommission and decontaminate the facility and continue to maintain the facility, including, where applicable, the storage, control and maintenance of the spent fuel, in a safe condition, and

(2) Conduct activities in accordance with all other restrictions applicable to the facility in accordance with the NRC regulations and the provisions of the specific 10 CFR Part 50 license for the facility."

5.2. No Significant Hazards Consideration

HDI has evaluated whether or not a significant hazards consideration is involved with the proposed amendment(s) by focusing on the three standards set forth in 10 CFR Part 50.92, “Issuance of amendment,” as discussed below:

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

Response: No.

The change allows for the approval of the LTP and provides the criteria for when changes to the LTP require prior NRC approval.

The definition of safety-related structures, systems, and components (SSCs) in 10 CFR 50.2 states that safety-related SSCs are those relied on to remain functional during and following design basis events to assure:

1. The integrity of the reactor coolant boundary,

2. The capability to shutdown the reactor and maintain it in a safe shutdown condition, or,

3. The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in 10 CFR 50.43(a)(1) or § 100.11.

The first two criteria (integrity of the reactor coolant pressure boundary and safe shutdown of the reactor) are not applicable to a plant in a permanently defueled condition.

The third criterion is related to preventing or mitigating the consequences of accidents that could result in potential offsite exposures exceeding limits. Since all nuclear spent fuel assemblies have been transferred to dry cask storage within an Independent Spent Fuel Storage Installation (ISFSI), none of the structures, systems or components (SSCs) at OCNGS are required to be relied on for accident mitigation. Therefore, none of the SSCs at OCNGS meet the definition of a safety-related SSC stated in 10 CFR 50.2. There are no postulated events which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in 10 CFR 50.43(a)(1) or § 100.11.

This change does not affect possible initiating events for the decommissioning accidents or events evaluated in the OCNGS DSAR, 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 OCNGS in the permanently defueled condition, 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 operations in the shutdown and defueled condition. 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 amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The safety analysis for the facility remains accurate as described in the OCNGS DSAR, as updated. There are sections of the LTP that refer to the decommissioning activities remaining (e.g. removal of large components, decontamination, etc.). However, these activities are performed in accordance with approved OCNGS work packages/steps and undergo 10 CFR 50.59 screening prior to initiation, when required.

   The proposed amendment makes mention of these processes and does not bring about physical changes to the facility. Therefore, the facility conditions for which the postulated accidents and events have been evaluated are still valid and no new accident scenarios or failure mechanisms 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. The proposed changes do not introduce any new failure modes.

   Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any previously evaluated.

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

Response: 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. As described in the OCNGS DSAR Chapter 6, there are no credible accidents that could result in a release that could exceed 10 CFR 100 limits.

The proposed amendment has no effect on the bounding accident for decommissioning, which is the resin container accident.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

5.3. Precedent

Several plants that have completed the decommissioning process, including Humboldt Nuclear Power Station (Reference 7.9), and Zion Nuclear Power Station (Reference 7.10), have requested and received amendments to their License to include the LTP approval and License requirements for maintaining the plan.

Several plants currently in the decommissioning process, including Fort Calhoun Station (Reference 7.11) and Vermont Yankee Nuclear Power Station (Reference 7.12), have requested amendments to their License to include the LTP approval and License requirements for maintaining the plan.

5.4. Conclusion

Based on the above, HDI concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

6. ENVIRONMENTAL CONSIDERATIONS

This amendment request meets the eligibility criteria for categorical exclusion from environmental review set forth in 10 CFR Part 51.22(c)(9) as follows. The proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure.

(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 DSAR. 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, Supplement 1” (Reference 7.13), and NUREG-1496, “Generic Environmental Impact Statement in Support of the Rulemaking on Radiological Criteria for License Termination” (Reference 7.14).

NUREG-0586 provides a generic environmental assessment of decommissioning a reference nuclear facility. Based on the findings in NUREG-0586, the NRC concluded a generic finding of “no significant (environmental) impact.” The NRC further concluded that no additional Environmental Impact Statement 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 OCNGS. The updated assessment also determined that the environmental effects from decommissioning OCNGS 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. The release of effluents from the facility will continue to be controlled by site procedures throughout the remaining decommissioning, and radioactive effluent management activities at OCNGS will continue to be performed in accordance with the OCNGS Offsite Dose Calculation Manual, as applicable.

(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 OCNGS, and the following conclusions were made:

- HDI will maintain annual occupational radiation exposure to individuals as low as reasonably achievable. These exposures will be at or below the estimated values in Table 4-1 of NUREG-0586, Supplement 1. LTP Section 3 provides a dose estimate for OCNGS decommissioning.
- HDI 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 OCNGS. The updated assessment also determined that the environmental effects from decommissioning OCNGS 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 OCNGS.

7. REFERENCES

7.1. Letter from Michael P. Gallagher, Exelon Generation Company, LLC to NRC, dated February 14, 2018, Certification of Permanent Cessation of Power Operations for Oyster Creek Nuclear Generating Station

7.2. Letter from Michael P. Gallagher, Exelon Generation Company, LLC to NRC, dated September 25, 2018, Certification of Permanent Removal of Fuel from the Reactor Vessel for Oyster Creek Nuclear Generating Station

7.3. Letter from Pamela B. Cowan, Holtec Decommissioning International, LLC to NRC, dated September 28, 2018, Notification of Revised Post-Shutdown Decommissioning Activities Report and Revised Site-Specific Decommissioning Cost Estimate for Oyster Creek Nuclear Generating Station

7.4. Letter from William Noval, Holtec Decommissioning International, LLC to NRC, dated October 13, 2023, Oyster Creek Defueled Safety Analysis Report (DSAR)

7.5. NUREG-1700, “Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans”

7.6. Regulatory Guide 1.179, “Standard Format and Contents for License Termination Plans for Nuclear Power Reactors”

7.7. NUREG-1575, “Multi-Agency Radiation Survey and Site Investigation Manual”

7.8. NUREG-1757, “Consolidated NMSS Decommissioning Guidance”

7.9. Humboldt Bay Power Plant Unit 3, Issuance of Amendment Re: License Termination Plan, dated May 4, 2016

7.10. Zion Nuclear Power Station, Units 1, and 2, Issuance of Amendments 191 and 178 for the Licenses to Approve the License Termination Plan, dated September 18, 2018

7.11. Fort Calhoun Station, Unit No. 1, License Amendment Request (LAR) 21-01; Revised Fort Calhoun Station License to Add License Condition 3.D to include License Termination Plan Requirements, dated August 3, 2021

7.12. Vermont Yankee Nuclear Power Station – License Amendment Request – Addition of License Condition 3.K, “License Termination Plan;” Proposed Chage No. 317, dated October 10, 2023

7.13. NUREG-0586, “Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities”

7.14. NUREG-1496, “Generic Environmental Impact Statement in Support of the Rulemaking on Radiological Criteria for License Termination”

Attachment 1

Markup of 10 CFR Part 50 License

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Insert (18), Attached

D. DELETED

E. DELETED

F. DELETED

3. Sale and License Transfer Conditions:

A. DELETED

B. DELETED

C. DELETED

D. DELETED

E. DELETED

F. DELETED

G. DELETED

H. DELETED

I. DELETED

(18) License Termination Plan (LTP)

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

1) Increases the derived concentration guideline levels and related minimum detectable concentrations for both scan and fixed measurement methods,

2) Increases the radioactivity level, relative to the applicable derived concentration guideline level, at which an investigation occurs,

3) Changes the statistical test applied to a test other than the Sign test or Wilcoxon Rank Sum test,

4) Results in significant environmental impacts not previously reviewed,

5) Increases the Type I decision error above the level stated in the approved LTP,

6) Changes the approach used to demonstrate compliance with the dose criteria, or

7) Changes parameter values or pathway dose conversion factors that would lead to a lower calculated dose than in the approved LTP.

Reclassification of survey areas, as described in MARSSIM, 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 (Class 1 to Class 2 area) will require NRC notification at least 14 days prior to implementation.

Attachment 2

Retyped 10 CFR Part 50 License

OYSTER CREEK ENVIRONMENTAL PROTECTION, LLC

AND

HOLTEC DECOMMISSIONING INTERNATIONAL, LLC

DOCKET NO. 50-219

OYSTER CREEK NUCLEAR GENERATING STATION

RENEWED FACILITY OPERATING LICENSE

Renewed License No. DPR-16

1. The Nuclear Regulatory Commission (the Commission) having previously made the findings set forth in License No. DPR-16, has now found that:

   A. The application for a Renewed Facility Operating License No. DPR-16 filed by the applicant complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I and all required notifications to other agencies or bodies have been duly made;

   B. DELETED

   C. Actions have been identified and have been or will be taken with respect to (1) managing the effects of aging during the term of this Renewed Facility Operating License No. DPR-16 on the functionality of structures and components that have been identified to require review under 10 CFR 54.21(a)(1); and
   (2) time-limited aging analyses that have been identified to require review under 10 CFR 54.21(c), such that there is reasonable assurance that the activities authorized by the renewed operating license will continue to be conducted in accordance with the current licensing basis, as defined in 10 CFR 54.3, for the facility, and that any changes made to the facility's current licensing basis in order to comply with 10 CFR 54.29(a) are in accordance with the Act and the Commission's regulations;

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

   E. There is reasonable assurance (i) that the activities authorized by this license 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 rules and regulations set forth in 10 CFR Chapter I;

   F. Oyster Creek Environmental Protection, LLC (Oyster Creek Environmental

Protection) is financially qualified and Holtec Decommissioning International, LLC (Holtec Decommissioning International) is financially and technically qualified to engage in the activities authorized by this license in accordance with the rules and regulations of the Commission;

G. Oyster Creek Environmental Protection and Holtec Decommissioning International have satisfied the applicable provisions of 10 CFR Part 140, "Financial Protection Requirements and Indemnity Agreements," of the Commission's regulations;

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

I. The receipt, possession and use of source, byproduct, and special nuclear materials as authorized by this license will be in accordance with the Commission's regulations in 10 CFR Parts 30, 40, and 70; and

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

2. Facility Operating License No. DPR-16, dated July 2, 1991, as amended, is superseded in its entirety by Renewed Facility Operating License No. DPR-16, hereby issued to Oyster Creek Environmental Protection and Holtec Decommissioning International, to read as follows:

A. This renewed license applies to the Oyster Creek Nuclear Generating Station, a boiling-water reactor and associated equipment (the facility), owned by Oyster Creek Environmental Protection and maintained and operated for decommissioning by Holtec Decommissioning International. The facility is located in Ocean County, New Jersey, and is described in the licensee's Updated Final Safety Analysis Report, as supplemented and amended, and in the licensee's Environmental Report, as supplemented and amended.

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

(1) Holtec Decommissioning International pursuant to Section 104b of the Act and 10 CFR Part 50, to possess, maintain, and decommission Oyster Creek Nuclear Generating Station at the designated location on the Oyster Creek site in Ocean County, New Jersey, in accordance with the procedures and limitations set forth in this renewed license;

(2) Oyster Creek Environmental Protection pursuant to Section 104b of the Act and 10 CFR Part 50, to possess Oyster Creek Nuclear Generating Station at the designated location on the Oyster Creek site in Ocean County, New Jersey, in accordance with the procedures and limitations set forth in this renewed license;

(3) Holtec Decommissioning International pursuant to the Act and 10 CFR Part 70, to possess at any time special nuclear material that was used as reactor fuel, in accordance with the limitations for storage, as described in the Updated Final Safety Analysis Report, as supplemented and amended;

(4) Holtec Decommissioning International pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use at any time any byproduct, source, or special nuclear materials as sealed neutron sources that were used for reactor startup, sealed sources that were used for calibration of reactor instrumentation and are used in radiation monitoring equipment, and as fission detectors in amounts as required;

(5) Holtec Decommissioning International pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess and use in amounts as required any byproduct, source, or special nuclear materials without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components; and

(6) Holtec Decommissioning International pursuant to the Act and 10 CFR Parts 30, 40, and 70, to possess, but not separate such byproduct, source, or special nuclear materials that were produced by the operation of the facility.

C. This license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I 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 or incorporated below:

(1) DELETED

(2) Technical Specifications

The Technical Specifications contained in Appendix A and B, as revised through Amendment No. 301, are hereby incorporated in the license. Holtec Decommissioning International shall possess, maintain, and decommission the facility in accordance with the Permanently Defueled Technical Specifications (PDTS).

(3) DELETED

(4) Holtec Decommissioning International shall fully implement and maintain in effect all provisions of the Commission-approved physical security, training and qualification, and safeguards contingency plans including amendments made pursuant to provisions of the Miscellaneous Amendments and Search Requirements revisions to 10 CFR 72.212(b)(9)

and to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The combined set of plans, which contains Safeguards Information protected under 10 CFR 73.21 is entitled; "Oyster Creek Nuclear Generating Station ISFSI Security Plan, Training and Qualification Plan, and Safeguards Contingency Plan[1]," approved by letter dated, June 25, 2021.

(5) DELETED

(6) DELETED

(7) DELETED

(8) DELETED

(9) DELETED

(10) DELETED

(11) DELETED

(12) DELETED

(13) DELETED

(14) DELETED

(15) DELETED

(16) DELETED

(17) DELETED

(18) License Termination Plan (LTP)

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

1) Increases the derived concentration guideline levels and related minimum detectable concentrations for both scan and fixed measurement methods,

2) Increases the radioactivity level, relative to the applicable derived concentration guideline level, at which an investigation occurs,

3) Changes the statistical test applied to a test other than the Sign test or Wilcoxon Rank Sum test,

[1] The Training and Qualification Plan and Safeguards Contingency Plan are Appendices to the Security Plan

4) Results in significant environmental impacts not previously reviewed,

5) Increases the Type I decision error above the level stated in the approved LTP,

6) Changes the approach used to demonstrate compliance with the dose criteria, or

7) Changes parameter values or pathway dose conversion factors that would lead to a lower calculated dose than in the approved LTP.

Reclassification of survey areas, as described in MARSSIM, 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 (Class 1 to Class 2 area) will require NRC notification at least 14 days prior to implementation.

D. DELETED

E. DELETED

F. DELETED

3. Sale and License Transfer Conditions:

A. DELETED

B. DELETED

C. DELETED

D. DELETED

E. DELETED

F. DELETED

G. DELETED

H. DELETED

I. DELETED

J. DELETED

K. DELETED

L. DELETED

M. DELETED

N. At the time of the closing of the transfer of Oyster Creek, and the respective license from Exelon Generation Company to Oyster Creek Environmental Protection and Holtec Decommissioning International, Exelon Generation Company shall transfer ownership and control of assets from the Oyster Creek Nuclear Generating Station Qualified Fund to the Oyster Creek Environmental Protection Qualified Nuclear Decommissioning Trust. Also, at the time of closing, decommissioning funding assurance provided by Oyster Creek Environmental Protection, using a method allowed under 10 CFR 50.75, must be equal to or greater than the minimum amount calculated on that date pursuant to, and required by 10 CFR 50.75 for Oyster Creek. Furthermore, funds dedicated for Oyster Creek prior to closing shall remain dedicated to Oyster Creek following the closing.

4. This license is effective as of the date of issuance and is effective until the Commission notifies the licensee in writing that the license is terminated.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Bruce S. Mallett
Deputy Executive Director for Reactor
and Preparedness Programs
Office of the Executive Director for Operations

Attachment:
Appendix A –
ISFSI Only Technical Specifications

Date of Issuance: XXX

Docket No. 50-219 October 1, 1986

APPENDIX A

RENEWED FACILITY LICENSE DPR-16 ISFSI
ONLY TECHNICAL SPECIFICATIONS

FOR

OYSTER CREEK NUCLEAR POWER PLANT UNIT

NO. 1

OCEAN COUNTY, NEW JERSEY

OYSTER CREEK ENVIRONMENTAL PROTECTION, LLC AND

HOLTEC DECOMMISSIONING INTERNATIONAL, LLC

Amendment No. ~~194, 210, 213~~, ~~296~~, ~~297,~~ ~~298,~~ ~~299,~~ XXX

Renewed License No. DPR-16
Amendment No. XXX

APPENDIX B

DELETED

Amendment No. ~~59, 66, 107, 194, 207, 210, 213, 271~~, ~~296, 297, 298~~, ~~299~~, XXX

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5.2 Spent Fuel Storage Page 5.1

Section 6 ADMINISTRATIVE CONTROLS

6.1- 6.12 DELETED

6.1- 6.12 DELETED

6.13 High Radiation Area Page 6.1

6.14-6.21 DELETED

SECTION 5

DESIGN FEATURES

5.1 SITE

The Oyster Creek Nuclear Generating Station facility is located adjacent to State Highway Route 9 near the Atlantic Ocean within the State of New Jersey. The facility site, approximately 152 acres, is in Lacey Township, Ocean County.

5.2 SPENT FUEL STORAGE

5.2.1 Spent Fuel Storage shall not be stored in the Spent Fuel Pool.

6.13 HIGH RADIATION AREA

6.13.1 In lieu of the "control device" or "alarm signal' required by Section 20.1601 of 10 CFR 20, each high radiation area in which the intensity of radiation at 30 cm (11.8 in.) is greater than deep dose equivalent of 100 mRem/hr but less than 1,000 mRem/hr shall be barricaded and conspicuously posted as a high radiation area and entrance thereto shall be controlled by requiring issuance of a Radiation Work Permit (RWP).

NOTE: Health Physics personnel shall be exempt from the RWP issuance requirement during the performance of their assigned radiation protection duties, provided they are following plant radiation protection procedures for entry into high radiation areas.

An individual or group of individuals permitted to enter such areas shall be provided with one or more of the following:

a. A radiation monitoring device which continuously indicates the radiation dose rate in the area.

b. A radiation monitoring device which continuously integrates the radiation dose rate in the area and alarms when a pre-set integrated dose is received. Entry into such areas with this monitoring device may be made after the dose rate levels in the area have been established and personnel have been made knowledgeable of them.

c. A health physics qualified individual (i.e., qualified in radiation protection procedures) with a radiation dose rate monitoring device who is responsible for providing positive exposure control over the activities within the area and who will perform periodic radiation surveillance at the frequency in the RWP. The surveillance frequency will be established by the management position responsible for radiological controls.

6.13.2 Specification 6.13.1 shall also apply to each high radiation area in which the intensity of radiation is greater than deep dose equivalent of 1,000 mRem/hr at 30 cm (11.8 in.) but less than 500 rads in 1 hour at 1 meter (3.28 ft.) from sources of radioactivity. In addition, locked doors shall be provided to prevent unauthorized entry into such areas and the keys shall be maintained under the administrative control of operations and/or radiation protection supervision on duty.

HDI-OC-24-018

Enclosure 2

Oyster Creek Nuclear Generating Station

License Termination Plan

Oyster Creek Decommissioning Project

License Termination Plan

Revision 0

August, 2024



HOLTEC
DECOMMISSIONING
INTERNATIONAL

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1

GENERAL INFORMATION

LIST OF ACRONYMS

Acronym	Full Form
AEC	Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
BWR	Boiling Water Reactor
DCGL	Derived Concentration Guideline Level
DECON	Decontamination
DOE	Department of Energy
DSAR	Decommissioning Safety Analysis Report
EDG	Emergency Diesel Generator
EPA	Environmental Protection Agency
FSS	Final Status Surveys
GPUN	General Public Utilities Nuclear
HDI	Holtec Decommissioning International LLC
HSA	Historical Site Assessment
ISFSI	Independent Spent Fuel Storage Installation
JCP&L	Jersey Central Power and Light
LAR	License Amendment Request
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MSL	Mean Sea Level
MWe	megawatts electric
MWt	megawatts thermal
NRC	United States Nuclear Regulatory Commission
OCNGS	Oyster Creek Nuclear Generating Station
OCEP	Oyster Creek Environmental Protection LLC
ORW	Old Radioactive Waste Building
PSDAR	Post-Shutdown Decommissioning Activities Report
RB	Reactor Building
TB	Turbine Building

1 GENERAL INFORMATION

1.1 Introduction

Oyster Creek Nuclear Generating Station (OCNGS), located at 741 Route 9 South Forked River, New Jersey, was a single unit Boiling Water Reactor (BWR)-2 with a Mark I type containment. It is in Lacey Township, Ocean County, New Jersey, approximately two miles south of the community of Forked River. OCNGS was licensed to generate 1930 megawatts thermal (MWt). The reactor began commercial operation on December 23, 1969, licensed to Jersey Central Power and Light (JCP&L).

In 1980, General Public Utilities (parent of JCP&L) assumed responsibility for the operation of OCNGS. The license was subsequently transferred to AmerGen on June 6, 1999, and then to Exelon Generation Company, LLC on December 23, 2008. The original license was renewed to allow the unit to operate until April 9, 2029.

Exelon announced its plan to retire OCNGS no later than October 31, 2018 (Reference 1-1), in accordance with 10 CFR §50.82(a)(l)(i) and 10 CFR §50.4(b)(8). OCNGS permanently shut down on September 17, 2018. Exelon certified to the United States Nuclear Regulatory Commission (NRC) that it had permanently removed fuel from the reactor vessel at OCNGS in accordance with 10 CFR §50.82(a)(2) (Reference 1-2).

Exelon submitted to the NRC an application for transfer of the OCNGS licenses to Oyster Creek Environmental Protection, LLC (OCEP) as owner and Holtec Decommissioning International, LLC (HDI) as operator (Reference 1-3).

On July 1, 2019, OCNGS license was transferred to OCEP as the licensed owner and HDI as the licensed operator for decommissioning (Reference 1-4).

OCNGS is being decommissioned and dismantled using the decontamination (DECON) method with a project goal of achieving unrestricted release of the site, except for the Independent Spent Fuel Storage Installation (ISFSI). This OCNGS License Termination Plan (LTP) describes the remaining activities that HDI will perform to complete nuclear decommissioning with a partial site release other than the ISFSI. This LTP addresses HDI's plans for demonstrating to the NRC that the area for partial site release meets the radiological criteria for release from the license.

NRC has established specific radiological criteria for the release of a nuclear power plant site for unrestricted use that must be met before the termination of a reactor license. NRC requires that the remaining radioactivity distinguishable from background radiation, not result in a Total Effective Dose Equivalent that would exceed 25 mrem per year to an average member of the critical group, including that from groundwater sources of drinking water and that the residual radioactivity be reduced to levels that are as low as reasonably achievable (ALARA). Determination of radioactivity levels that are ALARA is made with consideration of potential detriments that may result from further DECON and waste disposal.

HDI is submitting this LTP for OCNGS. The following is the licensee's name, address, license number, and docket number for OCNGS:

Holtec Decommissioning International, LLC

1 Holtec Blvd.

Camden, New Jersey 08104

License No. DPR-16

Docket No. 50-219 and 72-15

1.2 Historical Background

OCNGS was a single unit boiling water reactor utilized for the generation and transmission of electric power using nuclear fission as the source of production. The Atomic Energy Commission (AEC) issued a construction permit to JCP&L on December 15, 1964, and License Number DPR-16 was issued permitting reactor operation up to 5 MWt on Apri1 9, 1969. After low-power testing, the license was amended to authorize reactor operation at a power level of 1600 MWt on August 1, 1969. Full power was achieved on December 7, l969, and OCNGS entered commercial operation at 530 megawatts electric (MWe) net on December 23, 1969. Subsequent licensee changes through licensing actions with the NRC were denoted in Section 1.1, Introduction above. The reactor was refueled 26 times during operation spanning a period of almost a half-century and was the oldest U.S. BWR at the time of permanent shutdown and defueling in 2018.

Exelon submitted a Post-Shutdown Decommissioning Activities Report (PSDAR) pursuant to §50.82(a)(4)(i) choosing Safe Storage decommissioning option on May 21, 2018 (Reference 1-5). After the license transfer to HDI, Holtec submitted a revised PSDAR, choosing the prompt DECON decommissioning option on September 28, 2018 (Reference 1-6).

1.3 Scope

HDI intends to perform a partial site release from the 10 CFR §50 license. The ISFSI will remain under the Part 50 license until at such time the spent fuel is removed from the site. This LTP addresses only facilities and land areas within the licensed site.

1.4 Site Description

As described in the Decommissioning Safety Analysis Report (DSAR) (Reference 1-7), the OCNGS site is located near the Atlantic Ocean within the State of New Jersey. The site, about 152 acres, is partly in Lacey and partly in Ocean Townships of Ocean County, New Jersey, about two miles inland from the shore of Barnegat Bay and about seven miles west-northwest of Barnegat Light. The site is approximately nine miles south of Toms River, New Jersey, about fifty miles east of Philadelphia, Pennsylvania, and sixty miles south of Newark, New Jersey. The site is further identified by an intake canal flowing in from Barnegat Bay along the northern portion of OCNGS and a discharge canal flowing from the southern portion of OCNGS out to Barnegat Bay.

Topography in the region is relatively level landscapes associated with the coastal plains (Figure 1-1 and Figure 1-2). Site elevation ranges from approximately 0 to 15 feet above mean sea level (MSL) immediately adjacent to the Intake and Discharge Canals to slightly more than 30-feet

MSL in the northwest portion of the station property. The ground surface features are comparatively flat except for the man-made steep slopes at areas adjacent to the Intake and Discharge Canals. The terrain surrounding the site is relatively flat along the shoreline to gently rolling inland. About 4 miles inland, just west of the Garden State Parkway, the terrain rises to heights in the range of 65 to 90 feet above MSL.

The site is in a meteorological transition zone between the continent and the ocean, and the weather at the site is conditioned by this location. The prevailing winds are offshore. Thus, site weather is influenced, on average, more by continental than by maritime weather.

The Island Beach peninsula and Long Beach Island provide a barrier between Barnegat Bay and the Atlantic Ocean. This barrier, along with the shallowness of the Bay, minimizes tidal fluctuations in the Bay. A survey immediately north of the OCNGS site at Forked River showed a high tide elevation of 4.5 feet above MSL. The grade level at the site is 23 feet above MSL, which is well above the 4.5 feet recorded, and there is no record of the site being flooded or inundated, even during storms with high tidal conditions.

The nearest navigable waterway is Barnegat Bay. This body of water is relatively shallow, with an average depth of less than 5 feet and a range of less than 1 foot to 20 feet at mean low tide. The U.S. Army Corps of Engineers maintains the Intracoastal Waterway, which crosses Barnegat Bay at a depth of 6 feet, mean water line.

Surface water bodies in the vicinity of the site consist of the South Branch of Forked River, Oyster Creek, the Intake and Discharge Canals, and Barnegat Bay. The South Branch and Oyster Creek are freshwater sources from upland Pineland areas. In contrast, the Intake and Discharge Canals are saline due to their hydraulic connection to Barnegat Bay and the Atlantic Ocean. Vernal ponds also exist in some of the remaining wooded areas to the west, south, and east of the site.

With few exceptions, potable water in the vicinity of the site is provided by municipal water systems in Lacey and Ocean Townships. The Ocean Township Municipal Water System utilizes wells screened in the Cohansey and Kirkwood Aquifers (well depths range from 150 to 350 feet). The Lacey Township Municipal Water System is screened in the Kirkwood Aquifer (well depths range from 235 to 265 feet).

A review of permitted wells within 1 mile of the center of the OCNGS was performed in the spring of 2023 (see Figure 1-3). The 404 offsite wells identified within the 1-mile radius of the site were categorized as either potable drinking water wells or non-potable water wells, as listed in Table 1-1 and Table 1-2. The 1-mile radius well search is served by municipal water, and private domestic water well usage is prohibited by municipal ordinance.

Table 1-1 Potable Drinking Water Wells

User	Identified Wells
Domestic Water	254
Non-Public	3
Public Community	6
Public Non-Community	11
Total	274

Table 1-2 Non-potable Water Wells

User	Identified Wells
Irrigation (Agriculture/Horticulture/Aquaculture)	1
Boring / Individual	8
Cathodic Protection / Individual	1
Dewatering	4
Industrial	6
Irrigation	37
Monitoring	71
Open Loop Geothermal Heat Pump	2
Total	130

Based on the latest OCNGS monitoring well radiological data and hydrogeologic studies showing site subsurface water flows into the intake and discharge canals, no radiological impact to the identified wells would be anticipated from site decommissioning operations.

1.4.1 Nearby Residences and Facilities

West of the Garden State Parkway, the land is undeveloped woodland, and wooded wetlands are found along the banks of small creeks to the north, south, and west of the site. East of OCNGS along the shoreline of Barnegat Bay, the land is residentially developed for year-round and seasonal use.

Within 10 miles of the OCNGS, there are over 35 industrial facilities. An estimated 1,800 individuals were employed there.

The Barnegat Bay region of New Jersey is a well-known summer resort area, attracting visitors from much of the Middle Atlantic seaboard. The population distribution of the area surrounding the site changes significantly from winter to summer with the influx of summer vacationers during the months of June, July, and August. This seasonal population fluctuation occurs primarily in the eastern sectors. The nearest larger population center is Toms River in Dover Township, 9.5 miles north of the site.

A state game farm on which quail and pheasant are raised is located approximately 2.25 miles northeast of the station.

Most of the property immediately west of the OCNGS property is owned by FirstEnergy, an Ohio utility. A smaller parcel within the FirstEnergy property contains a 66 MWe dual-fired combustion turbine power plant owned by Forked River Power, LLC, and is only used during high energy demand periods. In addition, the property to the west also contains a transmission substation system and a recently purchased parcel to support offshore wind farm development by Ocean Wind 1, LLC.

The nearest military installations are Fort Dix, New Jersey (approximately 35 miles northwest), McGuire Air Force Base (on the Fort Dix Military Reserve), and Lakehurst Naval Air Station (14 miles north). There is also a military reserve approximately 12 miles west along U.S. Route 72, utilized as a practice bombing range. There is one general aviation airport, Robert J. Miller Airpark County Airport, approximately 9 miles northwest of the site.

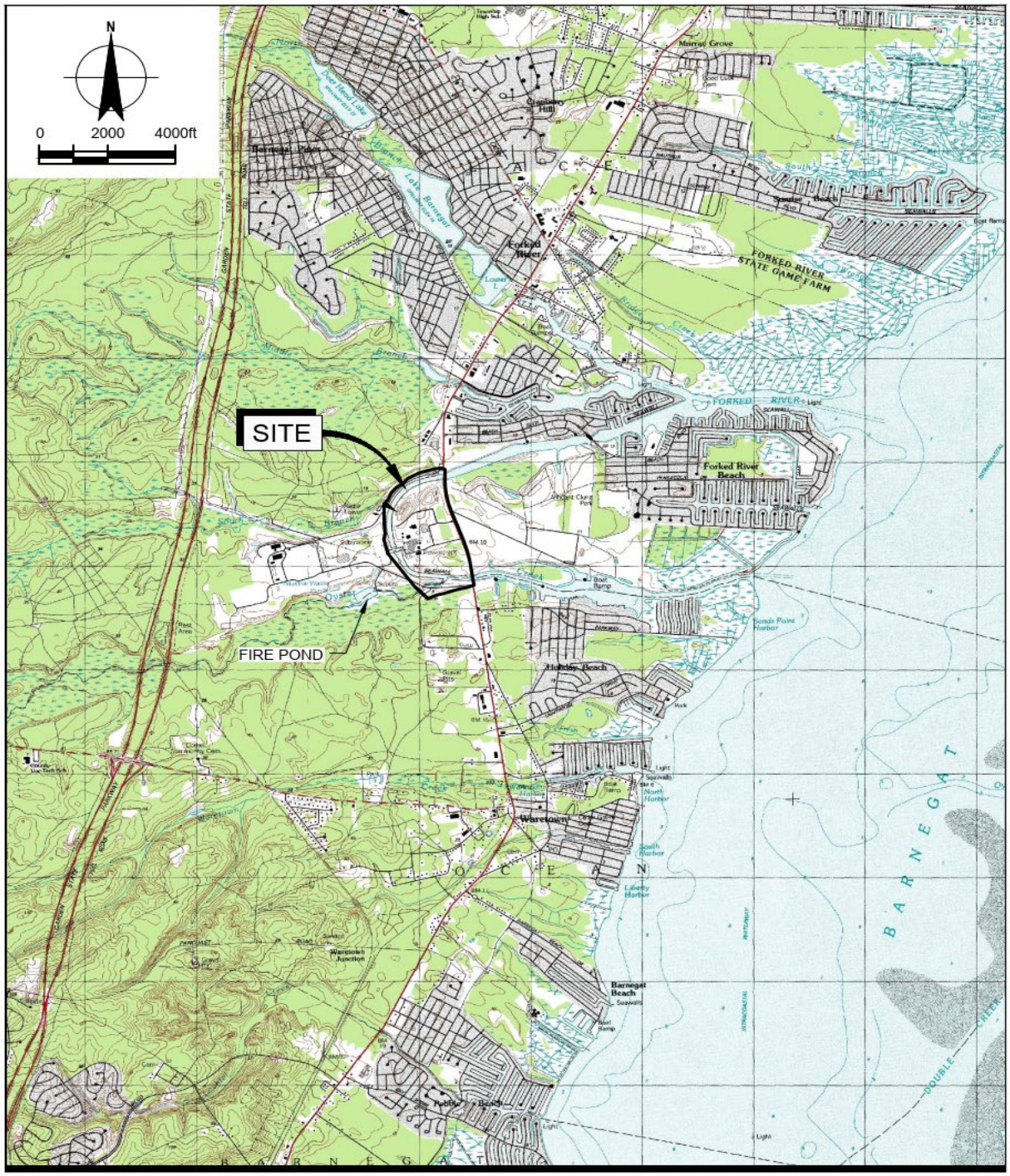


Figure 1-1 Oyster Creek Generating Station Site Location Map

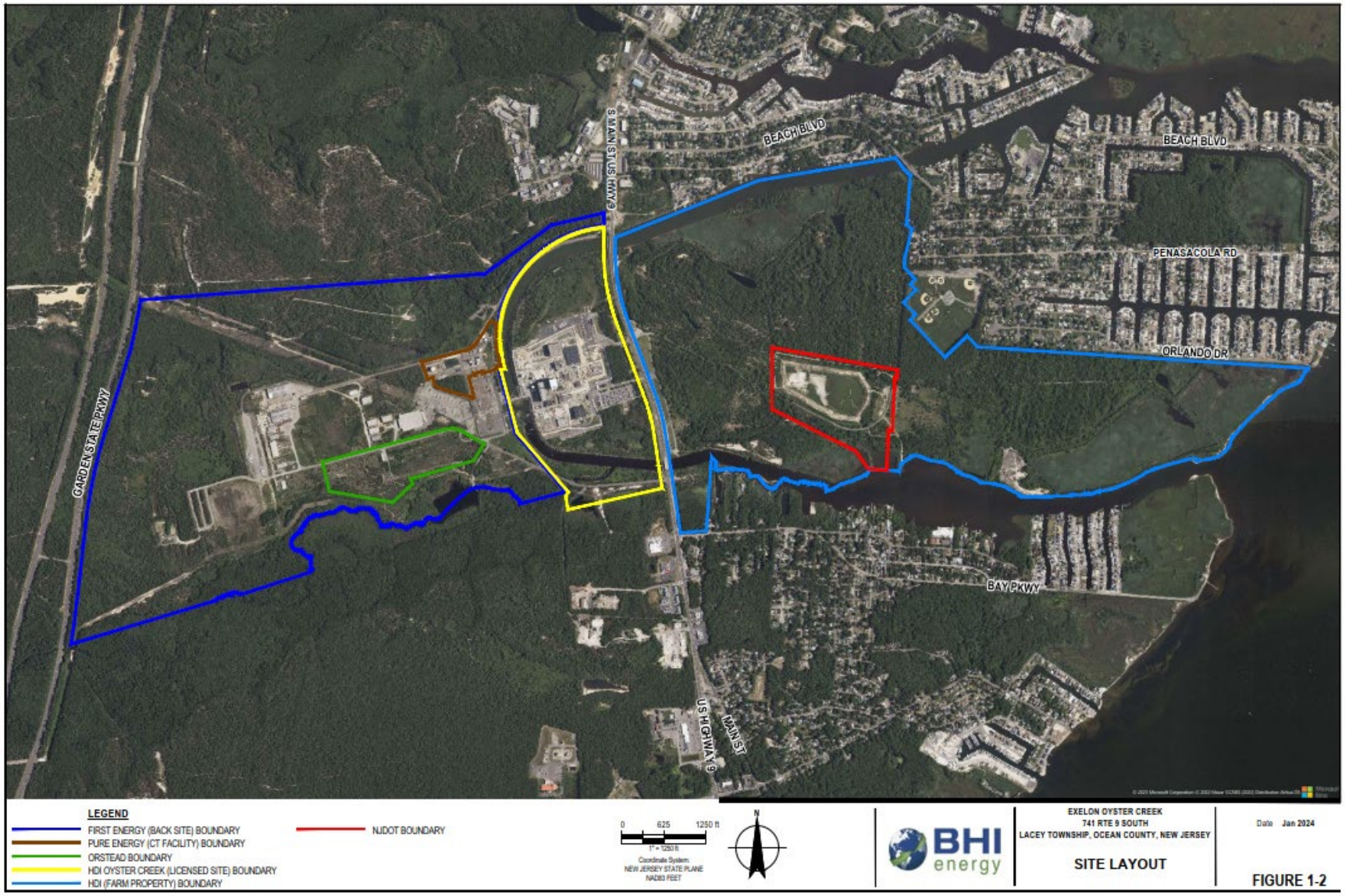


Figure 1-2 Oyster Creek Generating Station Site Layout

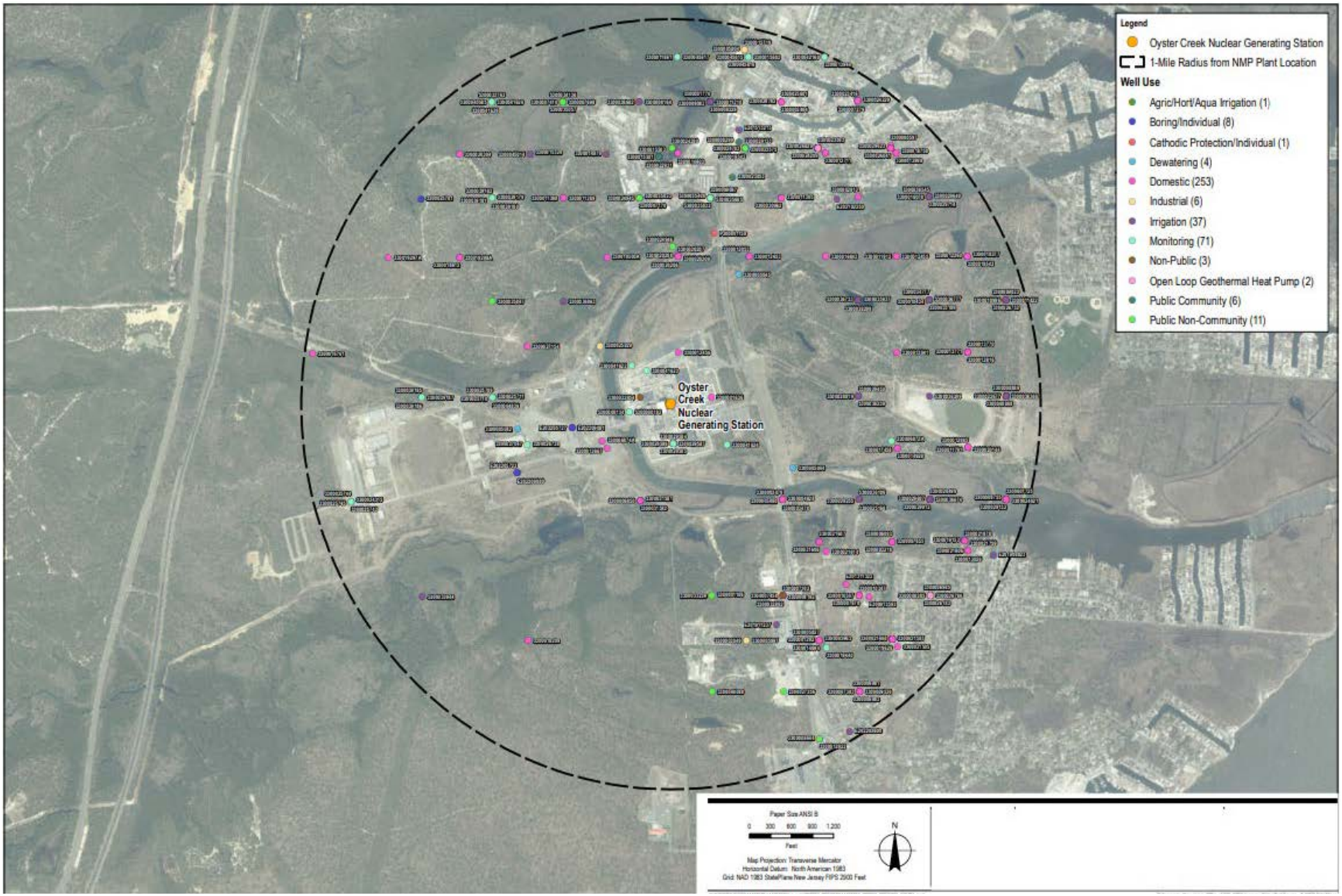


Figure 1-3 Oyster Creek Generating Station Vicinity Wells

As reported in the Normandeau Associates Land Use Survey conducted in March 2022 (Reference 1-8), the nearest residence, measured from the OCNGS Reactor Building (RB), was identified in the Southeast Sector at 3,073 feet. The survey examined each of the sixteen 22 1/2-degree meteorological sectors surrounding OCNGS, noting the nearest residence and garden larger than 500 square feet within a five-mile radius of the facility. All meteorological sectors contain a residence within a five-mile radius except for the WNW sector.

1.4.2 Site Boundaries

The following information is included pursuant to 10 CFR §50.82(a)(9)(ii)(H) requiring identification of parts of the facility or site that were released for use before approval of the LTP.

The original plant site consisted of approximately 800 acres, all owned by JCP&L. Coincident with the sale of OCNGS to AmerGen, approximately 572 acres of the original plant site were proposed to be removed from the site boundary and made available for unrestricted use subject to certain easements to support the continued operation of the nuclear power plant. This parcel of land, referred to as the Forked River property, was the construction site for the canceled Forked River nuclear project.

The NRC determined that release of a portion of a site would need to be supported by an acceptable safety evaluation pursuant to 10 CFR §50.59 and surveys to establish that the standards for unrestricted release of property in 10 CFR §20, Subpart E, were met (Reference 1-9). NRC also held a transcribed public meeting at Oyster Creek on October 29, 1999 (Reference 1-10).

Consistent with the NRC staff's guidance, the OCNGS operator General Public Utility Nuclear (GPUN) prepared a safety evaluation pursuant to 10 CFR §50.59 to change the description of the site boundary. The NRC reviewed this safety evaluation and as documented in an NRC inspection report (Reference 1-11), concluded that GPUN's safety evaluation was sufficient to demonstrate that the separation of the Forked River property would not result in an unreviewed safety question. GPUN performed surveys to show that the Forked River property met the criteria in 10 CFR §20 Subpart E for unrestricted release. Derived Concentration Guideline Levels (DCGLs) were based on the NUREG-1757 Volume 2, Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria (Reference 1-12) screening values.

An independent survey was performed for the NRC, and under the NRC's supervision, by the Oak Ridge Institute for Science and Education (Reference 1-13). The NRC noted that a safety inspection of the Forked River Property was conducted on November 15-18, 1999, and a confirmatory survey was completed as part of the inspection. In the inspection report, the NRC noted the following:

Based on the results of the Oak Ridge Institute for Science and Education independent measurements, we determined that the licensee's scoping / Final Status Survey (FSS) was adequate. No contamination survey results exceeded the DGCL for cobalt-60 or cesium-137. Surface and subsurface soil samples did not contain any residual radionuclides distinguishable from background and/or were comparable to the respective minimum detectable concentrations.

Water and sediment results were consistent with expected backgrounds, except for one water sample. The initial gross alpha and beta measurements were above the maximum contaminant level for radium-226 and strontium-90. Additional analyses on all four well-water samples confirmed no plant-related material. Therefore, all results were below the interim screening

values or DCGL for the radionuclides of concern and confirm the adequacy of the licensee's measurements.

Inspection Report 050000219/1999013 (Reference 1-14) concluded that the Forked River Property was adequately characterized to demonstrate that residual radioactive material from plant-related activities was well below the dose-based release criteria of 10 CFR §20, Subpart E. However, NRC noted that the switchyard had been excluded from the scoping survey, and it could not confirm the switchyard's status as a non-impacted area. GPUN committed to performing a radiological scoping survey of the switchyard during an upcoming OCNGS refueling outage. AmerGen fulfilled this commitment and confirmed the switchyard is a non-impacted area (Reference 1-15).

The property retained by AmerGen and ultimately sold to OECP resulted in the definition of a new (reduced) site boundary encompassing Lot 4.02 (139.62 acres) and Block 41, Lot 43 (12.01 acres) for a total of 151.63 acres.

Upon completion of decommissioning, a request for termination of the OCNGS Part 50 license, except for the ISFSI, will be submitted to the NRC and will include a discussion of the disposition of the property that was previously released.

1.5 Site Structures

Major structures at the site are briefly described below and depicted on Figure 1-4.

1.5.1 Reactor Building

The RB is constructed entirely of reinforced concrete to the refueling floor level at El. 119'-3". Above the refueling floor, the structure is a steel framework with insulated, corrosion-resistant metal siding. The foundation mat is 146 feet by 146 feet and about 10 feet thick. The finished top surface of the mat is at El. (-)19'-6" (or 42'-6" below grade). The drywell support pedestal in the center of the mat is a concrete cylinder about 67 feet in diameter and 19’-5” high. The drywell is centered on the pedestal and shielded by concrete to the level of the refueling floor. Top shielding was provided by removable concrete plugs. The pressure suppression pool (torus) is supported from the mat by a structural framework. All refueling equipment was inside the building, including the spent fuel storage pool.

1.5.2 Turbine Building

The Turbine Building (TB) is a reinforced concrete structure directly west of the RB. The building is about 265 feet long and 171 feet wide. The foundation mat is 6 to 8 feet thick, and the finished top is at El. 0'-0". The TB foundation mat overlaps the RB mat where the two buildings abut. Concrete walls extend from the basement levels to the operating floor at El. 46'-6" (about 23' above grade). Steel framework and insulated metal siding are used over the Turbine Generator area. The TB contains the plant Control Room and electrical equipment.

1.5.3 Main Office Building

The Main Office Building is a three-story concrete structure between the TB and the RB. The building houses offices, a laboratory area, showers, locker rooms and provides secondary access to controlled areas.

1.5.4 Old Radioactive Waste Building

The Old Radioactive Waste Building (ORW) is directly east of the RB. It is a single-story reinforced concrete building with a two-story penthouse. A small basement area is at El. 6'-6". The roof elevations are 39'-3" and 49'-10" to 50'-6". The building is no longer used for normal radwaste handling activities. However, some of the equipment housed in the building was used for waste handling during decommissioning.

1.5.5 New Radioactive Waste Building

The New Radwaste Building is a three-story building 44 feet high, 86 feet by 114 feet in plan dimensions, erected at grade approximately 250 feet north-northwest of the ventilation stack. The building is of structural steel framework with a poured reinforced concrete foundation, intermediate slabs, and roof slab. Shield walls have been constructed of solid concrete blocks, and other walls are insulated metal siding. The building houses the Liquid and Solid Radwaste Systems, designed to process low-level radioactive liquid wastes.

1.5.6 Emergency Diesel Generator Building

The plant Emergency Diesel Generators (EDG) and their associated fuel oil tanks are housed within separate vaults in a reinforced concrete building southwest of the TB. The one-story structures were constructed at approximately grade elevation near the eastern bank of the discharge canal.

1.5.7 Intake and Discharge Structures

Service water was drawn from Barnegat Bay through a 140-foot-wide canal dredged to a depth of (-)10'-0". The canal follows the general course of the south branch of Forked River, then curves south to the concrete intake structure, located 183 feet west of the RB. The 100-foot-wide discharge canal empties into Barnegat Bay following the general course of Oyster Creek.

1.5.8 Ventilation Stack

Tunnels link the 394-foot reinforced concrete stack (368 feet above grade) to the RB, TB, and ORW. The top of the stack foundation mat is at El. (-)3'-0". Exhaust fans for the ventilating ducts are outdoors at grade level and discharge to the stack above the second-floor level.

1.5.9 Storage Tanks

The largest tanks used during decommissioning are the 350,000-gallon Fire Water Tank, the 525,000-gallon Condensate Storage Tank, and the 175,000-gallon Demineralized Water Storage Tank.

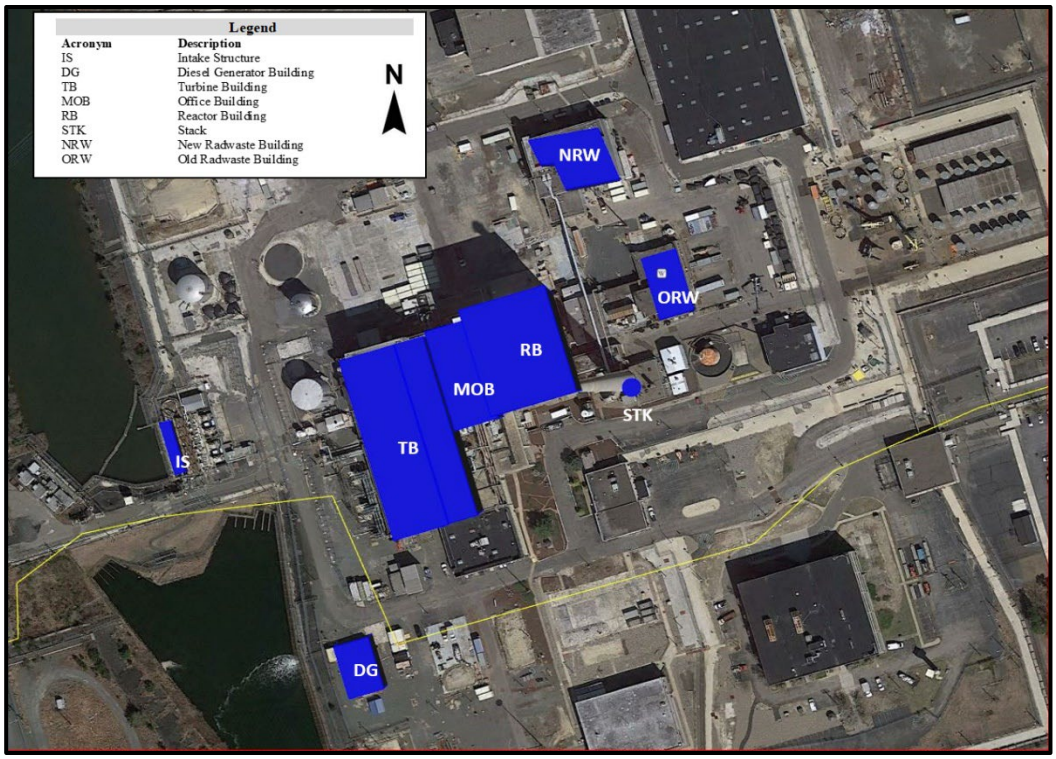


Figure 1-4 Oyster Creek Generating Station Site Structures

1.5.10 Independent Spent Fuel Storage Installation

The irradiated nuclear fuel has been moved to dry storage canisters shielded by a concrete and steel overpack and placed on concrete pads at the ISFSI until shipped offsite.

1.6 Decommissioning Approach

HDI is submitting this LTP to address residual radioactivity on the OCNGS site and discuss how the site will be remediated and verified to meet the release criteria. The LTP describes how the release criteria were determined and how they will be measured.

Structures on site will be removed except for the ISFSI and associated structures, Low-Level Radioactive Waste Storage Facility, Oyster Creek Administration Building, Site Emergency Building, Demineralized Water Storage Tank, New Gatehouse Facility, and the Warehouse.

1.7 Decommissioning Objective

The objective of decommissioning OCNGS is to reduce the level of residual radioactivity remaining from reactor operation to levels that permit the release of the OCNGS site for unrestricted use and allow for the termination of the 10 CFR §50 license for the site property, excluding the ISFSI. The OCNGS LTP satisfies the 10 CFR §50.82(a)(9) requirement to submit an LTP for NRC approval. The LTP submittal is accompanied by a License Amendment Request that establishes the criteria for making changes to the LTP without prior NRC approval. Once approved, the LTP will become a supplement to the OCNGS DSAR.

1.8 License Termination Plan Scope

HDI prepared the LTP using the following guidance:

- NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (Reference 1-16)
- Regulatory Guide 1.179, Standard Format and Contents for License Termination Plans for Nuclear Power Reactors (Reference 1-17)
- NUREG-1700, Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans (Reference 1-18)
- NUREG-1757, Consolidated Decommissioning Guidance: Characterization, Survey

The LTP includes a discussion of the following actions:

- Site characterization to ensure that FSS covers areas where contamination existed, remains, or has the potential to exist.
- Remaining decommissioning activities.
- Plans for site remediation.
- The FSS plan used to confirm that the site release criteria of 10 CFR §20, Subpart E are met.
- Dose modeling scenarios demonstrating compliance with the site release criteria of 10 CFR §20, Subpart E.
- Estimated remaining decommissioning costs.
- Environmental impacts from the decommissioning of OCNGS.

1.9 License Termination Plan Summary

The following subsections provide a summary of the seven chapters that address the requirements of 10 CFR §50.82(a)(9).

1.9.1 Site Characterization

Chapter 2 summarizes the Historical Site Assessment (HSA) (Reference 1-19). The HSA was completed in February 2020, and the current revision was issued in November 2021. It provided the preliminary information required to divide the site into survey areas. The survey areas were evaluated against MARSSIM criteria to determine their initial classification. The HSA also provided the foundation for further site characterization based on actual surveys to determine the extent and levels of radioactive contamination.

The initial site characterization of buildings and open land areas was performed between July and November of 2022 and was followed by an additional characterization campaign in 2023 focused on structural concrete that will remain in place following the completion of dismantlement activities. Data collected during site characterization may be used to change the original HSA classification of an area within the requirements specified in this LTP up to the time of the FSS.

1.9.2 Identification of Remaining Decommissioning Activities

Chapter 3 identifies the remaining dismantlement and DECON activities as of this LTP submittal. The information provided in this chapter includes the following:

- A summary of those activities that have been completed.
- A description of the areas requiring remediation.
- Radiological conditions that may be encountered.
- Estimates of occupational radiation dose.
- An estimate of the remaining quantity of radioactive material to be shipped for disposal.
- A description of proposed control mechanisms to ensure remediated areas or areas that have undergone final status survey and/or independent verification are not contaminated.

1.9.3 Site Remediation Plan

Chapter 4 discusses the remediation techniques that may be used to reduce residual contamination to levels that comply with the unrestricted release criteria of 10 CFR §20, Subpart E. The principal materials that will be remediated are structural surfaces and soil. Chapter 4 also discusses the ALARA evaluations, which will be used to determine if remediation is warranted beyond what is required to meet the radiological dose criteria. In addition, Chapter 4 describes the radiation protection program that will be implemented during remediation activities.

1.9.4 Final Status Survey Plan

Chapter 5 describes the process that will be used to verify that the OCNGS site complies with the 10 CFR §20 criteria for unrestricted use. The plan is implemented in accordance with approved procedures and work instructions, which comply with the FSS Quality Assurance Project Plan. To ensure that survey results are of sufficient quality and quantity to support decision-making, FSS design (e.g., scan area coverage, number of survey measurements, survey locations) is developed using the Data Quality Objective Process described in the MARSSIM. Data is statistically evaluated using the Data Quality Assessment process.

1.9.5 Compliance with Radiological Criteria for License Termination

Chapter 6 discusses the development of the DCGLs. The DCGLs are radionuclide-specific values derived from activity-dose relationships and the analyses of potential exposure pathways. DCGLs for assessing residual radioactivity levels on building surfaces and site soil have been developed for each radionuclide of concern. Also discussed in this chapter are the methodologies and models for dose assessment of backfilled basements, embedded and buried pipe/penetrations, subsurface soil, future land use scenarios, and dose computation models, including the sensitivity analysis, exposure pathways, and derivation of area factors.

1.9.6 Update of Decommissioning Costs

Chapter 7 provides a current estimate of the remaining costs to release the OCNGS site for unrestricted use. This chapter also compares the remaining costs with the remaining funds, as of this LTP submittal, and gives a verification of the adequacy of financial assurance.

1.9.7 Supplement to the Environmental Report

Chapter 8 identifies where OCNGS decommissioning activities continue to be bounded by previously issued environmental impact statements, specifically NUREG-0586, Supplement 1, Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors (Reference 1-20). Where the potential impact to a NUREG-0586 Supplement 1 environmental issue is considered site-specific, this chapter also contains a justification that the impact on the environment from remaining decommissioning activities will be small (i.e., no detectable impact). This section of the LTP is prepared pursuant to 10 CFR §51.53(d) and 10 CFR §50.82(a)(9)(ii)(G).

1.10 License Termination Plan Change Process

HDI is submitting this LTP as a supplement to the DSAR. Changes to decommissioning activities as described in the LTP must comply with the criteria in 10 CFR §50.59 and §50.82. Additionally, NUREG-1700, Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans, specifies additional restrictions on changes to the LTP. A change may not be made without prior NRC approval if a change would result in any of the following:

- An increase in the DCGLs and related minimum detectable concentrations (for both scan and fixed measurement methods).
- An increase in the radioactivity level, relative to the applicable DCGL, at which investigation occurs.
- A change in the statistical test applied using other than the Sign Test or Wilcoxon Rank Sum Test.
- An increase in the Type 1 decision error as stated in the LTP.
- Changes the approach used to demonstrate compliance with the dose criteria.
- Changes in parameter values or pathway dose conversion factors that would lead to a lower calculated dose than in the approved LTP.
- Significant environmental impacts not previously reviewed.

Additionally, NRC must be notified at least 14 days prior to reclassification of a survey unit to a less restrictive classification (e.g., Class 2 to Class 3). Reclassification of a survey unit to a more restrictive classification (e.g., Class 2 to Class 1) may be done without prior notification.

1.11 References

1-1 Gallagher, Michael, Exelon Generation Company, LLC. February 2018. Letter to NRC. *"Certification of Permanent Cessation of Power Operations for Oyster Creek Nuclear Generating Station"* (ML18045A084)

1-2 Gallagher, Michael, Exelon Generation Company, LLC. September 2018. Letter to NRC. *"Certification of Permanent Removal of Fuel from the Reactor Vessel for Oyster Creek Nuclear Generating Station"* (ML18268A258)

1-3 Fewell, Bradley, Exelon Generation Company, LLC. August 2018. Letter to NRC. *"Application for Order Approving Direct Transfer of Renewed Facility Operating License and General License and Proposed Conforming License Amendment"* (ML18243A489)

1-4 Snyder, Amy, NRC. July 2019. Letter to HDI. *"Oyster Creek Nuclear Generating Station, Issuance of Amendment Re: Application for Order Approving Direct Transfer of Renewed Facility Operating License and Independent Spent Fuel Storage Installation License and Conforming Amendment (EPID# L-2018-LLM-0002)"*. (ML19164A157)

1-5 Gallagher, Michael, Exelon Generation Company, LLC. May 2018. Letter to NRC. *"Oyster Creek Nuclear Generating Station - Post-Shutdown Decommissioning Activities Report"*. (ML18141A775)

1-6 Cowan, Pamela, HDI. September 2018. Letter to NRC. *"Notification of Revised Post-Shutdown Decommissioning Activities Report and Revised Site-Specific Decommissioning Cost Estimate for Oyster Creek Nuclear Generating Station"*. (ML18275A116)

1-7 OCNGS. 2018. *Decommissioning Safety Analysis Report*, Revision 0

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1-9 Travers, William, NRC. September 1999. Letter to NRC. *"Proposed Sale of Some Land That Is a Portion of a Licensee's Site, Including Land in the Exclusion Area"*. SECY 99-238

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1-12 Barr, C.S., Clark, S., Chapman, G.C., Esh, D.W, Fedors, R.W., Huffert, A.M., Kauffman, L.A., LaFranzo, M.M., McKenney, C.A., Parks, L.L., Schmidt, D.W., Schwartzman, & Watson, B.A. 2022. *Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria*. NUREG-1757, Volume 2, Revision 2, NRC, Washington, D.C. (ML22194A859)

1-13 Abelquist, E.W. 2000. *Confirmatory Survey of the Oyster Creek Forked River Property Lacey Township, Ocean County, New Jersey*. (Docket No. 50-129, RFTA No. 99-040), NRC, Washington, D.C. (ML003685977)

1-14 White, John, NRC. March 2000. Letter to GPU Nuclear, Inc. *"Inspection No. 05000219/1999013"*. (ML003688276)

1-15 Gallagher, Michael, AmerGen Energy Company, LLC. September 2001. Letter to NRC. *"Oyster Creek Generating Station Facility Operating License No. DPR-16 NRC Docket No. 50-219 Forked River Property That Is Not Part of the Current Oyster Creek Generating Station Site"*. (ML012610070)

1-16 Department of Defense, DOE, EPA, NRC. 2000. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*. NUREG-1575, Revision 1, EPA 402-R-97-016, Revision 1, DOE/EH-0624, Revision 1, NRC, Washington, D.C. (ML003761445)

1-17 NRC. 2019. *Standard Format and Contents for License Termination. Plans for Nuclear Power Reactors*. Regulatory Guide 1.179, Revision 2, NRC, Washington, D.C. (ML19128A067)

1-18 Giebel, S., & Watson, B. 2018. *Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans*. NUREG-1700, Revision 2, NRC, Washington, D.C. (ML18116A124)

1-19 OCNGS. 2021. *Historical Site Assessment*. Revision 2, Comprehensive Decommissioning International, LLC. Unpublished internal company document.

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2

SITE CHARACTERIZATION

LIST OF ACRONYMS

Acronym	Full Form
AC	Assessment Criteria
ALARA	As Low As Reasonably Achievable
AOB	Auxiliary Office Building
AOG	Augmented Offgas
AREOR	Annual Radiological Environmental Operating Reports
ARERR	Annual Radiological Effluent Release Reports
bgs	Below Grade Structure
bkg	Background
BSTK	Base of Stack
CFR	Code of Federal Regulations
cm	centimeter
cpm	counts per minute
CSM	Conceptual Site Model
CST	Condensate Water Storage Tank
DBT	Design Basis Threat
DCA	Discharge Canal Area
DCGL	Derived Concentration Guideline Levels
DOE	Department of Energy
dpm	Disintegration per Minute
DQO	Data Quality Objective
DWST	Demineralizer Water Storage Tank
DWT	Demineralized Water Tank
EOCA	East Owner Controlled Area
EPA	Environmental Protection Agency
ESW	Emergency Service Water
FSS	Final Status Survey
GPS	Global Positioning System
HDI	Holtec Decommissioning International, LLC
HSA	Historical Site Assessment
HTD	hard-to-detect
in	inch
ISFSI	Independent Spent Fuel Storage Installation
ISO	International Organization for Standardization
IU	Industrial Use
JCP&L	Jersey Central Power and Light
LLRWSF	Low-Level Rad Waste Storage Facility
LTP	License Termination Plan

Acronym	Full Form
m	meter
m/s	meters per second
MAC	Monitor and Change
MAF	Main Access Facility
MARLAP	Multi-Agency Radiological Laboratory Analytical Protocols Manual
MARSSIM	Multi-Agency Radiological Survey and Site Investigation Manual
µCi/cc	microcuries per cubic centimeter
µCi/g	microcuries per gram
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
MeV	Megaelectron-Volt
MFOT	Main Fuel Oil Tank
MOB	Main Office Building
mrem	millirem
mrem/y	millirem per year
MWt	megawatts thermal
NGF	New Gatehouse Facility
NOCA	North Owner Controlled Area
NORM	Naturally Occurring Radioactive Material
NPA	North Protected Area
NRC	United States Nuclear Regulatory Commission
NRW	New Radioactive Waste
NRWT	New Radioactive Waste Pipe Tunnel
OCAB	Oyster Creek Administrative Building
OCNGS	Oyster Creek Nuclear Generating Station
ODCM	Offsite Dose Calculation Manual
ORW	Old Radioactive Waste
OSSC	Onsite Storage Container
pCi/g	picocuries per gram
pCi/l	picocuries per liter
QA	Quality Assurance
QC	Quality Control
RA	Radiological Assessments
RAGEMS	Radiation Gas Emissions Monitoring System
RCA	Radiologically Controlled Area
REMP	Radiological Environmental Monitoring Program
RGPP	Radiological Groundwater Protection Program
ROC	Radionuclide of Concern
RXB	Reactor Building

Acronym	Full Form
RXBT	Reactor Building Ventilation Tunnel
SAP	Survey Area Plan
SCP	Site Characterization Plan
SD	Standard Deviation
SEB	Site Emergency Building
SOCA	South Owner Controlled Area
SPA	South Protected Area
Spec	Spectroscopy
SSC	Systems, Structures, and Components
TBD	Technical Basis Document
TRU	Transuranic
TURB	Turbine Building
TURT	Turbine Building Ventilation Tunnel
TWST	Torus Water Storage Tank
VSP	Visual Sample Plan

2 SITE CHARACTERIZATION

2.1 Historical Site Assessment Summary

The Historical Site Assessment (HSA) (Reference 2-1) documents a comprehensive investigation that first identifies and then evaluates and classifies, on a preliminary basis, historical records and information pertaining to circumstances or events that may have resulted in radiological contamination during the operating history of the station. In addition, the HSA identifies areas of the station or systems, structures, and components (SSC) where there is a credible basis for significant or actionable contamination. In some cases, no definitive information indicates that these areas or SSC have been contaminated. Instead, the identified areas or SSC may be listed simply because of the materials used or stored there and the possibility that radiological or other contaminants may have been released to the adjacent environment.

The HSA delineates impacted areas from non-impacted areas of the site. It initially classifies the areas as Class 1, Class 2, and Class 3 to indicate the degree to which impact may have occurred based on known information. Area classifications are determined in accordance with guidance provided in NUREG-1575, Rev. 1, Multi-Agency Radiological Survey and Site Investigation Manual (MARSSIM) (Reference 2-2).

2.1.1 Objectives

The HSA is intended to assist in decommissioning planning for the Oyster Creek Nuclear Generating Station (OCNGS). The information contained within the HSA assists with planning for such activities as Site Characterization, preliminary planning for site remediation activities, and overall decommissioning scope and cost determinations.

2.1.2 Methodology

2.1.2.1 Preliminary Classification

The HSA investigation was designed to obtain sufficient information to identify the site land areas and structures as impacted or non-impacted. Impacted areas have a potential for contamination (based on historical data) or contain known contamination (based on past or preliminary radiological surveillance). Non-impacted areas are identified through knowledge of site history or previous survey information and where there is no reasonable possibility for residual radioactive contamination. Areas were classified as impacted from a radiological perspective.

The initial classification of OCNGS areas was based on historical information and available historical radiological survey data. Classifying a survey area has a minimum of two stages: initial classification and final classification. Initial classification is performed using the information available when the HSA is prepared. If the historical documentation indicated the area was impacted or likely impacted. In that case, subsequent characterization surveys evaluate the level of impact (e.g., Class 1, Class 2, or Class 3) in the areas using Final Status Survey (FSS) type survey instruments. Characterization surveys aim to resolve identified data gaps, provide additional radiological surveys comparable with FSS detection levels, and preliminarily identify areas and boundaries for future remediation and/or survey unit planning based on anticipated decommissioning scope and schedule. Surveys continue throughout decommissioning as inaccessible areas, commodities become accessible, or source terms that interfere with the desired detection sensitivities are removed. Final classification is performed and verified as a Data

Quality Objective (DQO) during FSS design. Radiological survey data from characterization surveys, operational surveys in support of decommissioning, routine surveillance, and any other applicable survey data may cause an increase or decrease in survey area classifications (e.g., from Class 3 to Class 2 and from Class 2 to Class 3) until the time of commencement of the FSS.

2.1.2.2 Documents Reviewed

The OCNGS HSA contains a compilation of event reports, issue reports, and 10 CFR §50.75(g)(1) files. Additionally, some historical evaluations on alpha contamination, tritium releases, and background Cesium were referenced in the HSA. Operational effluent and environmental process controls and annual reports were reviewed to obtain insight into the historical radionuclide profiles, dominant meteorological conditions, and areas potentially affected by routine liquid and airborne effluents containing low concentrations of radioactivity and not reported as events. Information sources for routine effluent monitoring were included in the following:

- OCNGS Offsite Dose Calculation Manual (ODCM)
- OCNGS Annual Radiological Effluent Release Reports (ARERR)
- OCNGS Annual Radiological Environmental Operating Reports (AREOR)
- OCNGS Annual Groundwater Protection Program Reports
- Hydrogeologic Investigation Reports
- Spill Prevention, Control, and Countermeasure Plan and Hazardous Waste Contingency Plan

2.1.2.3 Personnel Interviews

Interviews were conducted with long-tenured site personnel from various disciplines in 1999 when OCNGS owners considered permanent shutdown and decommissioning. A questionnaire was solicited for voluntary response regarding information related to work responsibilities and their recollection of historical contamination events that may have significance during plant decommissioning. Personnel recollections and/or anecdotal information were maintained in a database, which was retained when OCNGS was sold and remained operational. The database was used during the development of the HSA.

Station employees were consulted, especially retirees with a radiological background and solid institutional knowledge of operations and events. These individuals provided valuable and necessary information relating to events where data gaps existed, and documents were not as complete as required by 10 CFR §50.75(g)(1). Questions based on previous interview responses and recent fact findings were more specific about certain events.

2.1.3 Operational History

OCNGS, located at 741 Route 9 South Forked River, New Jersey, is a single unit boiling water reactor with a Mark I type containment. It is in Lacey Township, Ocean County, New Jersey, approximately two miles south of the community of Forked River. OCNGS was licensed to generate 1930 megawatts thermal (MWt). The reactor began commercial operation by Jersey Central Power and Light (JCP&L) on December 23, 1969.

In 1980, General Public Utilities (parent of JCP&L) assumed responsibility for the operation of OCNGS. The license was transferred to AmerGen on June 6, 1999, and then to Exelon Generation Company, LLC. on December 23, 2008. The original license was renewed to allow the unit to operate until April 9, 2029.

In February 2018, Exelon announced its plan to retire OCNGS no later than October 31, 2018, in accordance with 10 CFR §50.82(a)(l)(i) and 10 CFR §50.4(b)(8). OCNGS permanently shut down on September 17, 2018. Exelon certified to the United States Nuclear Regulatory Commission (NRC) that it had permanently removed fuel from the reactor vessel at OCNGS in accordance with 10 CFR §50.82(a)(2).

Holtec Decommissioning International, LLC (HDI) is a wholly owned subsidiary of Holtec International headquartered at the Krishna P. Singh Technology Campus, Camden, NJ. HDI functions as the licensed operator for Holtec-owned nuclear power plants. HDI provides the licensee oversight of the decommissioning work performed. HDI's goal for the project is to initiate the prompt decommissioning of OCNGS.

2.1.4 HSA Events

2.1.4.1 Radiological Events

The following is a synopsis of the radiological events described in the HSA that may be encountered during active decommissioning. The summary provides insight and information for future biased sampling or surveys, potential remedial actions, and the development of FSS Plans within each survey area.

Figure 2-1 provides a general reference to the survey areas conceived for initial characterization and are intended as major survey areas moving forward with the decommissioning. Note that the areas are not necessarily the same as described in the HSA. For example, the HSA identifies an area as the west protected area near the intake and discharge canals that is now part of the north or south protected area (SPA). The Independent Spent Fuel Storage Installation (ISFSI) is also shown east of the Radiologically Controlled Area (RCA). The ISFSI is mentioned in the HSA and the subsequent text but is not part of the characterization of the site or the License Termination Plan (LTP).

The Appendix 10.2 of the HSA includes additional entries concerning sampling and relocation of soils, spoils, and bulk materials. The radiological analyses show that identified radionuclides were either Naturally Occurring Radioactive Material (NORM) or low levels of Cs-137, likely from global fallout in the environment since no other licensed radionuclides were identified. These entries are not included in Table 2-1 to maintain brevity and focus on the survey areas that were radiologically impacted.

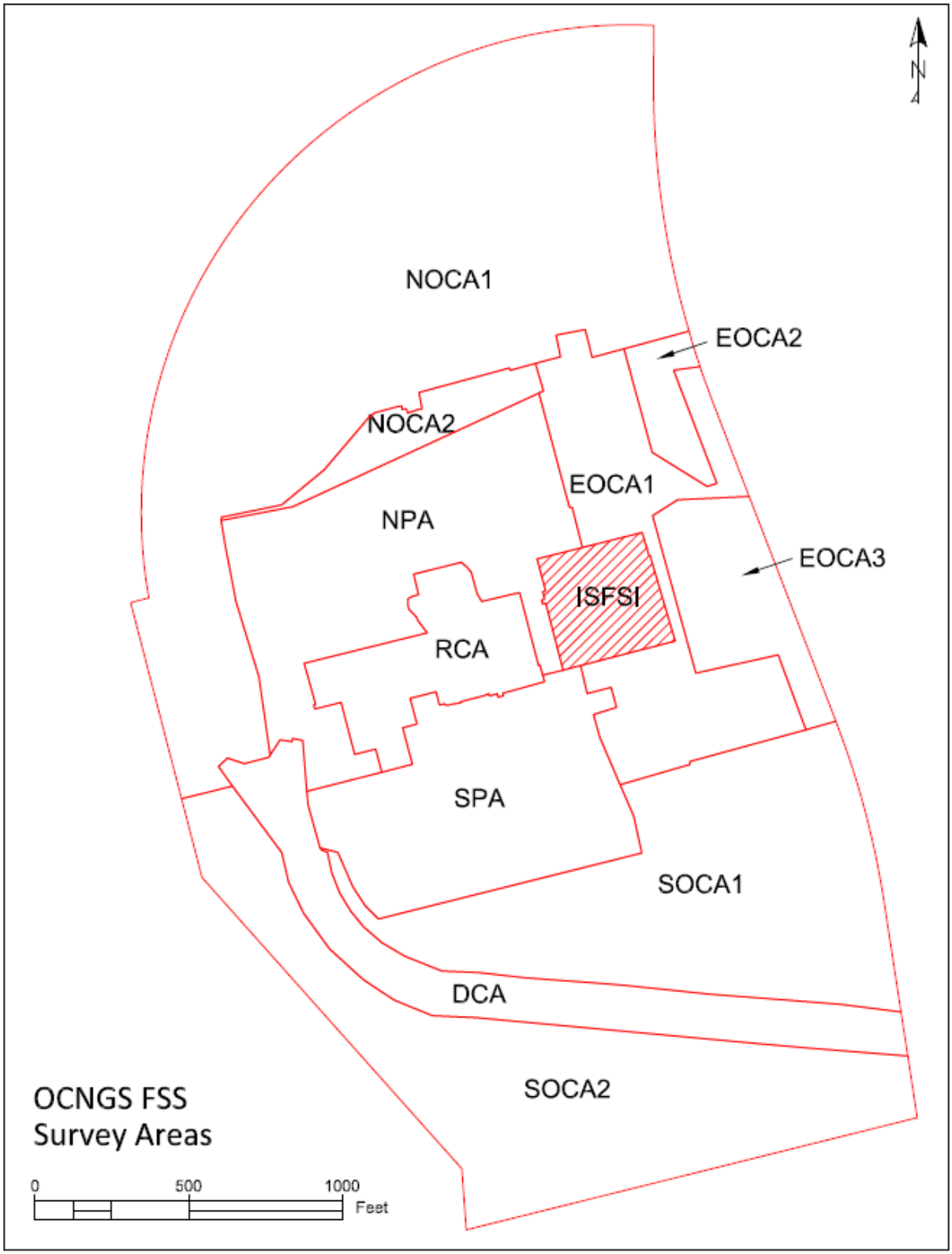


Figure 2-1 Survey Areas Within the OCNGS Site Boundary

Table 2-1 HSA Events

Approx. Date	North Owner Controlled Area (NOCA)1 Events	HSA Reference
	The NOCA1 area has a spoils pile to the north of East Owner Controlled Area (EOCA)1 from various site operational construction activities, with reported trace levels of Cs-137.	7.2.1.3.7. p171
2004	2004 Soil sampling was conducted as part of the Design Basis Threat (DBT) project. RP-OC-1001-07-004, in 2007, soil, brush, cement, and asphalt were removed from the northeast corner of the owner-controlled area. A survey plan was developed prior to the removal. This evaluation was to support the DBT project. RP-OC-1 001-07-004, Removal of 560 cubic yards of concrete; RP-OC-1001-07-005, Removal of 400 cubic yards of brush and soil; RP-OC-1 001-07-006, Removal of 15-20 cubic yards of dirt, wood, cement, and asphalt; In 2008 a detailed RP-AA-228 Attachment 1 was completed to capture the radiation protection calculation and position papers documenting the release surveys and results for the DBT spoils relocated north of the fuel pumps.	p239

Approx. Date	South Owner Controlled Area (SOCA)1 Events	HSA Reference
	None Found	

Approx. Date	SOCA2 Events	HSA Reference
2/24/04	Canal Roadway sample identified NORM	p232

Approx. Date	EOCA1 Events	HSA Reference
	New Gas Station - receiving area for the relocation of the DBT spoils described above	p230

Approx. Date	North Protected Area (NPA) Events	HSA Reference
	Demineralizer Water Storage Tank (DWST) – structure has been removed, but subgrade is to be evaluated.	7.2.1.2.3. p146
	Low-Level Rad Waste Storage Facility (LLRWSF) – trenches, sumps	7.2.1.3.4. p165
1987 and 1991	The Condensate Storage Tank (CST) in the RCA and the Torus Water Storage Tank (TWST) outside the RCA had a history of spills and pipe leaks contaminating soils outside the area. A valve on the CST froze and broke in 1987, releasing contaminated water to the soil, and the CST bottom leaked in 1991. The CST has been demolished to grade. Some cut and capped underground piping is expected.	7.2.1.3.12. p181
1993	The TWST had a valve leak that released approximately 50-gallons of liquid to the ground. Spills, leaking piping, and the use of an externally contaminated fire hose spread contamination to the sand and gravel. These soil and gravel were remediated and removed in drums. The TWST has been demolished to grade. Some cut and capped underground piping is expected.	7.2.1.2.11. p157

Approx. Date	North Protected Area (NPA) Events	HSA Reference
1994	The DWST had underground piping capped and abandoned in place due to a history of leakage. The demineralized water system was cross-contaminated with fuel pool water. Most of the system was thoroughly flushed. The DWST has been demolished to grade. Some cut and capped underground piping is expected.	7.2.1.2.3. p146
4/18/01	Soil samples taken at the dirt pile north of the New Maintenance Building - Co-60 was reported as not identified to a maximum of 6.98E-07 µCi/g; Cs-137 was reported as not identified to a maximum of 6.98E-08 µCi/g	p232
5/19/95	Soil samples were taken at accessible locations to support construction of the site protective barriers. Samples showed no activity greater than background (bkg). Samples were taken on the surface and at a depth of 1 foot along the south side of the access road to LLRWSF, as well as surface samples taken inside the nuisance fence at gate 6.	p231
10/16/03	South Side of Warehouse - Cs-137 2.16E-08 µCi/gm	p232
2009	Elevated tritium levels were identified in water pumped out of a concrete vault containing Emergency Service Water (ESW) cables. The cause was determined to be from leaks in the 8 inch and 10-inch carbon steel condensate transfer system lines SS-4 and CS-24 respectively.	7.2.1.3.12. p181
	STORAGE OF DRYWELL HEAD SEGEMENTS IN OUTDOOR RMA - Contaminated drywell head segments are being stored in a Radioactive Materials Area (RMA) recently established near the Redundant Fire Water Tank in the west protected area. The segments are to be stored for a time when their ultimate disposition for disposal is decided and arranged. The area is posted, segments are wrapped with external contamination levels less than 1000 dpm/100cm^2, and the segments are covered to protect from the weather.	p248 and 7.2.1.2.9. p155

Approx. Date	SPA Events	HSA Reference
5/6/1993	SOIL SAMPLING PRIOR TO BUILDING THE NEW OFFICE BUILDING - Prior to the construction of the new Oyster Creek Administrative Building (OCAB), soil sampling was conducted (see memo 6632-93-008A dated 5/6/1993). All but two locations were less than the minimum detectable concentration (MDC). These two locations were the grass area by the hydrogen storage tanks and the grass/dirt area between the main parking lot and the main road. Additional sampling was conducted in July 1993.	p228
9/4/97	A 30-cubic-yard dumpster containing a mixture of intake screen debris and low levels of radiologically contaminated soil was inadvertently transported off-site and disposed of in the landfill. Soil was returned and placed in an area next to the Old Radioactive Waste (ORW) Surge Tank in the RCA. The berm storing this material and its contents were removed for demolition of the ORW Surge Tank.	p227
1/6/00	1/6/00 Surface soil mound west of south parking lot identified NORM	p232
12/19/05	15 soil samples taken at the proposed overflow parking lot identified NORM. Map of sample locations included in the file.	p232

Approx. Date	SPA Events	HSA Reference
2/1/06	Soil samples taken at the proposed overflow parking lot identified NORM. Map of sample locations included in the file.	Hp232
2015	2015 ASPHALT SAMPLING - Sampling and on-site analyses by gamma spectroscopy were performed from asphalt located in a former parking lot south of the OCAB. The approximate area was 50 feet by 150 feet. A review of the 10 CFR §50.75(g)(1) files did not identify radioactive material in or moved to the area. Radiation Protection specified that ten random core samples be collected and then analyzed by high purity germanium detector. Results did not identify licensed material associated with the operation, with only NORM being reported or identified by energy line analysis. This entry was made to document the survey and results for future reference. The results can be found on the common drive under K:\Radcon\RadiologicalEngineering\10CFR50.75(g)(1)\OCAB 2015 Asphalt Project.	p242
	SOIL RELOCATION FROM NORTH OF OCAB - This entry documents information relevant to site characterization and survey in accordance with §20.1402 Radiological criteria for unrestricted use. Soil and large landscape wall blocks were removed from three locations north of the OCAB building. Approximately 862 m^3 (1,127 yd^3) of materials were moved when the project was completed in March 2019. The location for the materials was the north yard west of LLRWSF. Plans are to locate some or all of the large landscape wall blocks to the intake and/or discharge structures for the Security modification. A review of this list and the §50.75(g)(1) files indicate these materials were brought to the Station for landscaping purposes. The large wall blocks are planned for reuse to support the intake structure modification project. Two samples were collected and analyzed onsite by gamma spectroscopy. Trace levels of Cs-137 were identified along with NORM. The Cesium was much less than 1% of the NRC screening value. No other licensed radioactive material was identified. Sample 6948 3.04E-02 pCi cm^{-3}; Sample 6949 4.64E-02 pCi cm^{-3}.	p244

Approx. Date	DCA Events	HSA Reference
	Sediment represents a likely scenario for contamination based on the previous history of overboard discharges and the restoration of an overboard radioactive release in 2019.	7.2.1.6. p194 and 7.3.7. p198
2/2/2006	During demobilization from the Alpha Main Condenser tube cleaning, the brushes used to clean the water box tubes unexpectedly alarmed the Small Article Monitor (SAM). It was discovered that the water supply used to brush clean the condenser tubes was from the Condensate Transfer system, not Demineralized Water as required. An estimated discharge of 11,250 gallons of condensate transfer water occurred.	p233

Approx. Date	NOCA2	HSA Reference
1982	The Site requested and received NRC approval to relocate contaminated soil under a §20.302(a) disposal provision. Approximately 17,000 cubic feet of soil were transferred from the RCA to an area that is believed to be the north parking lot. The actual location is not known. The disposal method was burial in shallow trenches below a minimum cover of six inches of clean soil. The submittal indicated that the area would be asphalt-capped in the future, but that could not be validated. Cobalt-60 was reported as not identified to a maximum of 39,006 pCi/kg (3.91E-05 µCi/g); Cesium-137 was reported as 5,730 pCi/kg (5.73E-08 µCi/g) to a maximum of 28,366 pCi/kg (2.84E-05 µCi/g). The radionuclides Cs-134 and Mn-54 were also reported but are expected to be less than the MDC at time of FSS due to radiological decay.	7.2.1.3.5. p167 and General Public Utilities Nuclear Request

Approx. Date	RCA Events	HSA Reference
	According to historical records and interviews, many areas in the RCA Yard were the site of spills. Areas were remediated or paved over to contain radioactive material. The yard sewer drains are believed to be contaminated from spills and the operation of the isolation condensers.	7.2.1.3.8. p173
	Contamination was identified south of the Reactor Building (RXB) following a laundry drain line leak.	7.2.1.5.2. p190
1982	Samples collected in near the ORW loading dock identified radioactive concentrations exceeding the default screening values for release	7.2.1.5.2. p190
1982	Core bore sampling was conducted at the ORW Surge Tank and completed on 9/29/1982. The samples did not include analysis for Transuranics (TRU).] -60 was reported as not identified to a maximum of 79,807 pCi/kg (7.98E-05 µCi/g); Cesium-137 was reported as 125 pCi/kg (1.25E-07 µCi/g) to a maximum of 125,780 pCi/kg (1.26E-04 µCi/g). The radionuclides Cs-134 and Mn-54 were also reported but are expected to be less than the MDC due to radiological decay. The ORW Surge has been demolished to grade. Some cut and capped underground piping is expected in the soil and adjacent underground vaults.	p230
4/1/1986	During Drywell Chiller Pad Installation (See Memo 9300-86-0073), 504 cubic feet of soil with low levels of Co-60 and Cs-137 were removed and distributed in a non-paved area of the RCA yard.	p231
10/30/1998	Contaminated Soil Summary is provided in the HSA and lists several areas where subsurface radiological contamination is expected.	p226
11/8/2002	Five (5) samples were collected west of New Radioactive Waste (NRW) in RCA. Cobalt-60 was reported as not identified to a maximum of 4.12E-08 µCi/g; Cesium-137 was reported as 4.52 x E-08 µCi/g to a maximum of 7.13E-08 µCi/g.	p232

Approx. Date	RCA Events	HSA Reference
5/8/2004	Radioactive material was found on and inside of a storm drain east of NRW within the RCA. Samples collected of the silt in the storm drain identified Co-60, Cs-137, Mn-54, and K-40 were reported as 1.67E-06 µCi/g to a maximum of 1.39E-05 µCi/g. Material was removed from on and inside the storm drain.	p233
7/17/2007	The area under the isolation condensers was found contaminated after auto initiation of the isolation condensers.	7.2.1.3.8. p173 and RP-OC-1001-10-002
2/2009	Following a plant shutdown, dripping water from the Bravo Isolation Condenser was observed. This water had an activity concentration for tritium of 2.19E-05 µCi/cc. No gamma activity was identified.	p239
	Radiological spills in the RCA are described in the HSA and are not reiterated. The extensive remediation that is required in this area precludes assessment until source terms are removed and remediation nears completion. Most of the structures will be assessed for waste disposal as decommissioning progresses. The remaining structures or partial structures will be evaluated for compliance with license termination requirements.	

2.1.4.2 Historical Tritium Evaluations

Intake and Discharge Canal Structures: Tritium in below-grade structure (bgs) concrete and evaluation of wooden stop logs (HSA 7.2.1.1.19. p71).

NOCA1: Fish Sample Pond sediment – tritium and Dilution Pump House- bgs concrete – tritium. This is potentially contaminated media and recommended future investigation activity (HSA 7.2.1.1.15. p63).

1991 Lysimeter Collection: Tritium was found in water samples collected from locations on both sides and down the gradient of the CST (HSA p227).

2006 TRITIUM PROJECT: In 2006, a tritium project was conducted to characterize the OCNGS relative to tritium (HSA p238).

2009 TRITIUM IN ESW VAULT: In 2009, elevated tritium levels were identified in water pumped out of a concrete vault containing ESW cables. Investigation of the issue determined that leaks in the 8-inch and 10-inch carbon steel Condensate Transfer System lines, SS-4 and CS-24, respectively, caused tritiated water release. The original record dated 16 June 2009 was revised. The change was driven by new information and calculations, leading to a lower release of activity than originally estimated and subsequent lowering of dose (HSA p239).

2.1.4.3 Historical Alpha Evaluations

A site alpha assessment was performed in 2008 in accordance with RP-AA-302 Determination of Alpha Monitoring Levels (Reference 2-3). The initial alpha assessment has been updated to include smears collected and analyzed in components and areas that were both previously determined to be of higher for significant relative abundance of TRU or are suspect and not

previously evaluated. Additionally, alpha analyses are performed during routine surveys as required by RP-AA-302 based on the classification of the area or component. Ratios were determined between gross beta-gamma results and gross alpha-measurement results. Levels were determined based on the ratios and risk of alpha contamination. Radiation Protection calculation and position paper OC-16-008 2016 – Alpha Characterization Refuel Outage 1R26 (Reference 2-4), documents the latest update to the area and systems classification based on data obtained during refuel outage 1R26. This action is required by RP-AA-302.

OCNGS ceased permanent operation on 17 September 2018 at 12:33. As OCNGS enters decommissioning, accurate site characterization becomes more important to future decommissioning planning. Radiation Protection calculation and position paper OC-16-008 addresses the changes to current alpha characterizations and classifications due to the differences in half-lives between the easy-to-detect beta-gamma emitters and the hard-to-detect (HTD) TRU alpha emitters (HSA, p35, p39, p40, p41, p249-251).

2.1.4.4 Historical Cs-137 Background Evaluation

2007 CESIUM PROJECT: In 2007, a study was undertaken to characterize the bkg Cesium levels in and around OCNGS (HSA, p238).

2.1.4.5 Historical ISFSI Evaluations

SOIL SAMPLING PRIOR TO ISFSI CONSTRUCTION: Initial samples were taken on 8/6/1992 in the area north of the contractor parking, including all of level D storage and the fuel pump area. Soil samples were collected from various areas in and around the level D storage and current gas station site (HSA p73, p226, p229, p241).

ISFSI (berm on south side contains excavated soil).

2011 AREAS POTENTIALLY IMPACTED BY PLANT OPERATION: Several areas were identified by NRC that could be, or might have been, impacted by plant operation, which would be of interest during the preparation of the decommissioning HSA and LTP. These included: a swale east of the ISFSI is a collection point for drainage from the ISFSI pad; soils from the CST project have been relocated from their original location on site; spoils have been generated and relocated from the ISFSI pad project, Well 73, and Main Transformer project (HSA p241).

2.1.4.6 Non-Radiological Events

No noteworthy non-radiological events affecting decommissioning were found. There is further discussion regarding the environmental impacts of decommissioning in Chapter 8.

2.1.5 Initial Survey Areas and Classification

Seventy-eight (78) locations of interest on the site have been evaluated for the potential for radiological impact. The locations of interest are subdivided into SSC (47), exterior tanks (11), open land areas (12), subsurface SSC (1), subsurface soil (5), and the Intake and Discharge Canals (2). All areas of interest have been determined to be radiologically impacted. The areas have been initially classified as either MARSSIM Class 1 (27 total), Class 2 (14 total), Class 3 (20 total), and composite MARSSIM Class (3 total) when the MARSSIM classification applied (i.e., SSC, exterior tanks, and open land areas). Some SSC described by revision 1 of the HSA are no longer physically intact or present at the Site.

2.1.6 Initial Survey Areas and Classification

2.1.6.1 Survey Areas

The entire 152-acre OCNGS site was divided into preliminary survey areas, and initial classifications were assigned based on operational history and the incidents and processes documented for a specific survey area. The survey areas established by the HSA and the OCNGS Site Characterization Plan (SCP) (Reference 2-5) were used as initial survey areas for characterization. A survey area is a structure, portion of a structure, open land area, or system surveyed and evaluated as a single entity. Survey areas were delineated as physical areas with similar operational history or similar potential for residual radioactivity. A summary of the initial survey area classifications is presented in the following sections.

2.1.6.2 Class 1 Open Land Areas

Table 2-2 presents the open land areas initially classified as impacted Class 1. The bases for the initial classification are the open land proximity to Class 1 structures, events documented in the HSA that resulted in localized soil contamination outside building structures, and the location of the waste haul path and waste loadout structures.

Table 2-2 Class 1 Open Land Survey Areas

Survey Area	Structure Description	Classification
RCA	Radiologically Controlled Area (RCA) Yard	1
NOCA2	North Owner Controlled Area – North Parking Lot	1

Class 1 areas have potential radioactive contamination at concentrations greater than the site release criteria. The Class 1 open land survey areas are illustrated in Figure 2-1.

2.1.6.3 Class 2 Open Land Areas

Table 2-3 presents the open land areas that have been initially classified as impacted Class 2. Class 2 areas have a potential for radioactive contamination at concentrations expected to be less than the site release criteria.

The Class 2 open land survey areas are illustrated in Figure 2-1. EOCA1 was initially treated as a Class 2 area and based on additional information gathered during characterization, the wooded areas have been recharacterized as Class 3 and subsequently carry the designation EOCA2 and EOCA3.

Table 2-3 Class 2 Open Land Survey Areas

Survey Area	Structure Description	Classification
NOCA1	North Wooded Area	2
DCA	Discharge Canal Area	2
EOCA1	East Wooded Area	2
EOCA1	Main Parking Lot	2
NPA	North Protected Area	2
EOCA1	Northeast Parking Lot	2
SPA	South Protected Area	2
NPA/SPA	West Protected Area	2

2.1.6.4 Class 3 Open Land Areas

Table 2-4 presents the open land areas that have been initially classified as impacted Class 3. Class 3 areas are expected to have residual radioactivity at a small fraction of the site release criteria.

Table 2-4 Class 3 Open Land Survey Areas

Survey Area	Structure Description	Classification
NOCA1	Intake Canal	3
NOCA1	North Wooded Area	3
SOCA1	South Parking Lot	3
SOCA1/SOCA2	South Wooded Area	3

The Class 3 open land survey areas are illustrated in Figure 2-1.

2.1.6.5 Class 1 Structures

Table 2-5 below, the Class 1 structures are the RXB, the Turbine Building (TURB), and the Radwaste Processing Buildings. The structures contain the nuclear reactor, primary reactor systems, reactor support systems, radioactive waste systems, and nuclear fuel handling and storage systems. Radioactive material was routinely handled, transferred, and stored within these buildings during operations. Throughout facility operations, these structures were subjected to spills of radioactive liquids, the spread of loose surface contamination, and airborne radioactive material.

Most of these Class 1 buildings and structures are planned for source-term removal, demolition, and remediation or waste disposal during decommissioning. Limited characterization was performed during the initial characterization of the site. Characterization to support waste disposal efforts is sufficiently understood.

Table 2-5 Class 1 Structure Survey Areas

Survey Area	Structure Description	Classification	End State
RCA	Augmented Offgas (AOG)	1	Demolish
RCA	Boiler House	1	Demolish
RCA	Building 3 Old Machine Shop	1	Demolish
NPA	Condensate Transfer Pump House	1	Demolish
RCA	Drywell Processing Center	1	Demolish
RCA	Hot Machine Shop/Hot Tool Room	1	Demolish
NPA	Low-Level Rad Waste Storage Facility	1	Remain
RCA	Monitor and Change (MAC) Facility	1	Demolish
RCA	Main Office Building (MOB)	1	Demolish
RCA	New Sampling/Service Water Monitor Buildings	1	Demolish
RCA	New Radioactive Waste (NRW) Building	1	Demolish
RCA	Old Radioactive Waste (ORW) Building	1	Below grade Remain
RCA	ORW North Annex/RCA Onsite Storage Container (OSSC)	1	Demolish
RCA	Reactor Building (RXB)	1	Below Grade Remain
RCA	Respirator Facility	1	Demolish
RCA	Scaffold Building	1	Demolish
RCA	Stack and Base of Stack (BSTK)/Stack Radiation Gas Emissions Monitoring System (RAGEMS)	1	Below Grade Remain

Survey Area	Structure Description	Classification	End State
RCA	Turbine Building (TURB)	1	Below Grade Remain
RCA	Turbine RAGEMS Building	1	Demolish
RCA	Condensate Water Storage Tank	1	Demolish
RCA	ORW Surge Tank	1	Demolish
RCA	Outside Tank and Enclosure	1	Demolish

2.1.6.6 Class 2 and 3 Structures

The primary functions of Class 2 and 3 structures are to act as maintenance, office, warehouse, or security space. Table 2-6 Below is a list of the Class 2 and 3 structures in relation to the OCNGS protected area. Most of these structures did not routinely house radioactive systems or materials during operations. However, it was possible, due to their physical proximity to effluent release pathways, temporary storage, and transport of radioactive materials in and through these buildings, and past incidents involving the loss of control of radioactive material, that residual radioactive material could be found in, on, or around these structures. Consequently, the initial Class 2 or 3 designations are justified. Structure survey areas are depicted in Figure 2-2 and Figure 2-3.

Initial MARSSIM Structure Classifications at OCNGS		
MAP ID	Building Name	MARSSIM Class
1	AOB	N/A
2	AOG	1
3	Boiler Houses	1
4	Breathing Air Compressor Building	3
5	Building 3 Old Machine Shop	1
6	Building 4 Site Storage Building	N/A
7	Chlorination Building	3
8	Clean Rigging and Storage Trailers	3
9	Condensate Transfer Pump House	1
10	Contractor Trailer Complex (CB&I)	N/A
11	Diesel Generator Building	3
12	Dilution Pump House	2
13	Drywell Processing Center	1
14	Fire Water Pump House	3
15	Fish Sample Pond	2
16	Hazard Collection Building	3
17	Hot Machine Shop/Hot Tool Room	1
18	Intake and Discharge Structure	2
19	ISFSI	1
20	Level D Building	3
21	LLRWSF	1
22	MAC Facility	1
23	MAF	2
24	Main Gate Security Center	2
25	Maintenance Supervisor Building	N/A
26	MOB - Office Building	1
27	New Maintenance Building	N/A
28	New Sampling/Service Water Monitor Buildings	1
29	NRW Building	1
30	NRW Chlorination Facility	3
31	OCAB	3
32	ORW Building	1
33	ORW North Annex/RCA OSSC	1
34	Pretreatment Building	3
35	Reactor Building	1
36	Respirator Facility	1
37	Scaffold Building	1
38	SEB	3
39	Stack and Base of Stack/Stack RAGEMS	1
40	Turbine Building	1
41	Turbine Generator Services Trailer	2
42	Turbine RAGEMS Building	1
43	Warehouse	2

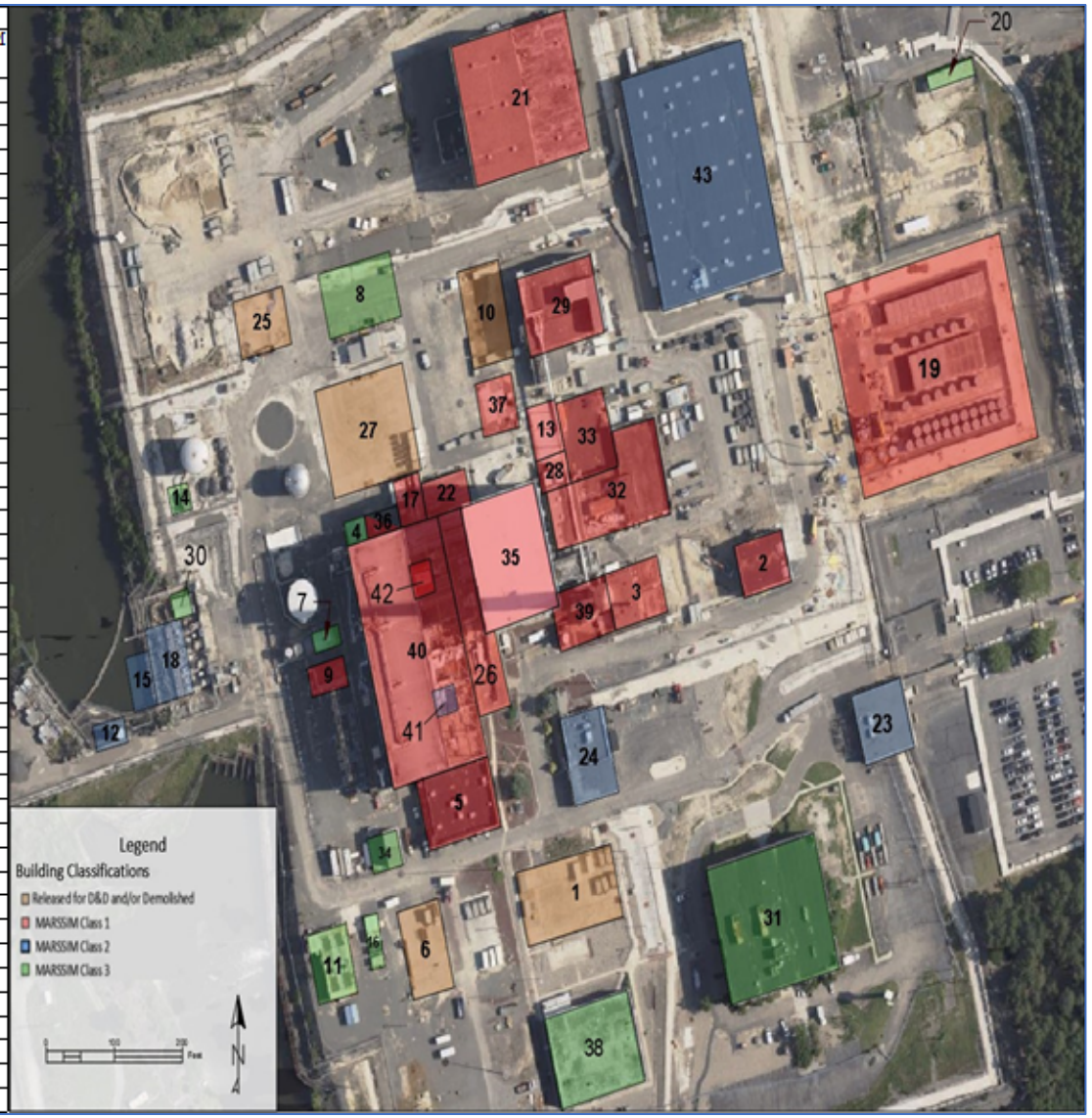


Figure 2-2 Initial MARSSIM Structure Classifications at the OCNGS

Initial MARSSIM Structure Classifications at OCNGS		
MAP ID	Building Name	MARSSIM Class
1	CST / DWST	N/A
2	Dirty Oil New DWT	1
3	Liquid Nitrogen Tank	1
4	MFOT	3
5	ORW Surge Tank	1
6	Outdoor Tank & Enclosure	N/A
7	Redundant Fire Water Tank	3
8	Sodium Hypochlorite Storage Tanks	3
9	TWST	1



Figure 2-3 Initial MARSSIM Outdoor Tank Classifications at OCNGS

Table 2-6 Class 2 and 3 Structure Survey Areas

Survey Area	Structure Description	Classification	End State
RCA	Breathing Air Compressor Building	3	Demolish
NPA	Chlorination Building	3	Demolish
NPA	Clean Rigging and Storage Trailers	3	Demolish
SPA	Diesel Generator Building	3	Demolish
NOCA1	Dilution Pump House	2	Remains
NPA	Fire Water Pump House	3	Demolish
NOCA1	Fish Sample Pond	2	Demolish
SPA	Hazard Collection Building	3	Demolish
NPA	Intake and Discharge Structures	2	Remains
EOCA1	Level D Building	3	Demolish
SPA	Main Access Facility (MAF)	2	Remain
SPA	Main Gate Security Center	2	Demolish
NPA	NRW Chlorination Facility	3	Demolish
SPA	Oyster Creek Administrative Building (OCAB)	3	Remain
NPA	Pretreatment Building	3	Demolish
SPA	Site Emergency Building (SEB)	3	Remain
RCA	Turbine Generator Services Trailer	2	Demolish
NPA	Warehouse	2	Remain
NPA	New Demineralized Water Tank	3	Remain
RCA	Main Fuel Oil Tank (MFOT)	3	Demolish
NPA	Redundant Fire Water Tank	3	Demolish
NPA	Sodium Hypochlorite Storage Tank	3	Demolish

2.2 Characterization Approach

The OCNGS site was characterized in accordance with the SCP, which was developed to provide guidance and direction to the personnel responsible for designing and implementing characterization survey activities. Implementation of the SCP is accomplished using approved procedures and area-specific Survey Area Plans (SAP)s, which ensure the implementation of requirements in the SCP and govern the specific survey/sampling activities within the targeted area.

Characterization data acquired through the execution of the sample plan is used to meet three primary objectives:

- Provide radiological inputs necessary for the design of FSS.
- Develop the required inputs for the LTP and dose assessments.
- Support the evaluation of remediation alternatives and technologies.

Characterization efforts focused on open land areas, subsurface structures, and structures intended to remain after License Termination that will be subjected to FSS. In accordance with NUREG-1757, Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria (Reference 2-6), Volume 2, Appendix O, extensive characterization of equipment, systems, or structures that will be removed before the performance of FSS is not required.

Characterization surveys collect data using instrumentation with sensitivities similar to those used during FSS surveys to confirm the preliminary classification. The appropriate classification of a survey unit is critical to the survey design for FSS. A classification that underestimates the potential for contamination could result in a survey design that does not obtain adequate information to demonstrate that the survey unit meets the release criteria. In some cases, this can increase the potential for making decision errors.

- Bounding site-specific Derived Concentration Guideline Levels (DCGL)s were used for the OCNGS when the characterization surveys were performed; action levels were based on the bounding DCGLs.

As stated in the NUREG-1757 guidance, the models, scenarios, and parameters used to develop the screening values were intended to be conservative. The lack of information about a site warrants the use of conservative models and default conditions to ensure that the derived dose is not underestimated.

2.2.1 Data Quality Objectives

DQOs were implemented for characterization surveys like that anticipated for FSS. However, the goal of characterization is contamination quantification and delineation of the nuclide suite. In contrast, the FSS goal is data comparison against the null hypothesis of the Sign test as defined by MARSSIM. Characterization inspections and surveys of sufficient quality and quantity were performed to determine the nature, extent, and range of radioactive contamination in each applicable survey area, including applicable structures, residues, soils, and surface water.

The seven steps in the DQO development process are as follows:

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.
7) Optimize the design for obtaining data.

The DQOs for site characterization included identifying the types and quantities of media to collect. Soils and structural concrete were sampled volumetrically. Sufficient measurements were obtained to achieve statistically significant results so that the mean and maximum activity and the sample standard deviation (SD) could be determined. Direct measurements and scans of structural surfaces and surface soils were made using the same instruments and MDCs planned for use during FSS. Volumetric samples that exhibited the highest activity were sent to an off-site laboratory for analysis of HTD radionuclides.

2.2.2 Radionuclides of Concern

Information collected and reviewed during the HSA did not identify specific radionuclides or a uniform mix of radionuclides suitable for use during characterization surveys. Based on the elimination of some of the theoretical neutron activation products, noble gases, and radionuclides with a half-life of less than two years, the suite of Radionuclides of Concern (ROC) for OCNGS decommissioning was prepared and is shown in Table 2-7. The complete technical basis for the ROCs can be found in OCNGS Technical Basis Document (TBD) 20-6002-1362 Revision 1 (Reference 2-7).

Table 2-7 Radionuclides of Concern

ROC	Half-Life (y)	ROC	Half-Life (y)
Am-241	4.32E+02	Nb-94	2.00E+04
C-14	5.70E+03	Ni-63	1.00E+02
Cm-243	2.91E+01	Np-237	2.14E+06
Cm-244	1.81E+01	Pu-238	8.77E+01
Co-60	5.30E+00	Pu-239	2.40E+04
Cs-137	3.00E+01	Pu-240	6.58E+03
Eu-152	1.30E+01	Pu-241	1.40E+01
Eu-154	8.60E+00	Sb-125	2.76E+00
Fe-55	2.70E+00	Sr-90	2.90E+01
H-3	1.20E+01	Tc-99	2.10E+05
Mn-54	8.56E-01		

2.2.3 Assessment Criteria

Subsequently, using screening values as action levels during characterization reasonably assures that a survey area is conservatively classified. The Assessment Criteria (AC) used for characterization data evaluation are provided below Table 2-8. The AC are based on the 15 mrem/y annual dose criteria in the New Jersey Administrative Code to ensure compliance with the NRC unrestricted release criteria. The resident farmer scenario was used initially as a conservative model.

Following initial characterization efforts of surface soil and above-ground structures, DCGLs were developed for an industrial use (IU) scenario. In 2023, characterization efforts were undertaken to evaluate subsurface concrete structures within the RCA, intended to remain after license termination. The IU scenario concrete AC were developed as part of a basement fill model scenario and are based on the 15 mrem/y criteria.

Table 2-8 Assessment Criteria

ROC	Resident Farmer Soil (pCi/g)	Building Occupancy (dpm/100cm^2)	Industrial Use Concrete (pCi/g)
Am-241	1.6E+01	9.9E+02	3.0E+04
C-14	1.7E+00	3.9E+06	6.7E+04
Cm-243	5.3E+01	1.4E+03	7.5E+04
Cm-244	2.9E+01	1.8E+03	7.5E+04
Co-60	2.4E+00	8.1E+03	3.3E+02
Cs-137	5.8E+00	2.8E+04	1.5E+03
Eu-152	5.9E+00	1.6E+04	7.3E+02
Eu-154	5.4E+00	1.5E+04	6.7E+02
Fe-55	3.1E+04	2.3E+07	3.5E+08
H-3	3.0E+02	1.3E+08	2.1E+06
Mn-54	1.0E+01	3.2E+04	1.4E+03
Nb-94	4.2E+00	1.1E+04	5.1E+02
Ni-63	4.3E+02	9.8E+06	3.2E+08
Np-237	6.6E-01	8.0E+02	2.4E+03
Pu-238	1.3E+01	1.1E+03	9.1E+03
Pu-239	1.7E+01	1.0E+03	1.2E+04
Pu-240	1.7E+01	1.0E+03	1.2E+04
Pu-241	5.3E+02	4.1E+04	1.0E+06
Sb-125	1.8E+01	4.5E+04	2.3E+03
Sr-90	1.1E+00	4.9E+04	1.8E+05
Tc-99	9.4E+00	3.0E+06	5.7E+05

2.2.4 Survey Design

Characterization surveys were designed and performed in accordance with procedures, the SCP, and approved SAPs. The survey design incorporated a graded approach based on the DQOs for each survey area.

There are three approaches to survey design: biased (judgmental), systematic, or random. Biased survey designs use known information or process knowledge to select locations for static measurements or samples. Systematic survey design, usually only utilized for FSS, selects static measurement or sample locations using a systematic sampling design (typically a square or triangular grid) with a random start. Random survey design selects static measurements or sample locations randomly. The decision of whether to perform the survey design using a judgmental, systematic, or random approach was addressed by the DQO process. A judgmental approach was warranted when the characterization effort was designed to delineate the extent of an area that requires remediation. Alternatively, a systematic or random approach was warranted if the characterization effort was designed to verify the basis for classification. Characterization surveys of Class 2 and Class 3 survey units utilize random and judgmental approaches to survey design. For Class 1 survey units, samples are primarily judgmental.

2.2.4.1 Number of Static Measurements or Samples

The number of measurements or samples taken in each survey unit was determined by assessing the population size necessary to satisfy the DQOs.

For the characterization of Class 1 survey units, the number of static measurements or samples was of sufficient quality and quantity to satisfy the DQO decision in the professional judgment of the responsible radiological engineer.

The characterization of Class 2 survey units, the minimum number of systematic measurements in each unit was commensurate with the probability of residual radioactive contamination. The number of samples or measurements was determined based on the survey objectives, the expected level of contamination, and the variability of the radioactive material distribution. This approach ensured that the sample size was sufficient to provide statistically significant results, allowing for a robust assessment of the mean contamination levels and their variability.

For Class 3 survey units, the primary characterization DQO is to establish the basis for the Class 3 or non-impacted classification. Consequently, the population of random measurements or samples was sufficiently robust so that the basis for the classification presented a high degree of confidence that no licensee-generated radioactive material resides in these areas. Since the recommended survey unit size for Class 3 is unlimited, additional measurements or samples above the minimum population calculated may be necessary to address this DQO.

2.2.4.2 Determination of Survey Locations

For impacted survey units, the responsible radiological engineer determined the location of measurements or samples to be taken in each survey area. For judgmental measurement or sample locations, consideration was given to locations containing measurable radioactivity, depressions, discolored areas, cracks, low-point gravity drain points, actual and potential spill locations, or areas where the surface had been disturbed. Historical information found in the HSA aided in judgmental location selection.

For Class 1 survey areas, the location of measurements or samples was biased to suspect areas. For Class 2 and 3 survey areas, the location of measurements or samples was chosen randomly and augmented with biased measurements or samples, as necessary. Sample locations were determined by generating random coordinates corresponding to specific locations within a survey area. This was accomplished using a random number generator or using the computer software Visual Sample Plan (VSP).

2.2.4.3 Scan Coverage

Survey areas were scanned according to their classification. The scan areas in each area were determined using professional judgment during the survey design process.

2.2.5 Types of Measurements and Samples

The characterization survey of building surfaces consisted of scans (alpha, beta, and gamma), static measurements, and smears. The open land area characterization survey consisted of surface gamma scans, static gamma measurements, and volumetric samples. The characterization survey of subsurface structures consisted of gross alpha/beta scans, static measurements, smears, and volumetric concrete samples. The following is a description of the distinct types of measurements and samples that were utilized.

2.2.5.1 Static Measurements

Static measurements were performed to detect total surface contamination on structural surfaces of the buildings or asphalt paved areas. These measurements were performed using a 126 cm^2 gas flow proportional detector (Ludlum Model 43-68), 88 cm^2 plastic scintillation detectors (Ludlum Model 43-93), and gamma scintillation detectors (Ludlum Model 44-10).

Static measurements were conducted by placing the detector near the surface to be counted and acquiring data over a pre-determined count time. A count time of one minute was used for surface measurements and generally provides detection levels well below the action level. Instrument count times could be adjusted, as appropriate, to achieve an acceptable MDC for static measurements. Adjustments to count times were controlled procedurally with management oversight.

2.2.5.2 Alpha/Beta Surface Scans

Scanning was performed to locate areas of residual activity above the investigation level. Alpha/Beta scans were performed over accessible surfaces, including floors, walls, and roofs. Cart-mounted gas flow proportional detectors (Ludlum Model 43-37), hand-held gas flow proportional detectors (Ludlum Model 43-68), and plastic scintillation detectors (Ludlum Model 43-93) were used for scans of structural surfaces.

Alpha/Beta scanning was performed with the detector position maintained within 1.27 cm (0.5 in) of the surface and with a scanning speed of one detector active window per second. If surface conditions prevented scanning at the specified distance, the detection sensitivity for an alternate distance was determined, and the scanning technique was adjusted accordingly. Scanning speed is calculated *a priori* to ensure the MDC for scanning was appropriate for the stated objective of the survey. Adjustments to scan speed and distance could be made when necessary. Adjustments to scan speed and distance were controlled procedurally with management oversight.

Technicians monitored the survey instrument's audible response to identify elevated activity locations that required further evaluation. Areas of elevated contamination located during scan surveys were identified for further investigation.

2.2.5.3 Gamma Surface Scans

Gamma scans were performed over open land surfaces to identify locations of residual surface activity. Sodium iodide gamma scintillation detectors (i.e., Ludlum Model 44-10) were used for these scans.

Scanning was performed by moving the detector in a serpentine pattern while advancing at a rate not to exceed 0.15 m (6 in) per second. The distance between the detector and the surface was maintained within 7.62 cm (3 in) of the surface. Audible signals were monitored, and locations of elevated direct levels were flagged for further investigation. For areas where the background count rate exceeded 11,000 counts per minute, the scan speed was slowed to 3 inches per second, and the distance between the detector and the surface was maintained within 7.62 cm (3 in) of the surface to maintain the desired detection sensitivity.

2.2.5.4 Removable Surface Contamination

If applicable, removable contamination or smear surveys were performed to verify that loose surface contamination was less than the action level. A 100 cm^2 surface area was wiped with a circular cloth or paper filter using moderate pressure. Smears were then analyzed for the presence of gross beta and gross alpha activity. Counting was performed using the iMatic Low Bkg Counter.

2.2.5.5 Material Sampling

Samples of soil and sediment were obtained from designed sample locations and other biased locations in areas exhibiting elevated activity that were identified by scanning. Surface soil is usually defined as the top 15 cm (6 in) layer, while subsurface soil is generally defined as the soil below the top 15 cm layer in 1-meter increments. Surface soil was collected using a split spoon sampling system, hand trowels, or other suitable sampling tools.

Subsurface soil was sampled by direct push sampling systems (i.e., split spoon) or hand trowels. Subsurface soil sampling was performed, as necessary, to address the DQOs for the survey unit.

An adequate amount of material (may range from 0.5 liters up to two liters) was collected at each location. Sample preparation included the removal of extraneous material and the homogenization and drying of the soil for analysis. Separate containers were used for each sample, and accountability for each container was present throughout the analysis process as specified in the SAP.

Volumetric concrete samples were collected in subsurface structures intended to remain following license termination with a depth profiling objective in mind. A hand-held impact drill equipped with a waffle bit or similar was used to collect surface (approximately 1/8 to 1/4-inch) scabble. A drill fitted with a 2-inch core drilling bit was used to obtain cores of roughly 5 inches in length. The cores were segmented into 6 - 1/2-inch wafers for analysis.

Sand samples were obtained from the fill material between the 3’- 6” false floor and the 0’- 0” base mat of the TURB. Samples were obtained at various levels during excavation and mixed to homogeneity for analysis.

2.2.6 Instrument Selection, Use, and Minimum Detectable Concentrations

The radiation detection instruments used during characterization were chosen for reliable operation and sensitivity and to detect ROCs below established action levels. Detector selection was based on detection sensitivity, operating characteristics, and expected performance in the field. In all cases, the instruments and detectors selected for static measurements and analysis could detect the anticipated ROC at an MDC of 50% of the applicable action level.

Commercially available portable and laboratory instruments and detectors were used to perform the three basic survey measurements: (1) surface scanning, (2) static measurements, and (3) analysis of material samples.

The instrumentation and nominal MDC values employed during characterization are listed in Table 2-9. As the project proceeds, other measurement instruments or technologies, such as continuous data collection scan devices, may be added.

Table 2-9 Example of Instrument Types and Nominal MDC

Detector Model	Instrument Model	Application	Nominal Detection Sensitivity[a]	
			Static MDC (dpm/100cm^2)	Scan MDC (dpm/100 cm^2)
Ludlum Model 43-37	Ludlum 3003	β Static and Scan	N/A	7,267
Ludlum Model 43-68	Ludlum 3003	α Static and Scan	61	N/A
Ludlum Model 43-68	Ludlum 3003	β Static and Scan	920	1329
Ludlum Model 43-93	Ludlum 3002	α Static and Scan	64	N/A
Ludlum Model 43-93	Ludlum 3002	β Static and Scan	557	1030
Ludlum Model 44-10	Ludlum 3003	Gamma Scan	3.1[b] @ 0.15 m/s	5.6[b] @ 0.5 m/s
HPGe	N/A	Gamma	<0.244[c] Co-60 <0.576[c] Cs-137	N/A
iMatic Low Bkg Counter	N/A	Alpha/Beta Smear	7.06[d] α 86.45[d] β	N/A N/A

(a) Based on 1-minute count time and default values for surface efficiencies (ϵ_s) as specified in International Organization for Standardization (ISO) 7503-1, Part 1, Evaluation of Surface Contamination, Beta-Emitters (maximum beta energy greater than 0.15 MeV) and Alpha-Emitters (Reference 2-8)
(b) Assumes a bkg of <7500 cpm to achieve near $DCGL_{Cs-137}$ of 15 mrem/y and 25 mrem/y criteria.
(c) Units are pCi/g
(d) iMatic Detection Sensitivity is Minimum Detectable Activity (MDA) in units of dpm.

2.2.6.1 Instrument Calibrations

All data logging instruments and associated detectors that were used for characterization were calibrated on an annual basis using National Institute of Standards and Technology traceable sources. The calibration of instruments used for characterization was provided by the contractor providing initial characterization services (Westinghouse Electric Company/BHI Energy), and calibration records are available in the project files.

2.2.6.2 Instrument Use and Control

The receipt, inspection, issue, controls, and accountability of portable radiological instrumentation used for characterization are performed in accordance with the appropriate applicable procedures governing portable radiological instrumentation. The issue and control of instruments used for characterization were provided by the contractor providing initial characterization services (Westinghouse Electric Company/BHI Energy). Calibrated instruments were performance checked prior to and after use when in use.

2.2.6.3 Laboratory Instrument Methods and Sensitivities

The on-site radiological laboratory performed gamma spectroscopy and gross removable alpha/beta analyses. Gamma and alpha spectroscopy and liquid scintillation analysis were performed by an approved vendor laboratory, GEL Laboratories, in accordance with approved laboratory procedures. HDI ensured that the contracted off-site vendor laboratories' quality programs met or exceeded the on-site laboratory.

Analytical methods were established in all cases to ensure that required MDC values were achieved. The analysis of radiological contaminants used standard, approved, and generally accepted methodologies or other comparable methodologies. Table 2-10 below are the analytical methods employed and the nominal laboratory MDCs achieved by GEL Laboratories.

Table 2-10 GEL Laboratories Methods, MDCs, and Reporting Limits

Test	Technique	Method	Nominal MDC (pCi/g)
C-14	Liquid Scintillation	EPA EERF C-01 Modified	0.603
Fe-55	Liquid Scintillation	DOE RESL Fe-1, Modified	147
Co-60	Gamma Spectroscopy	DOE HASL 300, 4.5.2.3/Ga-01-R	0.0130
Ni-63	Liquid Scintillation	DOE RESL Ni-1, Modified	23.8
Sr-90	Gas Flow Proportional	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	0.0784
Tc-99	Liquid Scintillation	DOE EML HASL-300, Tc-02-RC Modified	1.25
Cs-137	Gamma Spectroscopy	DOE HASL 300, 4.5.2.3/Ga-01-R	0.0122

2.2.7 Quality Assurance

Section 2.2 of MARSSIM discusses the need for a quality system to ensure the adequacy of data used to demonstrate that site conditions are acceptable for unrestricted release. Laboratory quality for sample analyses taken to support characterization and FSS is discussed in NUREG-1576, Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) (Reference 2-9) and Regulatory Guide 4.15, Quality Assurance of Radiological Monitoring Programs (Inception through Normal Operations to License Termination) – Effluent Streams and the Environment (Reference 2-10). OCNGS does not maintain onsite laboratory programs under a

MARLAP program. Onsite laboratory capabilities and quality are consistent with the guidance provided in NUREG-1575. Independent laboratories used for characterization sample analysis maintain Quality Assurance Plans designed for their facility. Chain of custody and sample preparation protocols are provided as required by the off-site analysis laboratory. Sample duplicates and QC samples are maintained in an onsite sample archive in accordance with the sampling DQOs in specific area sample plans.

Characterization activities essential to data quality were implemented and performed using approved procedures. The implementation of characterization was verified through audit and surveillance activities, including field walk-downs by characterization management and program self-assessments, as appropriate. Corrective actions were prescribed, implemented, and verified when deficiencies were identified. These measures applied to any applicable services provided by off-site vendors and on-site personnel.

The SCP was developed according to the essential elements of the quality assurance and quality control (QA/QC) program for decommissioning OCNGS. The QA/QC program elements applicable to characterization are as follows:

- Establish and implement plans, procedures, and protocols for field operations.
- Actions to ensure that the implementing staff understands and follows the procedures.
- Documentation of the data collected.

Details of the QA/QC elements specific to characterization are presented in the SAP, plan instructions, and the implementing procedures. Characterization operations and the associated data acquisition and recording were guided and conducted in compliance with these QA/QC requirements. The specific QA/QC program components for site characterization are as follows:

- Personnel qualifications, experience, and training
- Execution in accordance with approved procedures
- Proper documentation of survey data and sample analyses
- Selection of appropriate instruments to perform the surveys
- Proper instrument calibration and daily functional checks
- Management oversight of characterization activities relative to the adherence to procedures, protocols, and documentation requirements

2.3 Summary of Characterization Survey Results

Site characterization surveys were performed from August 2022 through September 2022 for open land areas. In January 2020, characterization of the open land survey areas commenced. Characterization activities were performed in parallel with radioactive commodity removal and radioactive waste shipment activities at OCNGS. Consequently, access to certain areas to collect meaningful characterization survey data was prohibited. Characterization has been deferred in these cases until radiological or physical conditions allow for substantial survey. Characterization

surveys ("continuing characterization") continue throughout the decommissioning process. Section 2.5 provides more details on the planned continuing characterization.

The characterization results presented in this chapter were taken from the OCNGS Radiological Characterization Report (Reference 2-11).

2.3.1 Open Land Area Soil Sampling and Scanning

Each sample was analyzed using the on-site gamma spectroscopy system. Analysis count times were adjusted to achieve an MDC equal to or less than 0.244 pCi/g for Co-60 and 0.576 pCi/g for Cs-137. By the procedure, at least 10 percent of the soil samples were sent off-site to GEL Laboratories for full-suite ROC analysis.

2.3.1.1 Survey Results for Class 3 Open Land Survey Areas

The Class 3 open land areas at OCNGS total 349,736 m^2 of surface area. The Class 3 open land surface area was broken into three geographically separated survey areas (NOCA1, SOCA1, and SOCA2) in accordance with the area descriptions, sizes, and boundaries presented in the SCP. The Class 3 open land survey units are illustrated in Figure 2-1. The following sections provide characterization details of those Class 3 areas.

2.3.1.2 NOCA1 Survey Area

Survey and field activities were governed by SAP 01, North Owner Controlled Area-1. Survey planning for the NOCA1 area included using the VSP program to identify 15 random sample locations consistent with MARSSIM methodology. In addition, the Radiological Engineer selected 8 biased locations where radioactivity from other areas may have been introduced due to plant-related activities. The sample locations are illustrated in Figure 2-4.

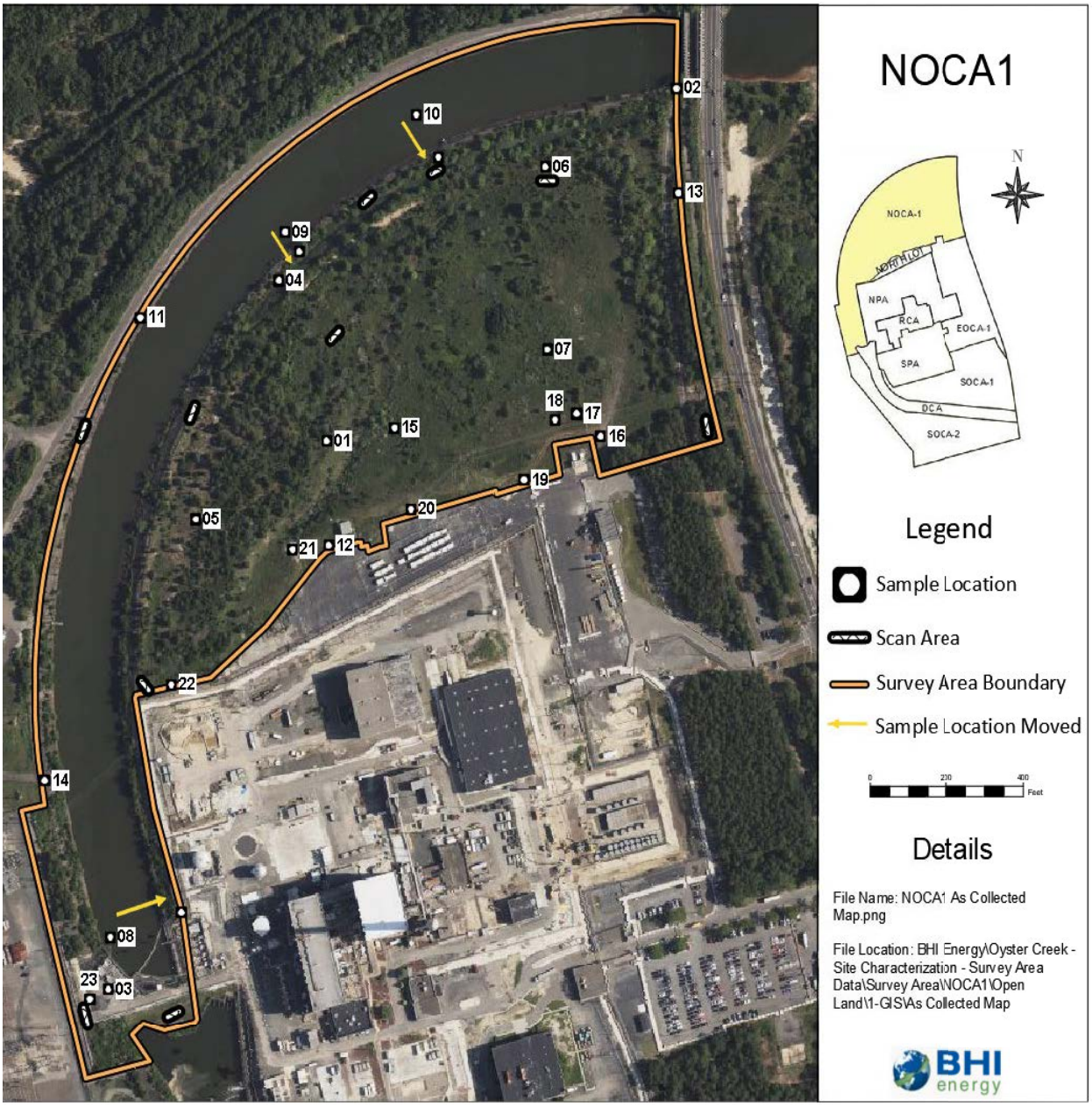


Figure 2-4 NOCA1 Survey Area

Three random sample locations (NOCA1-SOIL-08, -09, and -10) were relocated due to their original location in the intake canal area. During sampling, alternative sample locations were selected from nearby areas where representative soil samples could be safely collected. Westinghouse Electric Company/BHI Energy recorded Global Positioning System (GPS) coordinates for the alternate sample locations to document the new locations.

A total of 30 samples were obtained from the NOCA1 area: 23 surface soil samples (15 random and 8 bias locations), 2 sediment samples (1 random and 1 bias location), 2 asphalt samples (1 random and 1 bias location), and 3 samples at depths greater than 6 in (all bias sample locations). Asphalt samples were obtained from locations where the soil was covered by asphalt (NOCA1-ASPH-03 and NOCA1-ASPH-22-B).

Two of the samples obtained at depths greater than 6 inches (NOCA1-DEP1-17-B and NOCA1-DEP1-18-B) were selected based on the belief that potentially contaminated soil and/or sandblasting grit had been placed there based on aerial photographs. At the client's request, the third sample was obtained at depths greater than 6 inches (NOCA1-DEP1-23-B). This request was based on the sample location where contaminated soil had been deposited and piled.

Walk-over gamma scans at the NOCA1 boundaries were performed using calibrated Ludlum Model 44-10 detector pairings with Model 3003 multi-detector survey meters. The scans were based on professional judgment, focusing on areas of potential migration of radioactivity into or out of the survey area. Gamma scan measurements were also conducted at each sample location. Count rates were observed between 4,100 and 11,500 cpm at sample locations in the NOCA1 area. A total of 173 m^2 were scanned. The gamma scans did not identify areas with an "audible distinction" above the location bkg count rate.

Cesium-137 concentrations were less than the achieved MDC values for most NOCA1 samples. However, Cs-137 was detected at concentrations greater than the MDC values in 5 samples (NOCA1-SOIL-07, NOCA1-SOIL-18-B, NOCA1-SOIL-23-B, NOCA1-SEDI-22-B, and NOCA1-DEP1-23-B). The 5 samples were comprised of 3 surface soil samples, 1 sediment sample, and 1 deep subsurface soil sample. Results can be seen in Table 2-11, Table 2-12, and Table 2-13, respectively. The "pink" highlighted results in the tabular data indicate positive results or >MDC. The positive findings are all less than 1.60E-01 pCi/g, which is less than 27% of the Class 3 AC for Cs-137. The low Cs-137 concentrations may be attributable to the movement of potentially contaminated soil, site runoff, or fallout from gaseous effluent releases. Table 2-14 provides the results for the asphalt samples.

In contrast, Co-60 concentration results were all below the achieved MDC values. The Co-60 MDC values ranged from 2.71E-02 pCi/g to 8.00E-02 pCi/g, indicating that, if present in NOCA1, Co-60 contamination would likely not be widespread or exceed a small fraction of the Class 3 AC for Co-60.

The presence of HTD beta-emitting ROCs (i.e., Sr-90, C-14, Fe-55, Ni-63, and Tc-99) in the NOCA1 survey area was evaluated using analytical results for the QC samples transferred to the off-site laboratory. As shown in Table 2-15, the results did not identify any HTD beta-emitting ROC above the MDC value.

Table 2-11 Gamma Analysis Results for NOCA1 Soil Samples

Soil Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**NOCA1**			**Number of Samples:**			**23**	
Initial Classification:	**Class 3**							
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)
NOCA1-SOIL-1	-1.51E-02		3.65E-02	N	6.37E-02		9.72E-02	N
NOCA1-SOIL-2	-1.67E-02		7.33E-02	N	3.42E-02		6.34E-02	N
NOCA1-SOIL-3-QC	3.52E-03		3.35E-02	N	-2.13E-02		5.38E-02	N
NOCA1-SOIL-4	2.41E-03		3.14E-02	N	2.29E-03		5.48E-02	N
NOCA1-SOIL-5-D	2.15E-02		4.02E-02	N	8.80E-03		5.81E-02	N
NOCA1-SOIL-6	9.88E-03		4.94E-02	N	3.81E-02		9.72E-02	N
NOCA1-SOIL-7	1.09E-02		4.13E-02	N	1.47E-01		5.43E-02	N
NOCA1-SOIL-8	2.11E-03		2.71E-02	N	2.90E-03		5.83E-02	N
NOCA1-SOIL-9	2.90E-02		6.07E-02	N	-1.66E-02		6.56E-02	N
NOCA1-SOIL-10	7.69E-03		4.70E-02	N	4.58E-02		8.51E-02	N
NOCA1-SOIL-11-QC	6.87E-03		4.86E-02	N	4.01E-02		7.58E-02	N
NOCA1-SOIL-12	2.66E-02		4.81E-02	N	6.73E-02		1.05E-01	N
NOCA1-SOIL-13	8.12E-04		5.71E-02	N	4.23E-02		1.15E-01	N
NOCA1-SOIL-14-D	1.90E-02		4.85E-02	N	-1.05E-02		7.11E-02	N
NOCA1-SOIL-15	4.90E-03		5.65E-02	N	3.17E-02		8.71E-02	N
NOCA1-SOIL-16-B	1.65E-02		5.49E-02	N	2.19E-02		5.87E-02	N
NOCA1-SOIL-17-B	4.65E-03		4.81E-02	N	8.19E-03		5.97E-02	N
NOCA1-SOIL-18-B	1.08E-02		4.01E-02	N	8.13E-02		4.39E-02	N
NOCA1-SOIL-19-B-D	-1.07E-02		4.13E-02	N	2.61E-02		7.28E-02	N
NOCA1-SOIL-20-B-QC	1.11E-02		4.58E-02	N	4.88E-02		8.54E-02	N
NOCA1-SOIL-21-B	2.09E-02		5.47E-02	N	3.84E-02		8.09E-02	N
NOCA1-SOIL-22-B	3.60E-02		4.84E-02	N	-1.90E-03		7.35E-02	N
NOCA1-SOIL-23-B	2.42E-02		4.82E-02	N	1.55E-01		6.21E-02	N
Average	9.86E-03				3.71E-02			
SD	1.34E-02				4.49E-02			
Data Range	-1.67E-02	to	3.60E-02		-2.13E-02	to	1.55E-01	

Table 2-12 Gamma Analysis Results for NOCA1 Sediment Samples

Sediment Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**NOCA1**			**Number of Samples:**			**2**		
Initial Classification:	**Class 3**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
NOCA1-SEDI-3	4.10E-02		6.15E-02	N	-1.83E-03		5.92E-02	N	
NOCA1-SEDI-22-B	3.91E-02		8.00E-02	N	1.21E-01		6.41E-02	N	
Average	4.01E-02				5.96E-02				
SD	1.34E-03				8.69E-02				
Data Range	3.91E-02	to	4.10E-02		-1.83E-03	to	1.21E-01		

Table 2-13 Gamma Analysis Results for NOCA1 Deep Samples

Deep Composite Soil Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**NOCA1**			**Number of Samples:**			**3**		
Initial Classification:	**Class 3**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
NOCA1-DEP1-17-B	8.37E-03		6.27E-02	N	2.81E-02		6.49E-02	N	
NOCA1-DEP1-18-B	9.91E-03		6.29E-02	N	1.03E-02		7.86E-02	N	
NOCA1-DEP1-23-B	2.32E-02		5.78E-02	N	1.02E-01		6.36E-02	N	
Average	1.38E-02				4.68E-02				
SD	8.15E-03				4.86E-02				
Data Range	8.37E-03	to	2.32E-02		1.03E-02	to	1.02E-01		

Table 2-14 Gamma Analysis Results for NOCA1 Asphalt Samples

Asphalt Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**NOCA1**			**Number of Samples:**			**2**		
Initial Classification:	**Class 3**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
NOCA1-ASPH-3	2.33E-02		6.36E-02	N	2.00E-02		6.60E-02	N	
NOCA1-ASPH-22B	2.23E-03		5.03E-02	N	1.98E-02		6.21E-02	N	
Average	1.28E-02				1.99E-02				
SD	1.49E-02				1.41E-04				
Data Range	2.23E-03	to	2.33E-02		1.98E-02	to	2.00E-02		

Table 2-15 Laboratory HTD Results for NOCA1 Samples

Sample Number	Medium	HTD Beta	Measured (pCi/g)	Achieved MDC (pCi/g)	AC Exceeded (Y/N)
NOCA1-SOIL-03-QC	Soil	Sr-90	-1.70E-02	7.35E-02	N
		C-14	-7.45E-02	1.05E+00	N
		Fe-55	1.27E+01	1.97E+02	N
		Ni-63	5.21E+00	1.88E+01	N
		Tc-99	-7.48E-02	2.19E+00	N
NOCA1-SOIL-11-QC	Soil	Sr-90	2.61E-02	8.28E-02	N
		C-14	-4.00E-02	1.07E+00	N
		Fe-55	-1.65E+01	2.00E+02	N
		Ni-63	-7.22E+00	3.29E+01	N
		Tc-99	-1.83E-01	2.18E+00	N
NOCA1-SOIL-20-B-QC	Soil	Sr-90	3.89E-02	4.96E-02	N
		C-14	-3.68E-01	1.05E+00	N
		Fe-55	3.77E+01	1.21E+02	N
		Ni-63	7.43E+00	3.12E+01	N
		Tc-99	-2.39E-01	2.18E+00	N

The following conclusions were reached for the NOCA1 area:

- MARSSIM Class 3 designation is appropriate for the NOCA1 survey area.
- Excavation or remediation of soil within the NOCA1 area is not likely within this area to meet the site release criteria.

2.3.1.3 SOCA1 Survey Area

Survey and field activities were governed by SAP 03, South Owner Controlled Area-1. Survey planning for the SOCA1 area included using the VSP program to identify 15 random sample locations consistent with MARSSIM methodology. In addition, 7 biased locations were selected by the Radiological Engineer as locations where plant-related radioactivity may have been introduced from other areas. The sample locations are shown in Figure 2-5.

Three of the random sample locations were relocated due to the original location being within wetland areas (SOCA1-SOIL-10 and SOCA1-SOIL-12) and the inability to access due to a thorn thicket that made safe passage not possible (SOCA1-SOIL-06-D). Nearby areas where representative soil samples could be collected were selected as alternative sample points. GPS coordinates for these alternate sample locations were recorded during sampling to document the new locations.

Asphalt samples were obtained where the soil was covered by asphalt (SOCA1-ASPH-07 and SOCA1-ASPH-14). A total of 24 samples were obtained from the SOCA1 area: 22 surface soil samples (15 random and 7 bias samples) and 2 asphalt samples.

Walk-over gamma scans were conducted at the SOCA1 boundaries. They were performed using calibrated pairings of Ludlum Model 44-10 detectors with Model 3003 multi-detector survey meters to identify any areas of elevated radioactivity. A total of 152 m^2 were scanned. Gamma

scan measurements were also conducted at each sample location. Count rates were between 2,800 and 6,550 cpm at sample locations in the SOCA1 area. Scans did not identify areas with an "audible distinction" above the location bkg count rate.

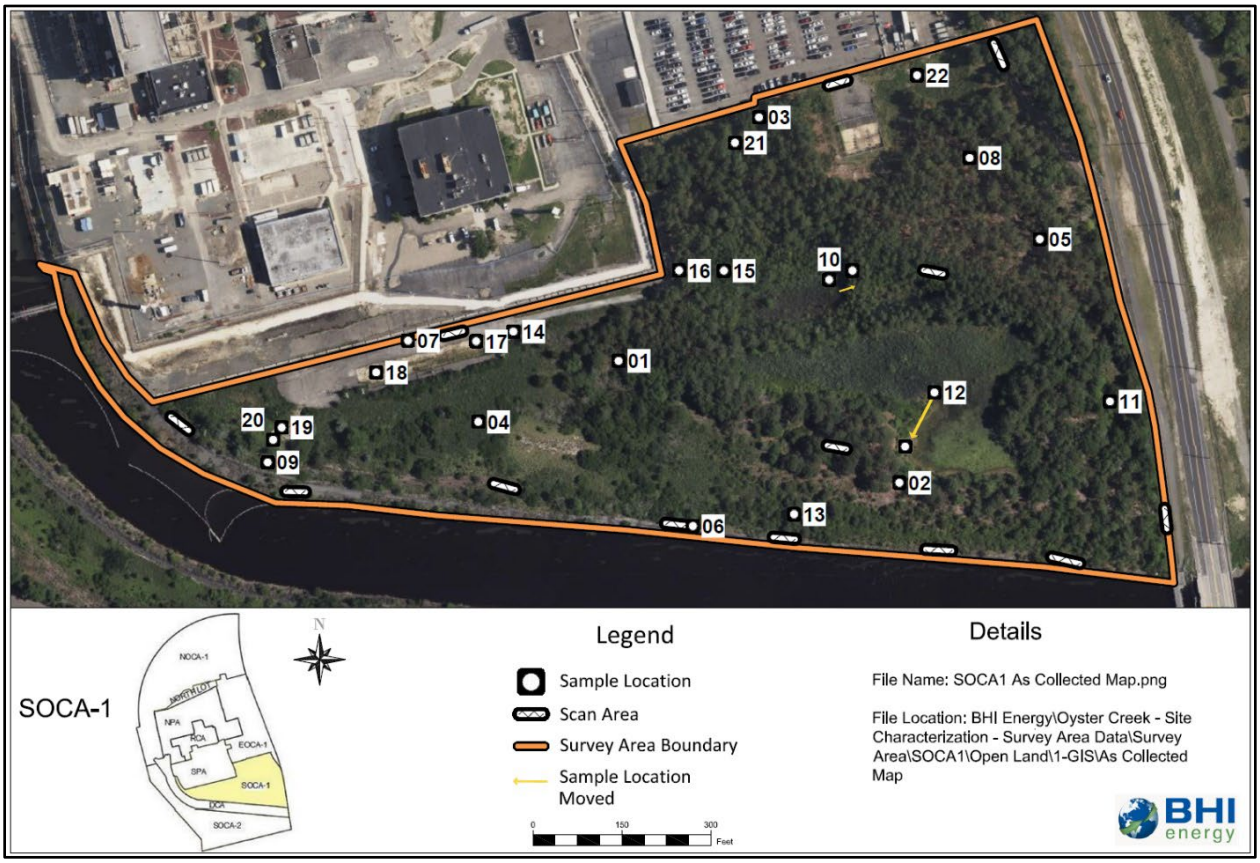


Figure 2-5 SOCA1 Survey Area

Cesium-137 concentrations were less than the achieved MDC values for most SOCA1 samples. However, Cs-137 and Co-60 were detected at concentrations greater than MDC in one sample (SOCA1-SOIL-22-B), and Cs-137 was detected at a concentration greater than MDC in five additional samples (SOCA1-SOIL-3, SOCA1-SOIL-4, SOCA1-SOIL-8, SOCA1-SOIL-9, and SOCA1-SOIL-10).

The positive Cs-137 findings are less than 2.46E-01 pCi/g, less than 43% of the Class 3 AC for Cs-137 (5.76E-01 pCi/g). The positive Co-60 finding is less than 1.07E-01 pCi/g, less than 44% of the Class 3 AC for Co-60 (2.44E-01 pCi/g). These results are shown in Table 2-16. Table 2-17 provides the results for the asphalt samples. The "pink" highlighted results in the tabular data indicate positive results or >MDC.

The sample containing Cs-137 and Co-60, SOCA1-SOIL-22-B, was collected from a culvert/drain outlet that receives runoff from the parking lot in the southeast corner of the EOCA1 survey area. Samples containing the highest Cs-137 concentrations, SOCA1-SOIL-09 and SOCA1-SOIL-10, were collected in a washout area at the southwest corner of SOCA1. This location was subject to runoff from the SPA and wet decomposing organic material. There is no record of current or historical use of radioactive materials in the SOCA1 survey area.

The presence of HTD beta-emitting ROCs (i.e., Sr-90, C-14, Fe-55, Ni-63, and Tc-99) in the SOCA1 survey area was evaluated using analytical results for the QC samples transferred to the off-site laboratory. As shown in Table 2-18, the results did not identify any HTD beta-emitting ROC above MDC.

Table 2-16 Gamma Analysis Results for SOCA1 Soil Samples

Soil Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**SOCA1**		**Number of Samples:**			**22**		
Initial Classification:	**Class 3**							
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)
SOCA1-SOIL-1	6.39E-03		5.65E-02	N	1.14E-02		7.96E-02	N
SOCA1-SOIL-2-D	1.25E-02		6.01E-02	N	3.93E-02		9.06E-02	N
SOCA1-SOIL-3	1.07E-02		4.24E-02	N	4.74E-02		4.68E-02	N
SOCA1-SOIL-4	8.38E-03		4.74E-02	N	4.43E-02		4.17E-02	N
SOCA1-SOIL-5-QC	5.01E-03		3.01E-02	N	2.10E-02		6.46E-02	N
SOCA1-SOIL-6-D	1.77E-02		5.55E-02	N	4.10E-02		8.67E-02	N
SOCA1-SOIL-7	1.36E-02		5.16E-02	N	2.64E-02		6.91E-02	N
SOCA1-SOIL-8	1.24E-02		4.32E-02	N	6.88E-02		3.63E-02	N
SOCA1-SOIL-9	9.22E-03		4.50E-02	N	2.24E-01		5.42E-02	N
SOCA1-SOIL-10	3.18E-03		5.80E-02	N	2.46E-01		7.30E-02	N
SOCA1-SOIL-11	1.13E-02		5.44E-02	N	4.97E-02		8.17E-02	N
SOCA1-SOIL-12	1.45E-02		5.18E-02	N	4.43E-02		5.21E-02	N
SOCA1-SOIL-13-QC	2.67E-02		5.83E-02	N	3.36E-02		7.74E-02	N
SOCA1-SOIL-14-D	-2.83E-02		4.48E-02	N	2.44E-02		7.34E-02	N
SOCA1-SOIL-15-QC	2.70E-02		6.28E-02	N	3.19E-02		8.72E-02	N
SOCA1-SOIL-16-B	1.20E-02		5.01E-02	N	-1.42E-02		7.31E-02	N
SOCA1-SOIL-17-B	1.81E-02		5.20E-02	N	-2.08E-02		6.62E-02	N
SOCA1-SOIL-18-B	2.71E-02		3.72E-02	N	-8.16E-02		5.78E-02	N
SOCA1-SOIL-19-B	1.89E-03		5.75E-02	N	4.61E-02		6.31E-02	N
SOCA1-SOIL-20-B	9.24E-03		6.69E-02	N	5.22E-02		8.74E-02	N
SOCA1-SOIL-21-B	1.46E-02		5.52E-02	N	4.68E-02		9.39E-02	N
SOCA1-SOIL-22-B	1.07E-01		9.68E-02	N	1.94E-01		1.27E-01	N
Average	1.55E-02				5.35E-02			
SD	2.33E-02				7.57E-02			
Data Range	-2.83E-02	to	1.07E-01		-8.16E-02	to	2.46E-01	

Table 2-17 Gamma Analysis Results for SOCA1 Asphalt Samples

Asphalt Sample Gamma Spec - Data Quality Assessment								
Survey Area:		**SOCA1**		**Number of Samples:**			**2**	
Initial Classification:		**Class 3**						
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)
SOCA1-ASPH-7	-3.86E-02		7.40E-02	n/a	2.72E-02		8.33E-02	n/a
SOCA1-ASPH-14	6.55E-03		5.01E-02	n/a	1.60E-03		6.02E-02	n/a
Average	-1.60E-02				1.44E-02			
SD	3.19E-02				1.81E-02			
Data Range	-3.86E-02	to	6.55E-03		1.60E-03	to	2.72E-02	

Table 2-18 Laboratory HTD Results for SOCA1 Samples

Sample Number	Medium	HTD Beta	Measured (pCi/g)	Achieved MDC (pCi/g)	AC Exceeded (Y/N)
SOCA1-SOIL-05-QC	Soil	Sr-90	-1.24E-02	6.81E-02	N
		C-14	-1.48E-01	6.14E-01	N
		Fe-55	-3.78E+01	1.43E+02	N
		Ni-63	-2.94E-01	2.85E+01	N
		Tc-99	4.82E-01	1.51E+00	N
SOCA1-SOIL-13-QC	Soil	Sr-90	2.91E-02	7.75E-02	N
		C-14	-2.34E-01	6.09E-01	N
		Fe-55	7.73E+01	1.97E+02	N
		Ni-63	-9.56E+00	2.85E+01	N
		Tc-99	6.63E-01	1.28E+00	N
SOCA1-SOIL-15-QC	Soil	Sr-90	5.09E-02	7.84E-02	N
		C-14	-3.41E-01	6.03E-01	N
		Fe-55	7.76E+01	1.47E+02	N
		Ni-63	1.10E+00	2.38E+01	N
		Tc-99	7.31E-01	9.42E-01	N

The following conclusions were reached for the SOCA1 area:

- MARSSIM Class 3 designation is appropriate for the SOCA1 survey area.
- Excavation or remediation of soil within the SOCA1 area is likely not necessary for the area to meet site release criteria.

2.3.1.4 SOCA2 Survey Area

Survey activities were governed by SAP 04, South Owner Controlled Area-2. Survey planning for the SOCA2 area included using the VSP program to identify 15 random sample locations consistent with MARSSIM methodology. The sample locations are shown in Figure 2-6.

Four sample locations were relocated because the original location was within wetland areas (SOCA2-SOIL-04, SOCA2-SOIL-09, SOCA2-SOIL-11, and SOCA2-SOIL-15). Alternative sample points where representative soil samples could be collected were selected. GPS coordinates for these alternate sample locations were recorded during sampling to document the new locations.

A total of 15 random surface soil samples were obtained from the SOCA2 area.

Walk-over gamma scans were conducted at the SOCA2 boundaries. They were performed using calibrated pairings of Ludlum Model 44-10 detectors with Model 3003 multi-detector survey meters to identify the presence of elevated radioactivity in runoff collection areas at the SOCA2 boundaries and each sample location. A total of 105 m^2 were scanned. The count rates logged during the gamma scans ranged between 2,800 and 6,670 cpm. Scans did not identify areas with "audible distinction" above the location bkg count rates.

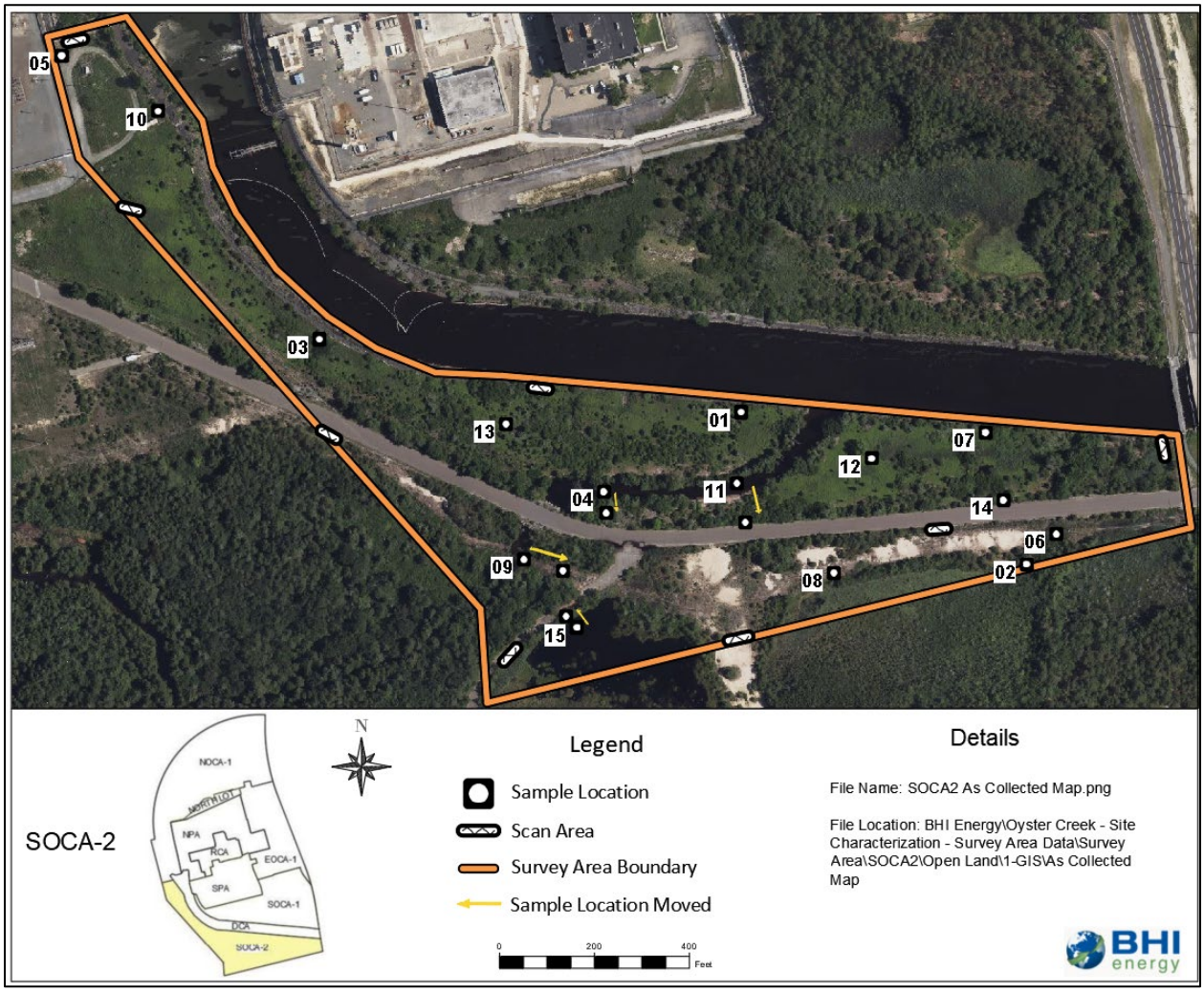


Figure 2-6 SOCA2 Survey Area

Cesium-137 concentrations were less than the achieved MDC values for just over 50% of the SOCA2 samples (8 of 15). However, Cs-137 was detected at concentrations greater than the MDC values in 7 samples, SOCA2-SOIL-1, SOCA2-SOIL-4, SOCA2-SOIL-7, SOCA2-SOIL-9,

SOCA2-SOIL-12, SOCA2-SOIL-13-QC, and SOCA2-SOIL-14. Although Cs-137 concentrations were less than the achieved MDC values for 8 EOCA1 samples, it was detected at low concentrations above the MDC values in 7 soil samples. The positive Cs-137 findings ranged from 5.85E-02 pCi/g to 1.63E-01 pCi/g, which falls below 29% of the Class 3 AC for Cs-137 (5.76E-01 pCi/g). The results can be seen in Table 2-19. The "pink" highlighted results in the tabular data indicate positive results or >MDC. The low Cs-137 concentrations may be attributable to fallout from gaseous effluent releases or the potential presence of background Cs-137.

In contrast, Co-60 concentration results were all below the achieved MDC values. The Co-60 MDC values ranged from 2.95E-02 pCi/g to 6.87E-02 pCi/g, indicating that, if present in SOCA2, Co-60 contamination would likely not be widespread or exceed a small fraction of the 2.44E-01 pCi/g Class 3 AC for Co-60.

The presence of HTD beta-emitting ROCs (i.e., Sr-90, C-14, Fe-55, Ni-63, and Tc-99) in the SOCA2 survey area was evaluated using analytical results for the QC samples transferred to the off-site laboratory. As shown in Table 2-20, HTD beta-emitting ROCs were not identified above the MDC.

Table 2-19 Gamma Analysis Results for SOCA2 Soil Samples

Soil Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**SOCA2**			**Number of Samples:**			**15**		
Initial Classification:	**Class 3**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
SOCA2-SOIL-1	1.57E-02		3.88E-02	N	1.62E-01		5.70E-02	N	
SOCA2-SOIL-2	1.56E-02		5.49E-02	N	1.79E-02		8.95E-02	N	
SOCA2-SOIL-3-D	1.45E-02		4.44E-02	N	7.68E-02		9.97E-02	N	
SOCA2-SOIL-4	1.55E-02		5.58E-02	N	7.73E-02		3.12E-02	N	
SOCA2-SOIL-5	3.35E-02		6.29E-02	N	4.13E-02		9.04E-02	N	
SOCA2-SOIL-6-QC	9.70E-03		3.40E-02	N	4.09E-02		8.84E-02	N	
SOCA2-SOIL-7	1.66E-02		3.66E-02	N	1.63E-01		5.99E-02	N	
SOCA2-SOIL-8-D	2.85E-02		6.43E-02	N	1.23E-02		7.65E-02	N	
SOCA2-SOIL-9	5.27E-03		4.61E-02	N	5.85E-02		4.28E-02	N	
SOCA2-SOIL-10	2.95E-02		6.87E-02	N	6.10E-02		6.35E-02	N	
SOCA2-SOIL-11	1.13E-02		6.71E-02	N	4.15E-02		6.41E-02	N	
SOCA2-SOIL-12	-2.63E-03		2.81E-02	N	1.03E-01		3.74E-02	N	
SOCA2-SOIL-13-QC	1.48E-02		3.03E-02	N	7.54E-02		3.77E-02	N	
SOCA2-SOIL-14	1.83E-02		2.95E-02	N	1.25E-01		4.96E-02	N	
SOCA2-SOIL-15	6.49E-03		3.76E-02	N	4.00E-02		4.24E-02	N	
Average	1.55E-02				7.31E-02				
SD	9.51E-03				4.69E-02				
Data Range	-2.63E-03	to	3.35E-02		1.23E-02	to	1.63E-01		

Table 2-20 Laboratory HTD Results for SOCA2 Samples

Sample Number	Medium	HTD Beta	Measured (pCi/g)	Achieved MDC (pCi/g)	AC Exceeded (Y/N)
SOCA2-SOIL-06-QC	Soil	Sr-90	2.08E-02	7.82E-02	N
		C-14	-9.40E-02	6.15E-01	N
		Fe-55	-9.93E+01	1.77E+02	N
		Ni-63	-8.56E+00	2.60E+01	N
		Tc-99	3.47E-01	1.57E+00	N
SOCA2-SOIL-13-QC	Soil	Sr-90	1.61E-02	1.07E-01	N
		C-14	-1.81E-02	6.08E-01	N
		Fe-55	1.34E-01	1.58E+02	N
		Ni-63	-8.98E+00	3.14E+01	N
		Tc-99	6.77E-01	1.75E+00	N

The following conclusions were reached for the SOCA2 area:

- MARSSIM Class 3 designation is appropriate for the SOCA2 survey area.
- Excavation or remediation of soil within the SOCA2 area is likely unnecessary for the area to meet site release criteria.

2.3.1.5 Survey Results for Class 2 Open Land Survey Areas

The Class 2 open land areas at OCNGS total 234,190 m^2 of surface area. The Class 2 open land surface area was divided into four survey areas (EOCA1, NPA, SPA, and DCA) in accordance with the area descriptions, sizes, and boundaries presented in the SCP. The Class 2 open land survey units are illustrated by Figure 2-1. The following sections provide characterization details of those Class 2 areas.

2.3.1.6 EOCA1 Survey Area

Survey and field activities were governed by SAP 05, East Owner Controlled Area-1. Planners of the EOCA1 SAP suspected that the North Wooded Area (EOCA2), East Wooded Area, and South Wooded Area (EOCA3) would meet MARSSIM Class 3 criteria. Therefore, survey planning included using VSP to identify 30 random sample locations consistent with MARSSIM methodology in the EOCA2 and EOCA3 areas (15 random samples in each area). During the walk-downs, 13 biased locations were identified for the remaining EOCA area. The boundaries of EOCA1A and EOCA1B were subsequently renamed EOCA2 and EOCA3, and the sample locations are shown Figure 2-7.

A total of 44 samples were obtained from EOCA1: 39 surface soil samples, 4 sediment samples, and 1 asphalt sample. These samples were obtained in the following areas:

- EOCA2 – 15 soil samples - Samples EOCA1-SOIL-01 through EOCA1-SOIL-15.
- EOCA3 – 15 soil samples - Samples EOCA1-SOIL-16 through EOCA1-SOIL-30.
- Northeast and Main Parking Lots – 9 soil samples, 4 sediment samples, and 1 asphalt sample - Samples EOCA1-SOIL-31 through EOCA1-SOIL-43. An asphalt sample EOCA1-ASPH-41-B was obtained where the soil was covered by asphalt. The sediment samples, EOCA1-SEDI-35-B through EOCA1-SEDI-38-B, were in the vicinity of 4 storm drains in the southeastern employee parking lot.

Walk-over gamma scans were conducted at the EOCA1 boundaries. They were performed using calibrated pairings of Ludlum Model 44-10 detectors with Model 3003 multi-detector survey meters to identify the presence of elevated radioactivity. Gamma scan measurements were also conducted at each sample location. A total of 393 m^2 were scanned. Count rates were logged between 3,540 and 29,100 cpm at sample locations in the EOCA1 area. The highest measurement was due to the proximity to the ISFSI pad. Scans identified no areas with an "audible distinction" above the location bkg count rate.

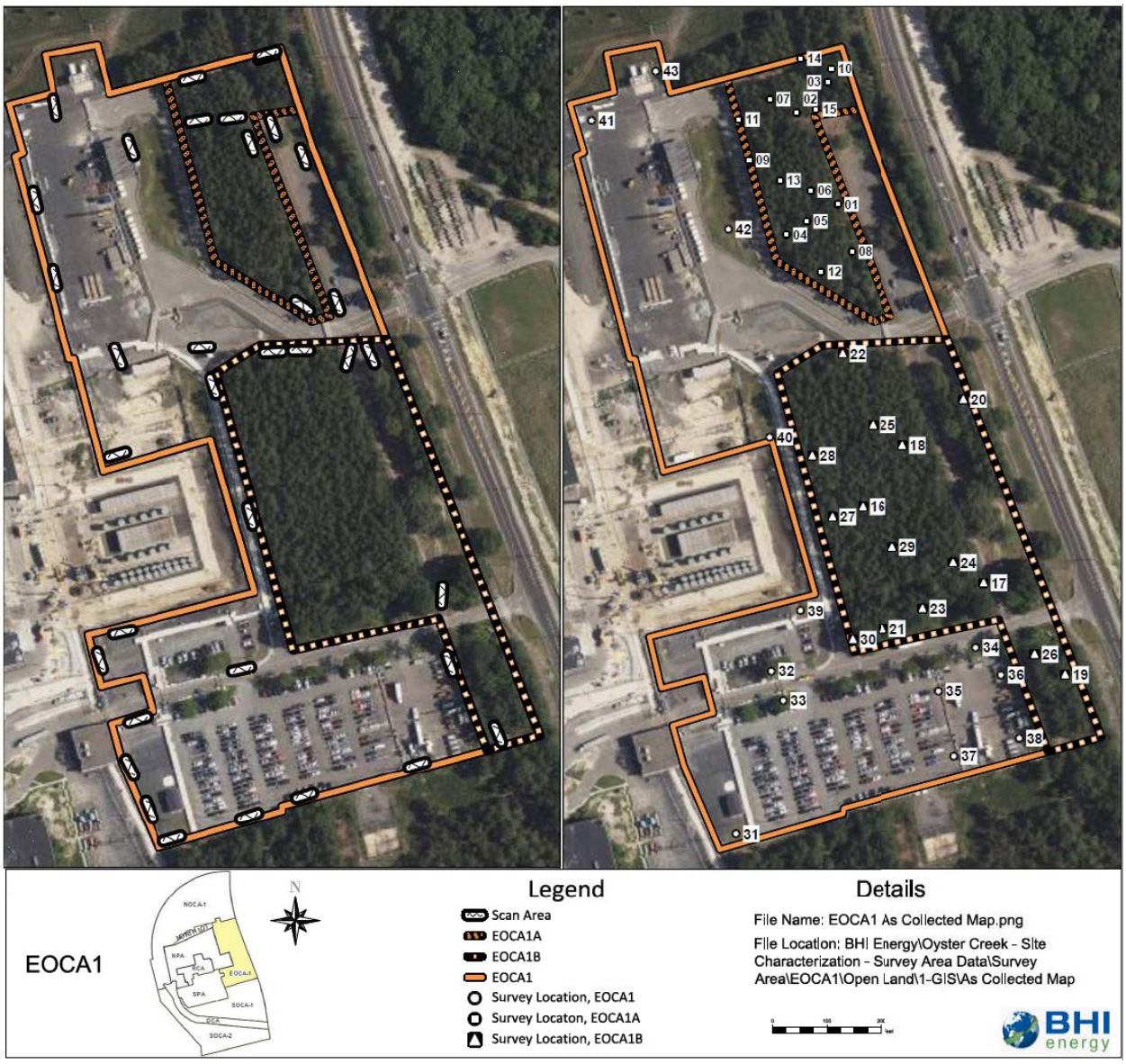


Figure 2-7 EOCA1 Survey Area

Twenty-eight of the 44 samples collected from EOCA1 contained low concentrations of Cs-137.

Fifteen samples were collected from the EOCA2 area (EOCA1-SOIL-1 through EOCA1-SOIL-15), 9 of which contained low concentrations of Cs-137. The results are provided in Table 2-21. The positive Cs-137 results ranged from 4.93E-02 pCi/g to 2.49E-01 pCi/g, less than 9% of the AC for Cs-137 (2.88E+00 pCi/g). Cobalt-60 was not detected in the EOCA1A soil samples.

Fifteen samples were collected from the EOCA3 area (EOCA1-SOIL-16 through EOCA1-SOIL-30), and 12 contained low concentrations of Cs-137. The positive Cs-137 results ranged from 4.12E-02 pCi/g to 2.18E-01 pCi/g, less than 8% of the Class 2 AC for Cs-137. Cobalt-60 was not detected in the EOCA1B soil samples. The results are provided in Table 2-21.

Thirteen samples were collected from 13 locations in the remaining EOCA1 area, including 8 soil, 4 sediments, and 1 asphalt. The soil sample results are provided in Table 2-21, the sediment

samples in Table 2-22, and the asphalt result is in Table 2-23. The "pink" highlighted results in the tabular data indicate positive results or >MDC. Six soil samples contained low levels of Cs-137. The positive Cs-137 results ranged from 6.96E-02 pCi/g to 2.85E-01 pCi/g, less than 10% of the Class 2 AC for Cs-137. Cobalt-60 was not detected in any of the samples.

One of the 4 sediment samples collected around the drains in the employee parking lot (EOCA1-SEDI-35-B) contained low concentrations of Cs-137 and Co-60. However, the measured Cs-137 and Co-60 concentrations were small percentages of the respective Class 2 ACs (less than 3% and 10%, respectively). Results for the other 3 sediment samples confirmed that widespread contamination is not present in the lot.

The presence of HTD beta-emitting ROCs (i.e., Sr-90, C-14, Fe-55, Ni-63, and Tc-99) in the EOCA1 survey area was evaluated using analytical results for the QC samples transferred to the off-site laboratory. As shown in Table 2-24, the results did not identify any HTD beta-emitting ROC above the MDC.

Table 2-21 Gamma Analysis Results for EOCA1 Soil Samples

Soil Sample Gamma Spec - Data Quality Assessment							
Survey Area:	**EOCA1**		**Number of Samples:**	**43**			
Initial Classification:	**Class 2**						
	Result Comparison						
	Co-60			**Cs-137**			
Sample #	Measured Activity (pCi/g)	Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)	Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)
EOCA1-SOIL-1	6.81E-03	2.92E-02	N	1.49E-01	4.48E-02	N
EOCA1-SOIL-2-D	4.29E-02	1.21E-01	N	2.24E-01	1.36E-01	N
EOCA1-SOIL-3	2.81E-02	3.61E-02	N	6.84E-02	5.37E-02	N
EOCA1-SOIL-4	1.52E-02	4.75E-02	N	2.49E-01	7.14E-02	N
EOCA1-SOIL-5	1.94E-02	4.89E-02	N	1.60E-01	4.83E-02	N
EOCA1-SOIL-6-QC	1.21E-02	3.15E-02	N	6.43E-02	4.64E-02	N
EOCA1-SOIL-7	-2.06E-02	2.84E-02	N	4.93E-02	3.93E-02	N
EOCA1-SOIL-8	-2.96E-03	4.46E-02	N	3.27E-02	7.63E-02	N
EOCA1-SOIL-9	1.75E-02	3.90E-02	N	2.58E-02	7.06E-02	N
EOCA1-SOIL-10-QC	9.42E-03	4.16E-02	N	2.13E-01	4.14E-02	N
EOCA1-SOIL-11	3.56E-03	5.40E-02	N	2.55E-02	5.60E-02	N
EOCA1-SOIL-12-QC	1.47E-02	5.16E-02	N	4.08E-02	5.32E-02	N
EOCA1-SOIL-13	-1.10E-02	3.03E-02	N	1.59E-01	5.13E-02	N
EOCA1-SOIL-14	3.45E-02	4.50E-02	N	4.61E-02	7.56E-02	N
EOCA1-SOIL-15	9.35E-03	4.65E-02	N	4.36E-02	7.20E-02	N
EOCA1-SOIL-16	-1.68E-02	5.02E-02	N	2.15E-01	6.53E-02	N
EOCA1-SOIL-17-QC	2.23E-02	4.50E-02	N	1.79E-01	6.46E-02	N
EOCA1-SOIL-18	1.41E-03	2.52E-02	N	3.47E-02	3.49E-02	N
EOCA1-SOIL-19	8.54E-03	4.70E-02	N	8.40E-02	5.54E-02	N
EOCA1-SOIL-20-D	1.48E-02	4.05E-02	N	4.99E-02	4.83E-02	N
EOCA1-SOIL-21	2.57E-02	4.36E-02	N	2.18E-01	5.71E-02	N
EOCA1-SOIL-22	2.82E-02	8.30E-02	N	4.03E-02	1.21E-01	N
EOCA1-SOIL-23	3.03E-03	2.81E-02	N	1.13E-01	5.30E-02	N
EOCA1-SOIL-24-D	5.84E-03	4.62E-02	N	7.65E-02	3.67E-02	N
EOCA1-SOIL-25	6.56E-03	3.08E-02	N	7.32E-02	4.98E-02	N
EOCA1-SOIL-26-D	4.34E-02	6.78E-02	N	7.69E-02	7.00E-02	N

Note:
Soil samples EOCA1-SOIL-1 through 15 were collected from the area redesignated EOCA2.
Soil Samples EOCA1-SOIL-16 through 30 were collected from the area redesignated EOCA3.

Soil Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**EOCA1**			**Number of Samples:**			**43**		
Initial Classification:	**Class 2**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
EOCA1-SOIL-27	1.32E-02		4.63E-02	N	1.97E-01		5.52E-02	N	
EOCA1-SOIL-28-QC	-1.13E-02		3.40E-02	N	4.12E-02		3.94E-02	N	
EOCA1-SOIL-29	-2.01E-03		3.47E-02	N	2.86E-02		5.17E-02	N	
EOCA1-SOIL-30	3.80E-03		3.15E-02	N	1.60E-01		5.21E-02	N	
EOCA1-SOIL-31-B	3.65E-03		5.13E-02	N	6.96E-02		5.49E-02	N	
EOCA1-SOIL-32-B	2.29E-03		7.38E-02	N	2.85E-01		8.50E-02	N	
EOCA1-SOIL-33-B-D	-1.11E-02		6.64E-02	N	1.45E-01		7.67E-02	N	
EOCA1-SOIL-34-B-QC	2.41E-02		6.53E-02	N	7.04E-02		5.74E-02	N	
EOCA1-SOIL-39-B	1.75E-02		7.10E-02	N	8.95E-02		4.94E-02	N	
EOCA1-SOIL-40-B	6.01E-03		5.32E-02	N	1.56E-01		4.30E-02	N	
EOCA1-SOIL-41-B	3.25E-02		4.53E-02	N	-1.11E-03		5.24E-02	N	
EOCA1-SOIL-42-B-QC	1.46E-03		3.70E-02	N	1.79E-02		6.40E-02	N	
EOCA1-SOIL-43-B	-1.09E-03		3.30E-02	N	3.46E-02		7.01E-02	N	
Average	1.03E-02				1.03E-01				
SD	1.51E-02				7.60E-02				
Data Range	-2.06E-02	to	4.34E-02		-1.11E-03	to	2.85E-01		

Table 2-22 Gamma Analysis Results for EOCA1 Sediment Samples

Sediment (SEDI) Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**EOCA1**			**Number of Samples:**			**4**		
Initial Classification:	**Class 2**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
EOCA1-SEDI-35-B	1.13E-01		2.91E-02	N	6.60E-02		5.78E-02	N	
EOCA1-SEDI-36-B	2.82E-02		6.25E-02	N	2.43E-02		6.90E-02	N	
EOCA1-SEDI-37-B	6.28E-02		8.56E-02	N	3.66E-02		6.41E-02	N	
EOCA1-SEDI-38-B	2.25E-02		6.99E-02	N	1.08E-02		6.33E-02	N	
Average	5.66E-02				3.44E-02				
SD	4.16E-02				2.35E-02				
Data Range	2.25E-02	to	1.13E-01		1.08E-02	to	6.60E-02		

Table 2-23 Gamma Analysis Results for EOCA1 Asphalt Samples

Asphalt Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**EOCA1**			**Number of Samples:**			**1**	
Initial Classification:	**Class 2**							
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)
EOCA1-ASPH-41-B	3.32E-03		8.22E-02	N	3.59E-02		9.43E-02	N
Average								
SD								
Data Range		to				to		

Table 2-24 Laboratory HTD Results for EOCA1 Samples

Sample Number	Medium	HTD Beta	Measured (pCi/g)	Achieved MDC (pCi/g)	AC Exceeded (Y/N)
EOCA1-SOIL-06-QC	Soil	Sr-90	4.96E-02	9.83E-02	N
		C-14	-2.73E-01	1.06E+00	N
		Fe-55	9.72E+00	1.47E+02	N
		Ni-63	-4.24E+00	3.35E+01	N
		Tc-99	2.05E-01	2.30E+00	N
EOCA1-SOIL-10-QC	Soil	Sr-90	6.23E-03	4.91E-02	N
		C-14	-3.31E-02	1.05E+00	N
		Fe-55	1.32E+02	1.99E+02	N
		Ni-63	4.55E+00	3.99E+01	N
		Tc-99	4.79E-01	2.20E+00	N
EOCA1-SOIL-12-QC	Soil	Sr-90	2.23E-02	7.60E-02	N
		C-14	7.44E-02	1.06E+00	N
		Fe-55	2.58E+01	1.08E+02	N
		Ni-63	-8.04E+00	2.59E+01	N
		Tc-99	1.00E+00	2.16E+00	N
EOCA1-SOIL-17-QC	Soil	Sr-90	5.10E-03	6.12E-02	N
		C-14	4.90E-01	1.08E+00	N
		Fe-55	1.17E+02	2.47E+02	N
		Ni-63	-9.24E-01	3.67E+01	N
		Tc-99	1.27E+00	2.13E+00	N
EOCA1-SOIL-28-QC	Soil	Sr-90	-4.40E-03	7.97E-02	N
		C-14	1.17E-02	6.14E-01	N
		Fe-55	6.32E+01	2.42E+02	N
		Ni-63	-4.05E+00	2.25E+01	N
		Tc-99	1.29E+00	1.86E+00	N

Sample Number	Medium	HTD Beta	Measured (pCi/g)	Achieved MDC (pCi/g)	AC Exceeded (Y/N)
EOCA1-SOIL-34-B-QC	Soil	Sr-90	-1.88E-03	5.92E-02	N
		C-14	1.70E-01	1.06E+00	N
		Fe-55	1.09E+02	1.87E+02	N
		Ni-63	-4.35E+00	3.53E+01	N
		Tc-99	3.20E+00	3.54E+00	N
EOCA1-SOIL-42-B-QC	Soil	Sr-90	2.74E-02	4.13E-02	N
		C-14	2.25E-03	6.12E-01	N
		Fe-55	-5.18E+00	1.03E+02	N
		Ni-63	-1.11E+01	2.55E+01	N
		Tc-99	-4.45E-03	1.70E+00	N

The following conclusions were reached in the EOCA1 area:

- MARSSIM Class 2 designation is appropriate for the waste travel routes within the EOCA1 boundary.
- EOCA2 and EOCA3 should be established as separate MARSSIM Class 3 areas. Residual plant-related contamination in the survey area meets the criteria in NUREG-1575 for a MARSSIM Class 3 area.
- Excavation or remediation of soil within EOCA1 Class 3 areas is likely not necessary to meet site release criteria.

2.3.1.7 NPA Survey Area

Survey and field activities were governed by SAP 06, North Protected Area. Planners of the SAP identified 13 sample locations where plant-related radioactivity might have been introduced from other areas. One sample point, NPA-SEDI-12-B, was relocated due to industrial safety concerns. An alternative sample location was selected close to the original point and where representative samples could be safely collected. The sample locations are shown in Figure 2-8. GPS coordinates for an alternate sample location were recorded during sampling to document the new location. One additional sample point, NPA-XXX-03-B, was canceled due to the presence of underground utilities and could not be safely collected as planned. The sample point was evaluated for relocation, and it was determined that due to the distance the sample would have to be moved, the intended purpose of the biased sample location would be lost. Following the initial walk-down and bias point selections, a water main break resulted in a significant erosion of soil. This location, NPA-SOIL-16-B, was selected following initial planning for sampling due to soil exposure. GPS coordinates for the sample location were recorded during sampling to document the location.

Sixteen samples were obtained from the NPA area: 8 soil samples, 7 sediment samples, and 1 asphalt sample. All sediment sample locations were chosen based on facility walk-downs and the identification of water runoff pathways. An asphalt sample was obtained at the location where the soil was covered by asphalt, NPA-ASPH-14-B.

Walk-over gamma scans were conducted at the NPA boundaries. They were performed using calibrated pairings of Ludlum Model 44-10 detectors with Model 3003 multi-detector survey meters to identify the presence of elevated radioactivity. Gamma scan measurements were also

conducted at each sample location. A total of 145 m^2 were scanned. Count rates were logged between 8,490 and 45,400 cpm at sample locations in the NPA area. The highest measurement was due to the proximity to the LLRWSF truck bay, where a resin liner was loaded into a shipping cask. The gamma scans performed in the NPA survey area did not identify elevated radioactivity requiring further investigation.

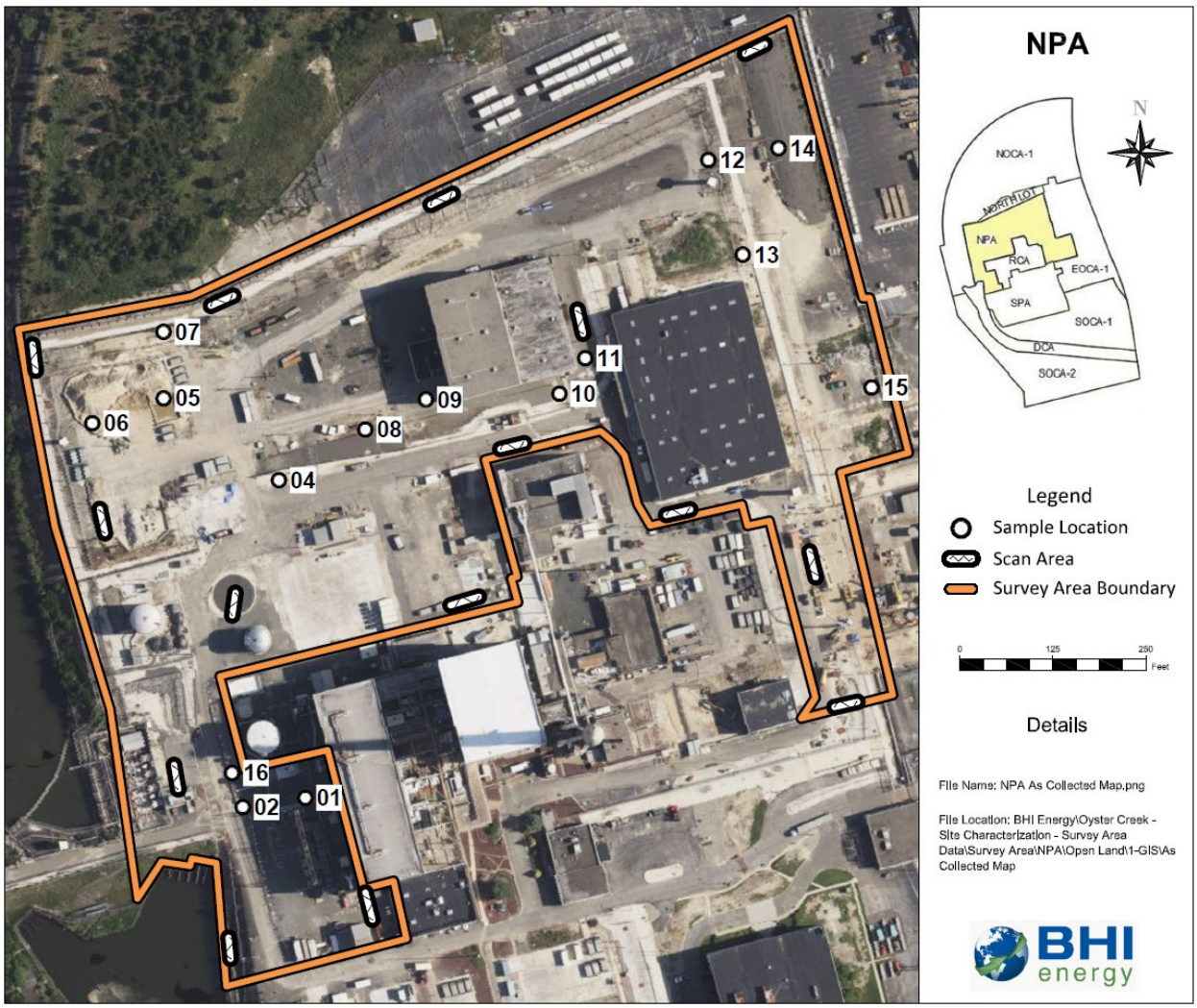


Figure 2-8 NPA Survey Area

Cesium-137 concentrations are less than the achieved MDC values for most NPA samples. However, Cs-137 was detected at concentrations greater than the MDC values in 4 samples (NPA-SOIL-09-B, NPA-SEDI-07-B, NPA-SEDI-11-B, and NPA-SEDI-12-B). The four samples were comprised of 1 surface soil sample and 3 sediment samples. Results can be seen in Table 2-25, Table 2-26, and Table 2-27. The "pink" highlighted results in the tabular data indicate positive results or >MDC. The positive findings are all less than 3.39E-01 pCi/g, which is less than 12% of the Class 2 AC for Cs-137 (2.88E+00 pCi/g).

Cobalt-60 concentrations are less than the achieved MDC values for most NPA samples. However, Co-60 was detected at concentrations greater than the MDC values in 2 samples (NPA-SEDI-02-B-D and NPA-SEDI-11-B); both samples were sediment samples. Results can be seen

in Table 2-26. The positive findings are all less than 1.24E-01 pCi/g, which is less than 11% of the Class 2 AC for Co-60 (1.22E+00 pCi/g). Cobalt-60 was not detected in any of the soil samples.

Cobalt-60 and Cs-137 concentrations for asphalt samples can be seen in Table 2-27 and are less than the achieved MDC values.

The characterization performed to date offers a snapshot of the present radiological condition in the NPA, which will likely evolve as the demolition of SSC in the NPA continues. Additional characterization surveys in the NPA may be required to aid in FSS planning as decommissioning activities progress. The presence of HTD beta-emitting ROCs (i.e., Sr-90, C-14, Fe-55, Ni-63, Tc-99, and Pu-241) in the NPA survey area was evaluated using analytical results for the QC samples transferred to the off-site laboratory. As shown in Table 2-28, those analyses did not identify any HTD beta-emitting ROC above the MDC value achieved during the analyses.

Table 2-25 Gamma Analysis Results for NPA Soil Samples

Soil Sample Gamma Spec - Data Quality Assessment									
Survey Area:			**NPA**		**Number of Samples:**				**8**
Initial Classification:			**Class 2**						
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
NPA-SOIL-1-B	6.93E-04		5.74E-02	N	2.42E-02		4.25E-02	N	
NPA-SOIL-4-B-QC	-9.91E-04		4.28E-02	N	2.56E-02		7.84E-02	N	
NPA-SOIL-8-B	9.78E-03		4.75E-02	N	1.69E-02		4.02E-02	N	
NPA-SOIL-9-B	4.32E-02		4.51E-02	N	6.36E-02		4.56E-02	N	
NPA-SOIL-10-B-D	2.82E-02		5.13E-02	N	2.05E-02		6.94E-02	N	
NPA-SOIL-14-B-QC	-1.46E-04		3.01E-02	N	2.76E-02		7.39E-02	N	
NPA-SOIL-15-B	-1.14E-02		4.52E-02	N	2.23E-02		5.90E-02	N	
NPA-SOIL-16-B	1.04E-02		5.86E-02	N	4.08E-02		7.49E-02	N	
Average	9.97E-03				3.02E-02				
SD	1.77E-02				1.52E-02				
Data Range	-1.14E-02	to	4.32E-02		1.69E-02	to	6.36E-02		

Table 2-26 Gamma Analysis Results for NPA Sediment Samples

Sediment Sample Gamma Spec - Data Quality Assessment									
Survey Area:	NPA			Number of Samples:	7				
Initial Classification:	Class 2								
Result Comparison									
	Co-60				Cs-137				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
NPA-SEDI-2-B-D	6.72E-02		4.63E-02	N	5.22E-02		5.67E-02	N	
NPA-SEDI-5-B	5.11E-03		4.75E-02	N	1.56E-02		7.03E-02	N	
NPA-SEDI-6-B	1.13E-02		3.93E-02	N	-4.96E-03		5.93E-02	N	
NPA-SEDI-7-B	4.18E-02		1.24E-01	N	3.39E-01		1.04E-01	N	
NPA-SEDI-11-B	1.24E-01		2.93E-02	N	1.93E-01		5.18E-02	N	
NPA-SEDI-12-B	4.18E-02		7.01E-02	N	1.91E-01		7.30E-02	N	
NPA-SEDI-13-B	-2.46E-02		3.15E-02	N	2.30E-02		7.00E-02	N	
Average	3.81E-02				1.16E-01				
SD	4.83E-02				1.28E-01				
Data Range	-2.46E-02	to	1.24E-01		-4.96E-03	to	3.39E-01		

Table 2-27 Gamma Analysis Results for NPA Asphalt Samples

Asphalt Sample Gamma Spec - Data Quality Assessment									
Survey Area:	NPA			Number of Samples:	1				
Initial Classification:	Class 2								
Result Comparison									
	Co-60				Cs-137				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
NPA-ASPH-14-B	-2.12E-02		6.38E-02	n/a	1.08E-02		7.14E-02	n/a	
Average									
SD									
Data Range		to				to			

Table 2-28 Laboratory HTD Results for NPA Samples

Sample Number	Medium	HTD Beta	Measured (pCi/g)	Achieved MDC (pCi/g)	AC Exceeded (Y/N)
NPA-SOIL-04-B-QC	Soil	Sr-90	2.08E-03	6.30E-02	N
		C-14	-6.22E-03	1.04E+00	N
		Fe-55	6.14E+01	1.21E+02	N
		Ni-63	6.81E+00	3.44E+01	N
		Tc-99	1.72E-01	2.15E+00	N
		Pu-241	8.05E+00	4.20E+01	N

Sample Number	Medium	HTD Beta	Measured (pCi/g)	Achieved MDC (pCi/g)	AC Exceeded (Y/N)
NPA-SOIL-14-B-QC	Soil	Sr-90	2.47E-02	4.98E-02	N
		C-14	8.14E-02	1.07E+00	N
		Fe-55	8.58E+01	1.79E+02	N
		Ni-63	4.29E+00	2.89E+01	N
		Tc-99	-5.72E-01	2.28E+00	N
		Pu-241	3.34E+01	4.19E+01	N

The following conclusions were reached for the NPA survey area:

- MARSSIM Class 2 designation is appropriate for the NPA survey area.
- The Cs-137 and Co-60 concentrations in NPA samples do not require excavation or remediation to meet site release criteria. The current radiological status may change as active decommissioning of the site commences.
- Radiological status changes may warrant additional site characterization collection to support FSS planning.
- Additional characterization in yard areas, including walk-over gamma scans and soil sampling, should be considered when the waste containers are removed.

2.3.1.8 SPA Survey Area

SAP 08, South Protected Area governed survey and field activities. SAP planners identified 16 biased sample locations where plant-related radioactivity might have been introduced from other areas. The sample locations are shown in Figure 2-9.

Twenty-four samples were obtained from the SPA area: 12 soil samples, 6 sediment samples, 4 asphalt samples, and 2 samples at depths greater than 6 inches. Sediment sample locations (SPA-SEDI-02-B-QC, -04-B, -06-B, and -11-B) were chosen based on facility walk-downs and the identification of water runoff paths. Sediment samples (SPA-SEDI-02-B-QC, -04-B, and -06-B) were planned as soil samples during the original walk down; however, when the team attempted to obtain the soil samples, the material was not soil but sediment that had filled depressions in the asphalt (SPA-SEDI-02-B-QC and SPA-SEDI-04-B) or sediment that covered concrete (SPA-SEDI-06-B). Samples SPA-SEDI-13-B, SPA-ASPH-13-B, SPA-ASPH-16-B, and SPA-SEDI-16-B were added to the originally planned samples because the original walk-down identified the location as soil; these samples were obtained to reach the soil samples below. The 2 remaining asphalt samples, SPA-ASPH-10-B and SPA-ASPH-12-B were obtained where asphalt covered the soil. Locations of samples greater than 6 inches (SPA-DEP1-15-B and SPA-SSUB-16-B) were selected due to the proximity to piping vaults and to check for potential subsurface migration of contamination, respectively. Sample SPA-SSUB-16-B was initially intended to be taken at a depth between 6 and 48 inches; however, resistance was met at 12 inches, so the sample was given the designator of SSUB, not DEP1.

Walk-over gamma scans were conducted at the SPA boundaries. They were performed using calibrated pairings of Ludlum Model 44-10 detectors with Model 3003 multi-detector survey meters to identify the presence of elevated radioactivity. Gamma scan measurements were also conducted at each sample location. A total of 106 m^2 was scanned. Count rates were logged between 4,670 and 16,7000 cpm at sample locations in the SPA area. The highest measurement was due to the proximity of radioactive material stored in the nearby RCA. The gamma scans performed in the SPA survey area did not identify elevated radioactivity requiring further investigation. Scans identified no areas with an "audible distinction" above the location bkg count rate, except as noted above.

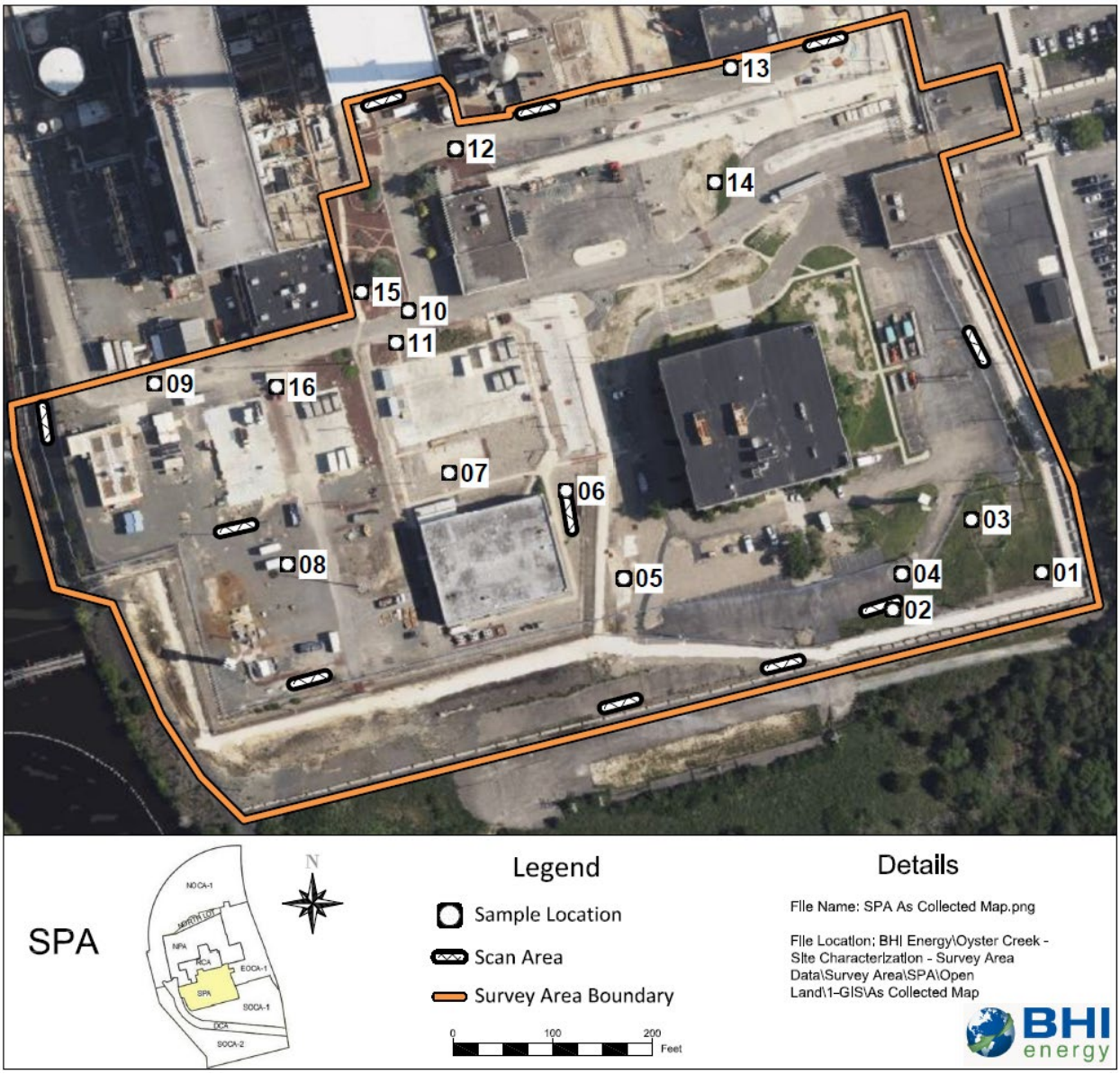


Figure 2-9 SPA Survey Area

Cesium-137 concentrations were less than the achieved MDC values for most (58%) SPA samples. However, Cs-137 was detected at concentrations greater than the MDC values in 10 samples (6 soil samples, 2 sediment samples, 1 asphalt sample, and 1 subsurface sample). The

10 samples are SPA-SOIL-01-B-D, SPA-SOIL-08-B, SPA-SOIL-10-B, SPA-SOIL-13-B, SPA-SOIL-14-B, SPA-SOIL-16-B, SPA-SEDI-02-B-QC, SPA-SEDI-04-B, SPA-SSUB-16-B, and SPA-ASPH-12-B. Results can be seen in Table 2-29, Table 2-30, Table 2-31, and Table 2-32, respectively. The "pink" highlighted results in the tabular data indicate positive results or >MDC. The positive findings are all less than 2.52E-01 pCi/g, which is less than 9% of the Class 2 AC for Cs-137 (2.88E+00 pCi/g).

Cobalt-60 concentrations were less than MDC values for most (83%) SPA samples. However, Co-60 was detected at concentrations greater than the MDC values in 4 samples (SPA-SOIL-13-B, SPA-SEDI-04-B, SPA-ASPH-12-B, and SPA-ASPH-13-B). The 4 samples were comprised of 1 soil sample, 1 sediment sample, and 2 asphalt samples. Results can be seen in Table 2-29, Table 2-30, and Table 2-31, respectively. The positive findings are all less than 2.23E-01 pCi/g, which is less than 19% of the AC for Co-60 (1.22E+00).

No activity was detected above the achieved MDC for the sample taken beyond 30 cm, SPA-DEP1-15-B, which can be seen in Table 2-33.

The presence of HTD beta-emitting ROCs (i.e., Sr-90, C-14, Fe-55, Ni-63, Tc-99, and Pu-241) in the SPA survey area was evaluated using analytical results for the QC samples transferred to the off-site laboratory. As shown in Table 2-34, the analyses did not identify any HTD beta-emitting ROC above the MDC value achieved during the analyses.

Table 2-29 Gamma Analysis Results for SPA Soil Samples

Surface Soil Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**SPA**			**Number of Samples:**			**12**		
Initial Classification:	**Class 2**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
SPA-SOIL-1-B-D	1.92E-02		5.13E-02	N	7.81E-02		6.06E-02	N	
SPA-SOIL-3-B	3.17E-02		1.97E-01	N	1.12E-01		2.63E-01	N	
SPA-SOIL-5-B	3.51E-02		1.65E-01	N	1.29E-02		1.62E-01	N	
SPA-SOIL-7-B	8.80E-03		5.08E-02	N	2.82E-02		3.90E-02	N	
SPA-SOIL-8-B	1.65E-02		6.34E-02	N	7.77E-02		7.24E-02	N	
SPA-SOIL-9-B	5.71E-03		6.39E-02	N	7.09E-03		7.77E-02	N	
SPA-SOIL-10-B	1.93E-02		8.53E-02	N	9.37E-02		7.08E-02	N	
SPA-SOIL-12-B-QC	2.88E-02		6.62E-02	N	2.94E-02		1.02E-01	N	
SPA-SOIL-13-B	7.60E-02		6.26E-02	N	2.52E-01		7.32E-02	N	
SPA-SOIL-14-B	3.52E-02		5.79E-02	N	7.83E-02		4.89E-02	N	
SPA-SOIL-15-B	7.99E-03		4.60E-02	N	3.31E-02		5.48E-02	N	
SPA-SOIL-16-B	2.63E-02		4.92E-02	N	1.05E-01		4.54E-02	N	
Average	2.59E-02				7.56E-02				
SD	1.89E-02				6.64E-02				
Data Range	5.71E-03	to	7.60E-02		7.09E-03	to	2.52E-01		

Table 2-30 Gamma Analysis Results for SPA Sediment Samples

Sediment (SEDI) Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**SPA**			**Number of Samples:**			**6**		
Initial Classification:	**Class 2**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
SPA-SEDI-2-B-QC	8.69E-03		6.04E-02	N	5.33E-02		4.15E-02	N	
SPA-SEDI-4-B	1.26E-01		7.44E-03	N	8.71E-02		4.76E-02	N	
SPA-SEDI-6-B-D	2.08E-02		5.18E-02	N	3.81E-02		7.38E-02	N	
SPA-SEDI-11-B	5.76E-02		2.96E-02	N	6.78E-02		5.90E-02	N	
SPA-SEDI-13-B	2.23E-01		4.28E-02	N	3.01E-01		6.60E-02	N	
SPA-SEDI-16-B	1.33E-02		2.53E-02	N	2.04E-03		6.91E-02	N	
Average	7.49E-02				9.16E-02				
SD	8.48E-02				1.07E-01				
Data Range	8.69E-03	to	2.23E-01		2.04E-03	to	3.01E-01		

Table 2-31 Gamma Analysis Results for SPA Asphalt Samples

Asphalt Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**SPA**			**Number of Samples:**			**4**		
Initial Classification:	**Class 2**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
SPA-ASPH-10-B	5.28E-02		9.57E-02	N	7.04E-02		1.05E-01	N	
SPA-ASPH-12-B	1.06E-01		4.56E-02	N	1.06E-01		5.45E-02	N	
SPA-ASPH-13-B	5.45E-02		9.31E-03	N	5.03E-02		1.17E-01	N	
SPA-ASPH-16-B	2.53E-02		6.53E-02	N	2.72E-02		4.63E-02	N	
Average	5.97E-02				6.35E-02				
SD	3.37E-02				3.34E-02				
Data Range	2.53E-02	to	1.06E-01		2.72E-02	to	1.06E-01		

Table 2-32 Gamma Analysis Results for SPA Subsurface Soil Samples

Sub-Surface Soil (SSUB) Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**SPA**			**Number of Samples:**			**1**		
Initial Classification:	**Class 2**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
SPA-SSUB-16-B	8.53E-03		5.21E-02	N	1.95E-01		3.87E-02	N	
Average									
SD									
Data Range		to				to			

Table 2-33 Gamma Analysis Results for SPA Deep Samples

Deep Composite Soil (DEEP) Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**SPA**			**Number of Samples:**			**1**		
Initial Classification:	**Class 2**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
SPA-DEP1-15-B	1.01E-02		6.03E-02	N	8.37E-02		9.91E-02	N	
Average									
SD									
Data Range		to				to			

Table 2-34 Laboratory HTD Results for SPA Samples

Sample Number	Medium	HTD Beta	Measured (pCi/g)	Achieved MDC (pCi/g)	AC Exceeded (Y/N)
SPA-SEDI-02-B-QC	Soil	Sr-90	7.04E-03	4.57E-02	N
		C-14	1.10E-01	1.06E+00	N
		Fe-55	5.96E+01	2.14E+02	N
		Ni-63	9.74E-01	3.06E+01	N
		Tc-99	1.41E+00	2.26E+00	N
		Pu-241	6.73E+00	4.11E+01	N
SPA-SOIL-12-B-QC	Soil	Sr-90	5.84E-02	6.63E-02	N
		C-14	1.90E-01	1.06E+00	N
		Fe-55	-4.58E+01	2.22E+02	N
		Ni-63	9.72E+00	3.23E+01	N
		Tc-99	5.85E-01	2.42E+00	N
		Pu-241	1.97E+01	4.43E+01	N

The following conclusions were reached based on the collected site characterization data from the SPA survey area:

- MARSSIM Class 2 designation is appropriate for the SPA survey area.
- The Cs-137 and Co-60 concentrations found in SPA samples do not require excavation or remediation to meet site release criteria. The current radiological status may change as active decommissioning of the site commences.
- Radiological status changes may warrant additional site characterization collection to support FSS planning.
- Additional characterization in yard areas, including walk-over gamma scans and soil sampling, should be considered when waste containers are moved.

2.3.1.9 DCA Survey Area

SAP 12, Discharge Canal Area, governed the survey and field activities. Seven sample locations were identified where plant-related radioactivity might have been introduced from the discharge of radioactive material. Four sample points were relocated to obtain sufficient sample material for analysis. GPS coordinates for the alternate sample locations were recorded during sampling to document the new locations. The sample locations are shown in Figure 2-10.

A total of 7 sediment samples were obtained from the DCA area.

Walk-over gamma scans of the DCA were not conducted within the DCA; however, scans were performed on the DCA border with the adjacent survey areas shown in Figure 2-10.

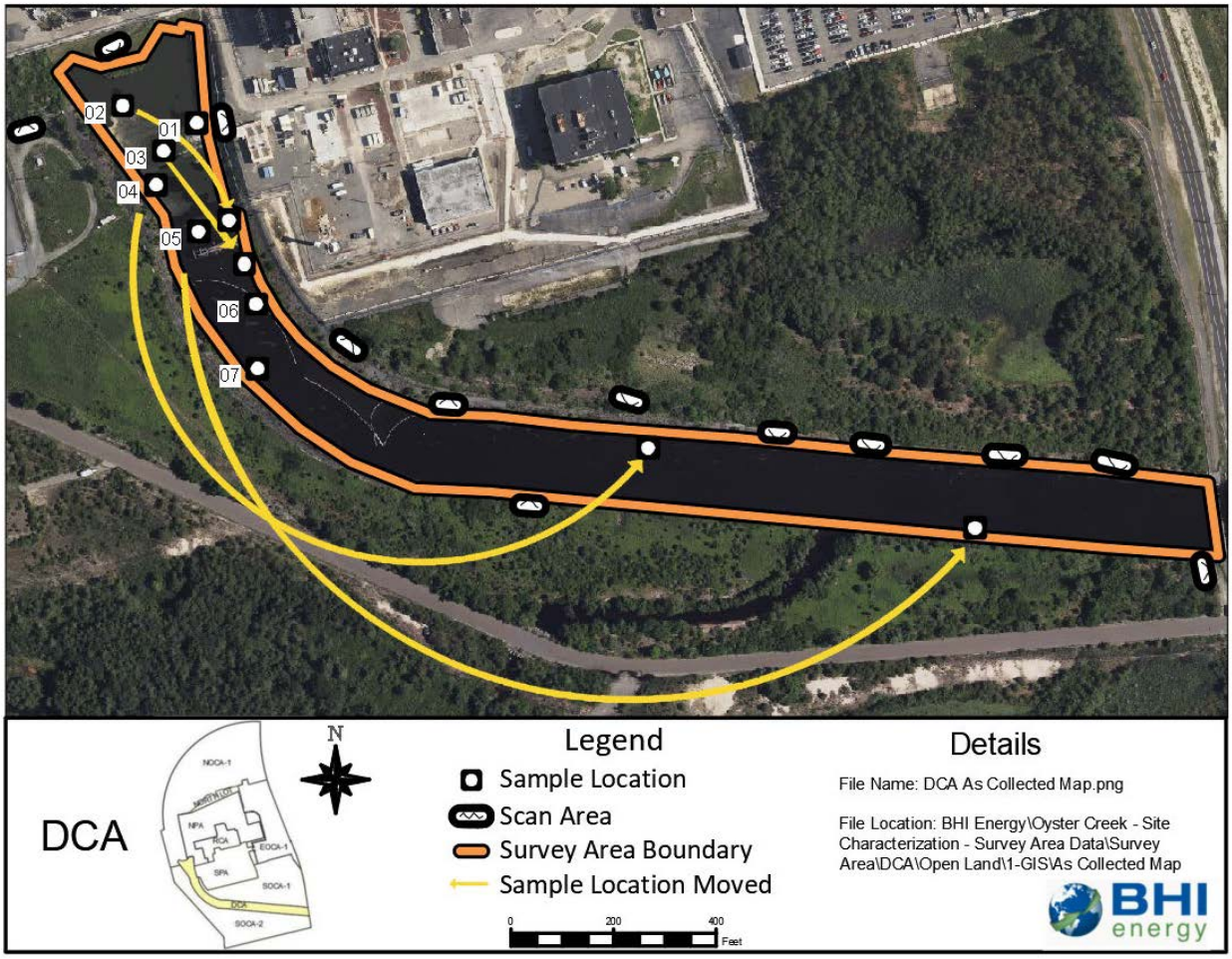


Figure 2-10 DCA Survey Area

Cesium-137 concentrations were less than the achieved MDC values for most DCA samples. However, Cs-137 was detected at concentrations greater than the MDC values in 1 sample, DCA-SEDI-02-B. Sample results can be seen in Table 2-35. The "pink" highlighted results in the tabular data indicate positive results or >MDC. The positive findings are all less than 2.35E-01 pCi/g, which is less than 41% of the Class 3 AC for Cs-137 (5.76E-01 pCi/g).

Cobalt-60 concentrations are greater than the achieved MDC values for most DCA samples. Concentrations greater than the MDC values were identified in 5 samples (DCA-SEDI-01-B-QC, -02-B, -03-B-D, -04-B, and 06-B). The positive samples range from a minimum concentration of 1.01E-01 pCi/g (approximately 41% Class 3 AC) to a maximum concentration of 5.51E-01 pCi/g (3 times the Class 3 AC).

The presence of HTD beta-emitting ROCs (i.e., Sr-90, C-14, Fe-55, Ni-63, and Tc-99) in the SOCA2 survey area was evaluated using analytical results for the QC samples transferred to the off-site laboratory. As shown in Table 2-36, the analyses did not identify any HTD beta-emitting ROC above the MDC value achieved during the analyses.

Table 2-35 Gamma Analysis Results for DCA Sediment Samples

Sediment (SEDI) Sample Gamma Spec - Data Quality Assessment										
Survey Area:	DCA			Number of Samples:	7					
Initial Classification:	Class 3									
Assessment Criteria										
	Class 1	Class 2	Class 3							
Co-60	2.44	1.22	0.244	pCi/g						
Cs-137	5.76	2.88	0.576	pCi/g						
Result Comparison										
	Co-60					Cs-137				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)		Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
DCA-SEDI-1-B-QC	2.32E-01		5.05E-02	N		2.20E-02		4.98E-02	N	
DCA-SEDI-2-B	1.01E-01		3.99E-02	N		2.35E-01		7.02E-02	N	
DCA-SEDI-3-B-D	5.51E-01		5.43E-02	Y		7.38E-02		1.21E-01	N	
DCA-SEDI-4-B	1.40E-01		2.64E-02	N		5.47E-02		9.11E-02	N	
DCA-SEDI-5-B	4.62E-02		1.75E-01	N		3.01E-02		2.17E-01	N	
DCA-SEDI-6-B	1.46E-01		4.20E-02	N		2.58E-02		7.15E-02	N	
DCA-SEDI-7-B	4.78E-02		1.37E-01	N		1.23E-02		1.20E-01	N	
Average	1.81E-01					6.48E-02				
SD	1.75E-01					7.80E-02				
Data Range	4.62E-02	to	5.51E-01			1.23E-02	to	2.35E-01		

Table 2-36 Laboratory HTD Results for DCA Samples

Sample Number	Medium	HTD Beta	Measured (pCi/g)	Achieved MDC (pCi/g)	AC Exceeded (Y/N)
DCA-SEDI-01-B-QC	Sediment	Sr-90	1.89E-02	5.32E-02	N
		C-14	-2.23E-01	6.14E-01	N
		Fe-55	2.06E+01	1.70E+02	N
		Ni-63	-2.01E+00	1.87E+02	N
		Tc-99	3.80E+00	1.72E+00	N

The following conclusions were reached for the DCA area:

- The Discharge Canal contains detectable quantities of Cs-137 and Co-60.
- The current Co-60 findings warrant the reclassification of the Discharge Canal to a Class 2 area.

2.3.1.10 Survey Results for Class 1 Open Land Survey Areas

The Class 1 open land areas at OCNGS total 34,409 m^2 of surface area. The Class 1 open land surface area was broken into two survey areas, RCA and NOCA2, in accordance with the area descriptions, sizes, and boundaries presented in the SCP. The Class 1 open land survey units are illustrated by Figure 2-1. The following sections provide characterization details of those Class 1 areas.

2.3.1.11 NOCA2 Survey Area

Survey and field activities were governed by SAP 02, North Owner Controlled Area-2. Survey planning for the NOCA2 area identified 4 sample locations where plant-related radioactivity might have been introduced from other areas. One sample location was relocated (NOCA2-XXX-04-B) due to the presence of underground utilities and could not be safely collected as planned. An alternative sample location was selected close to the original location and where a representative sample could be safely collected. GPS coordinates for this alternate sample location were recorded during sampling to document the new locations. The sample locations are shown in Figure 2-11.

A total of 10 samples were obtained from the NOCA2 area: 3 surface soil samples, 1 sediment sample, 3 asphalt samples, and 3 at depths greater than 6 in. All samples collected were from biased locations. Asphalt samples were obtained where the soil was covered by asphalt (NOCA2-ASPH-02-B, -03-B, and -04-B).

Sediment sample location NOCA2-SEDI-01-B was chosen because it has a storm drain that could collect runoff from the surrounding area.

Samples obtained at depths greater than 6 in (NOCA2-DEP1-02-B, -03-B, and -04-B) were selected based on information from the HSA regarding the on-site disposal of approximately 17,000 cubic feet of contaminated soil buried in shallow trenches within the NOCA2 boundary.

Walk-over gamma scans were conducted at the NOCA2 boundaries. They were performed using calibrated Ludlum Model 44-10 detectors with Model 3003 multi-detector survey meters to identify any areas of concern or potential migration of radioactivity beyond the survey area. Gamma scans were also conducted at each sample location. A total of 154 m^2 were scanned. The observed bkg count rates ranged between 11,200 and 30,500 cpm. Nearby external sources influenced the count rate observed in several locations. The scans did not identify areas with an "audible distinction" above the location bkg count rate.

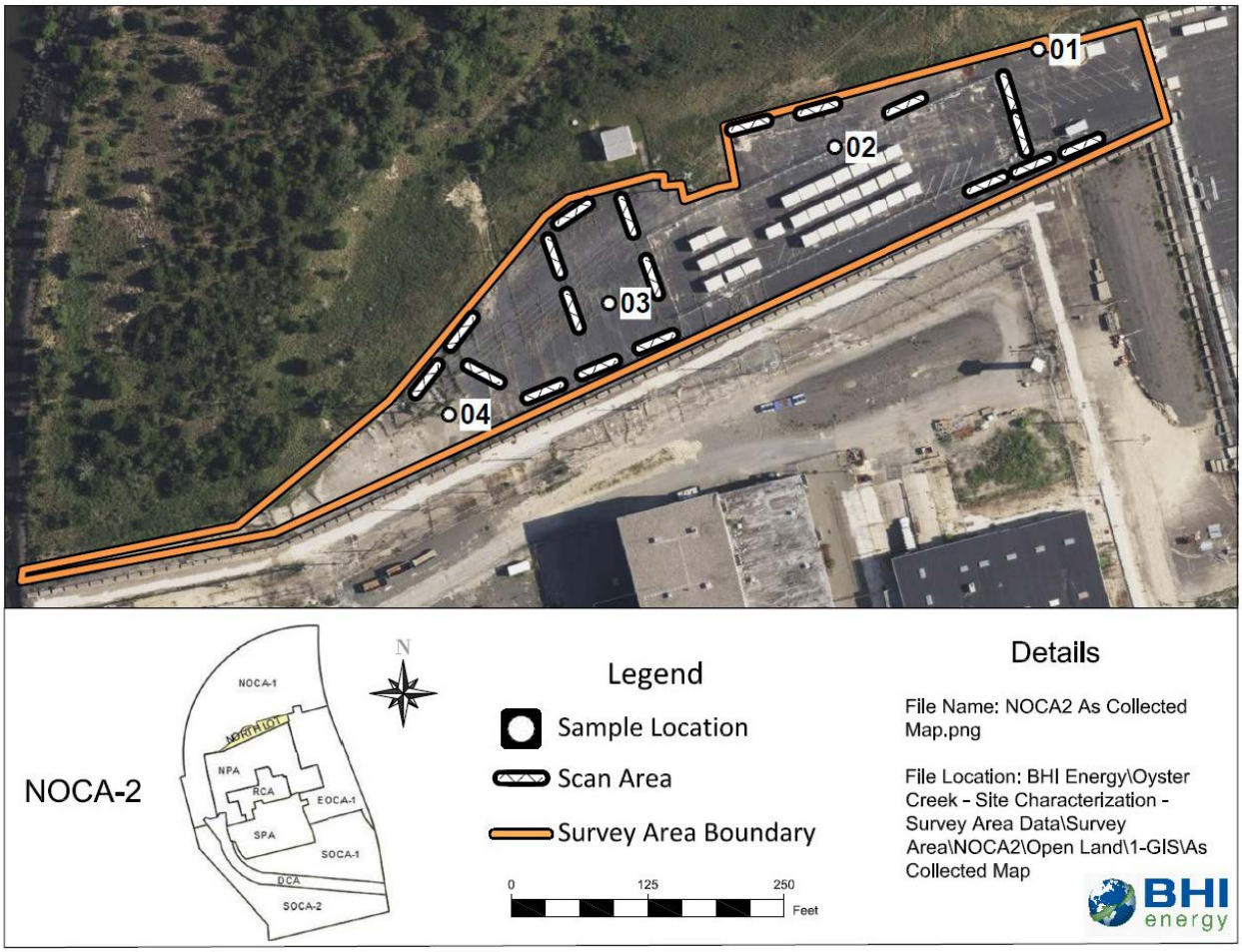


Figure 2-11 NOCA2 Survey Area

Cesium-137 concentrations were less than the achieved MDC values for most NOCA2 samples. However, Cs-137 and Co-60 were detected at concentrations greater than the MDC values in one sample (NOCA2-SEDI-01-B-D), and Cs-137 was detected at a concentration greater than the MDC value in one sample (NOCA2-DEP1-02-B) as seen in Table 2-37. The "pink" highlighted results in the tabular data indicate positive results or >MDC.

The deep soil sample was collected at a depth range of 6 inches to 4 ft.; the on-site gamma analysis report shows the Cs-137 concentration to be 4.75E-01 pCi/g, which is less than 9% of the Class 1 AC for Cs-137 (5.76E+00 pCi/g), as seen in Table 2-37. The asphalt and surface soil samples collected directly above the deep sample showed Cs-137 concentrations below the achieved MDC values. The Cs-137 concentration in the deep sample is potentially from the residual contamination associated with the NRC-approved relocation of contaminated site soil to the NOCA2 area in 1982 prior to the expansion of the North Parking Lot.

The sediment sample from the storm drain sample contained detectable Cs-137 and Co-60 at 1.07E-01 pCi/g and 6.51E-02 pCi/g, respectively. The activity concentration is less than 6% of the Class 1 AC for Co-60 and Cs-137, as seen in Table 2-38. Positive findings were not wholly unexpected because the storm drain is a collection point for site runoff that may have contained fallout from gaseous effluent releases.

The Co-60 concentrations in the asphalt (Table 2-39), surface soil (Table 2-40), and deep soil samples were below the achieved MDC values, which ranged from 4.66E-02 pCi/g to 9.81E-02 pCi/g indicating that if present in NOCA2, Co-60 contamination would likely not be widespread or exceed a small fraction of the Class 1 AC for Co-60.

The presence of HTD beta-emitting ROCs (i.e., Sr-90, C-14, Fe-55, Ni-63, and Tc-99) in the NOCA2 survey area was evaluated using analytical results for the QC samples transferred to the off-site laboratory. The results of those analyses (provided in Table 2-41) did not identify any HTD beta-emitting ROC above the MDC value achieved during the analyses.

Table 2-37 Gamma Analysis Results for NOCA2 Deep Samples

Deep Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**NOCA2**			**Number of Samples:**			**3**		
Initial Classification:	**Class 1**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
NOCA2-DEP1-2-B	6.98E-03		5.72E-02	N	4.75E-01		7.12E-02	N	
NOCA2-DEP1-3-B	-1.88E-02		7.73E-02	N	-1.88E-02		7.73E-02	N	
NOCA2-DEP1-4-B	3.73E-02		9.81E-02	N	3.73E-02		9.81E-02	N	
Average	8.49E-03				1.65E-01				
SD	2.81E-02				2.70E-01				
Data Range	-1.88E-02	to	3.73E-02		-1.88E-02	to	4.75E-01		

Table 2-38 Gamma Analysis Results for NOCA2 Sediment Samples

Sediment Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**NOCA2**			**Number of Samples:**			**1**		
Initial Classification:	**Class 1**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
NOCA2-SEDI-1-B-D	6.51E-02		4.69E-02	N	1.07E-01		6.85E-02	N	
Average									
SD									
Data Range		to				to			

Table 2-39 Gamma Analysis Results for NOCA2 Asphalt Samples

Asphalt Sample Gamma Spec - Data Quality Assessment									
Survey Area:	NOCA2			Number of Samples:			3		
Initial Classification:	Class 1								
Result Comparison									
	Co-60				Cs-137				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
NOCA2-ASPH-2-B	1.76E-02		6.91E-02	n/a	7.55E-03		7.06E-02	n/a	
NOCA2-ASPH-3-B	-2.00E-02		7.08E-02	n/a	-3.74E-02		6.55E-02	n/a	
NOCA2-ASPH-4-B	2.37E-02		7.22E-02	n/a	1.65E-02		7.32E-02	n/a	
Average	7.10E-03				-4.45E-03				
SD	2.37E-02				2.89E-02				
Data Range	-2.00E-02	to	2.37E-02		-3.74E-02	to	1.65E-02		

Table 2-40 Gamma Analysis Results for NOCA2 Soil Samples

Soil Sample Gamma Spec - Data Quality Assessment									
Survey Area:	NOCA2			Number of Samples:			3		
Initial Classification:	Class 1								
Result Comparison									
	Co-60				Cs-137				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
NOCA2-SOIL-2-B	1.01E-02		7.29E-02	N	-7.99E-03		9.88E-02	N	
NOCA2-SOIL-3-QC	-2.01E-03		4.66E-02	N	2.54E-02		7.81E-02	N	
NOCA2-SOIL-4-B	1.19E-02		4.95E-02	N	2.01E-02		5.24E-02	N	
Average	6.66E-03				1.25E-02				
SD	7.57E-03				1.79E-02				
Data Range	-2.01E-03	to	1.19E-02		-7.99E-03	to	2.54E-02		

Table 2-41 Laboratory HTD Results for NOCA2 Samples

Sample Number	Medium	HTD Beta	Measured (pCi/g)	Achieved MDC (pCi/g)	AC Exceeded (Y/N)
NOCA2-SOIL-03-B-QC	Soil	Sr-90	6.47E-02	8.22E-02	N
		C-14	1.11E-01	5.89E-01	N
		Fe-55	9.91E+01	1.44E+02	N
		Ni-63	-1.79E+00	2.70E+01	N
		Tc-99	-3.36E-02	9.42E-01	N

The following conclusions were reached for the NOCA2 area:

- Excavation of the contaminated soil relocated in 1982 under the North Parking is not likely necessary, as indicated by the low Cs-137 concentration in the deep soil sample (i.e., less than 10% of the Cs-137 AC). The measured Cs-137 and Co-60 concentrations in NOCA2 samples indicate that the area meets MARSSIM Class 3 criteria.
- MARSSIM Class 1 designation is appropriate for the NOCA2 survey area: basis (waste storage location).

2.3.1.12 RCA Survey Area

SAP 10, Radiologically Controlled Area governed survey and field activities. The Radiological Engineer identified 16 biased sample locations where plant-related radioactivity had been introduced from spills and plant operations, as indicated by the HSA. An additional 2 sample locations (RCA-XXX-18-B and RCA-SOIL-19-B). The sample locations are shown in Figure 2-12.

Thirty-three samples were collected from the RCA area: 17 surface soil samples, 4 sediment samples, 7 asphalt samples, and 5 samples at depths greater than 15 cm.

RCA-SOIL-06-B-QC was not able to be collected as initially planned. During asphalt sampling, a concrete slab was encountered; the asphalt sample, RCA-ASPH-06-B, was kept and analyzed. An alternate location was selected, resulting in 2 samples, RCA-ASPH-20-B and RCA-SOIL-20-B-QC. GPS coordinates for the alternative location were recorded.

Sediment sample locations RCA-SEDI-03-B and RCA-SEDI-14-B were selected near storm drains. Sediment was also obtained from RCA-SEDI-10-B and RCA-SEDI-18-B because sediment covered these planned survey locations.

Asphalt samples were obtained at locations where the soil was covered by asphalt. The only exception was sample RCA-ASPH-06-B, as discussed previously.

Samples at depths greater than 6 inches were obtained based on indications in the HSA where plant-related radioactivity had been introduced from spills and plant operations. Sample RCA-SSUB-05-B was obtained at a depth of 6-12 inches in the loading dock area of the ORW facility based on the historical potential for material to have penetrated the asphalt. The 4 remaining samples, taken at depths greater than 6 inches, were obtained from 6 inches to 4 feet. These locations (RCA-DEP1-01-B, -08-B, -11-B, and –15B) were chosen based on historical spills. Two samples were not obtained at depth per the SAP plan, RCA-DEP2-08-B and RCA-DEP1-16-B. RCA-DEP1-16-B was not obtained due to resistance during sampling in the form of a buried concrete slab.

Walk-over gamma scans were conducted at the RCA boundaries. They were performed using calibrated pairings of Ludlum Model 44-10 detectors with Model 3003 multi-detector survey meters to identify the presence of elevated radioactivity. Gamma scan measurements were also conducted at each sample location. A total of 90 m^2 were scanned. Count rates were logged between 2,710 and 24,600 cpm at sample locations in the RCA area. Multiple locations in the RCA were scanned with a collimator shield around the Ludlum 44-10 detector to reduce ambient bkg sources. The highest measurement was due to the presence of exposed Radioactive Waste piping. The gamma scans performed in the RCA survey area did not identify elevated radioactivity requiring further investigation. Scans identified no areas with an "audible distinction" above the location bkg count rate.

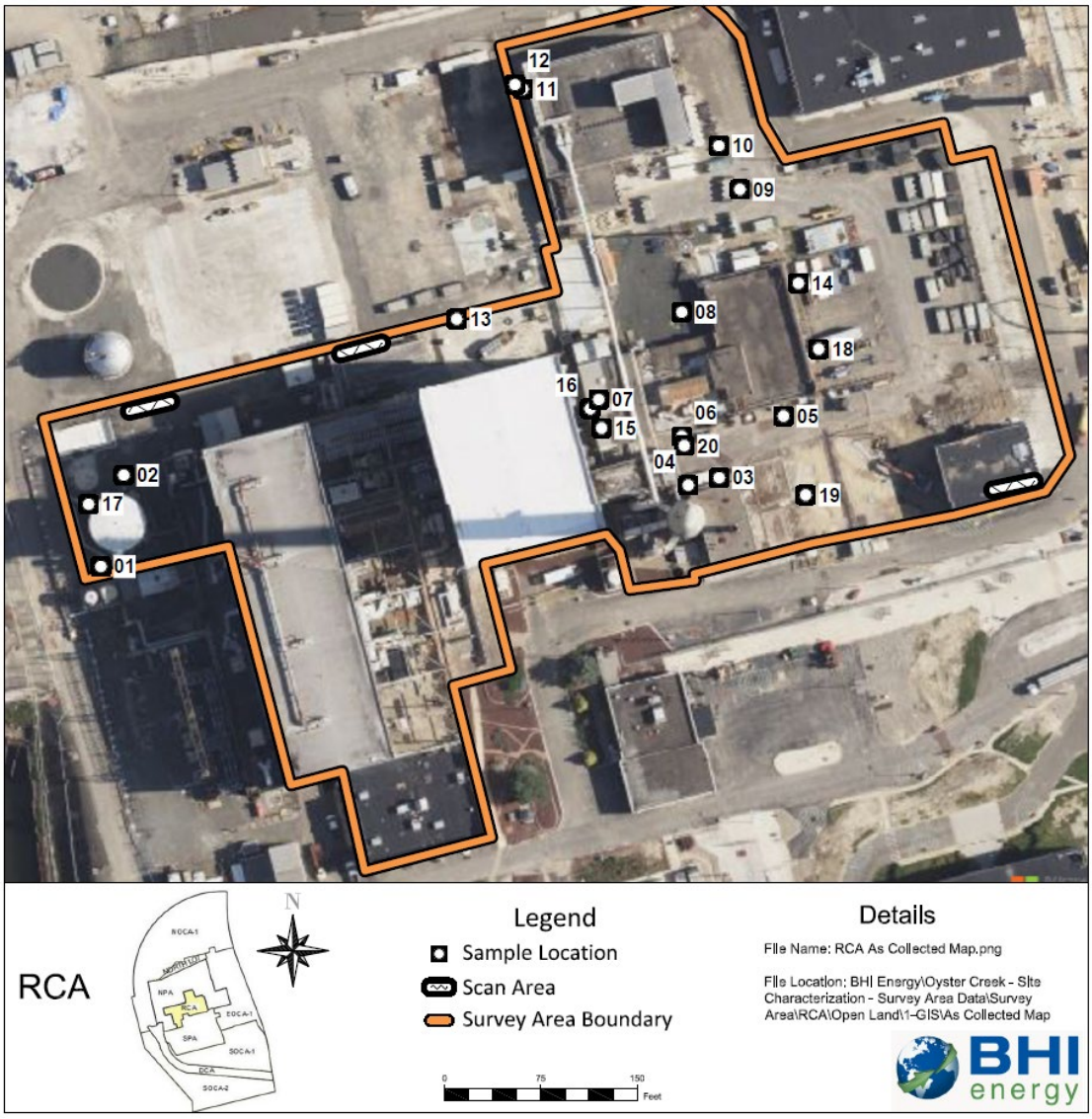


Figure 2-12 RCA Survey Area

Cesium-137 and Co-60 concentrations exceed the achieved MDC values for most RCA samples. Characterization data for surface soil samples are provided in Table 2-42, sediment samples are provided in Table 2-43, asphalt samples are provided in Table 2-44, and soil samples at depths

greater than 15 cm are provided in Table 2-45 and Table 2-46. The "pink" highlighted results in the tabular data indicate positive results or >MDC.

Cesium-137 concentrations in surface soil samples ranged from non-detectable concentrations (less than achieved MDC values) to a maximum concentration of 1.62E+01 pCi/g, exceeding the Class 1 AC value (approximately 3 times the AC) with 11 of 17 soil samples showing concentrations greater than MDC. The Co-60 concentrations in surface soil samples ranged from non-detectable concentrations (less than achieved MDC values) to a maximum Co-60 concentration of 5.97E+00 pCi/g, exceeding the Class 1 AC value (approximately 3 times the AC) with 10 of 17 soil samples showing Co-60 concentrations greater than MDC.

Cesium-137 concentrations in sediment samples were greater than the achieved MDC values, ranging from 1.36E+00 pCi/g (24% of the Class 1 AC) to 3.232E+01 pCi/g (approximately 6 times the Class 1 AC). For Co-60, concentrations in sediment samples were greater than the achieved MDC values and ranged from 1.10E+00 pCi/g (45% AC) minimum to 1.32E+01 pCi/g (approximately 6 times the AC) maximum, which exceeds the Class 1 AC value.

In asphalt samples, Cs-137 concentrations ranged from non-detectable concentrations (less than achieved MDC values) to a maximum 7 concentration of 1.97E+00 pCi/g (34% of the Class 1 AC). Five of 7 asphalt samples contained Cs-137 at concentrations greater than the MDC. The Co-60 concentrations in asphalt samples ranged from non-detectable concentrations (less than achieved MDC values) to a maximum concentration of 3.49E-01 pCi/g (approximately 14% of the Class 1 AC). A total of 4 of 7 asphalt samples contained Co-60 concentrations greater than MDC.

Soil samples collected at depths greater than 6 inches range from non-detectable concentrations (less than achieved MDC values) to a maximum Cs-137 activity concentration of 4.04E+02 pCi/g (approximately 70 times the AC). The Co-60 concentrations in those same deep samples range from non-detectable concentrations (less than achieved MDC values) to a maximum Co-60 concentration of 1.11E+02 pCi/g (approximately 45 times the Class 1 AC). The greater contamination levels found in the deep soil sample compared to the surface contamination levels indicate historical leakage from the south pipe chase and overflow from a valve pit.

This data provides a snapshot of the current radiological condition of the RCA survey area, which is expected to change as the decommissioning of the site moves forward. The collected site characterization data identified 2 areas that may require special attention during decommissioning. The location of samples RCA-SOIL-04-B-D (east of RXB railroad bay doors) and RCA-SOIL-15-B (east side of RXB near the south pipe chase) are areas where the concentrations of both Cs-137 and Co-60 in the surface soil exceeded the respective Class 1 AC values. The surface soil sample RCA-SOIL-04-B-D contained Cs-137 at an activity concentration of 1.62E+01 pCi/g (approximately 3 times the Class 1 AC) and Co-60 at 5.11E+00 pCi/g (approximately 2 times the Class 1 AC). Sample RCA-SOIL-15-B contained Cs-137 at a concentration of 4.94E+00 pCi/g (approximately 86% of the AC) and Co-60 at 5.97E+00 pCi/g (approximately 3 times the Class 1 AC).

The presence of HTD beta-emitting ROCs (i.e., Sr-90, C-14, Fe-55, Ni-63, Tc-99, and Pu-241) in the SOCA2 survey area was evaluated using analytical results for the QC samples transferred to the off-site laboratory. As shown in Table 2-47, the analyses did not identify any HTD beta-emitting ROC above the MDC value achieved during the analyses.

Table 2-42 Gamma Analysis Results for RCA Soil Samples

Soil Sample Gamma Spec - Data Quality Assessment									
Survey Area:	RCA			Number of Samples:	17				
Initial Classification:	Class 1								
Result Comparison									
	Co-60				Cs-137				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
RCA-SOIL-1-B	4.10E-03		1.02E-01	N	1.06E-01		1.47E-01	N	
RCA-SOIL-2-B	3.55E-02		1.17E-01	N	1.48E-02		1.01E-01	N	
RCA-SOIL-4-B-D	5.11E+00		1.21E-01	Y	1.62E+01		2.45E-01	Y	
RCA-SOIL-5-B	-2.29E-02		1.19E-01	N	2.22E+00		1.22E-01	N	
RCA-SOIL-7-B	5.95E-01		1.54E-02	N	3.51E-01		1.03E-01	N	
RCA-SOIL-8-B-QC	1.20E-01		5.59E-02	N	4.21E-01		1.10E-01	N	
RCA-SOIL-9-B	3.20E-02		8.83E-02	N	4.87E-02		8.81E-02	N	
RCA-SOIL-10-B	3.02E-02		9.47E-02	N	1.07E+00		1.16E-01	N	
RCA-SOIL-11-B	2.72E-01		5.27E-02	N	3.05E-01		1.00E-01	N	
RCA-SOIL-12-B-D	1.57E-01		1.35E-02	N	7.27E-01		1.05E-01	N	
RCA-SOIL-13-B-QC	1.36E-01		1.30E-01	N	5.47E-02		8.94E-02	N	
RCA-SOIL-15-B	5.97E+00		1.51E-01	Y	4.94E+00		2.60E-01	N	
RCA-SOIL-16-B	1.55E+00		1.35E-01	N	5.95E-01		1.45E-01	N	
RCA-SOIL-17-B	1.07E-01		1.09E-01	N	7.31E-02		8.86E-02	N	
RCA-SOIL-18-B	4.47E-03		1.05E-01	N	4.31E-03		1.08E-01	N	
RCA-SOIL-19-B	1.22E+00		1.09E-01	N	4.57E+00		1.77E-01	N	
RCA-SOIL-20-B-QC	1.36E-01		7.31E-02	N	3.34E+00		1.38E-01	N	
Average	9.09E-01				2.06E+00				
SD	1.80E+00				3.98E+00				
Data Range	-2.29E-02	to	5.97E+00		4.31E-03	to	1.62E+01		

Table 2-43 Gamma Analysis Results for RCA Sediment Samples

Sediment Sample Gamma Spec - Data Quality Assessment									
Survey Area:	RCA			Number of Samples:	4				
Initial Classification:	Class 1								
Result Comparison									
	Co-60				Cs-137				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
RCA-SEDI-3-B	1.10E+00		1.48E-01	N	1.40E+01		2.91E-01	Y	
RCA-SEDI-10-B	2.87E+00		9.56E-02	Y	2.15E+00		1.61E-01	N	
RCA-SEDI-14-B	1.32E+01		2.71E-01	Y	3.23E+01		4.45E-01	Y	
RCA-SEDI-18-B	1.41E+00		6.67E-02	N	1.36E+00		1.48E-01	N	
Average	4.65E+00				1.25E+01				
SD	5.76E+00				1.44E+01				
Data Range	1.10E+00	to	1.32E+01		1.36E+00	to	3.23E+01		

Table 2-44 Gamma Analysis Results for RCA Asphalt Samples

Asphalt Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**			**Number of Samples:**			**7**	
Initial Classification:	**Class 1**							
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)
RCA-ASPH-5-B	5.57E-02		8.93E-02	N	1.97E+00		1.19E-01	N
RCA-ASPH-6-B	1.20E-01		1.23E-01	N	1.49E+00		1.51E-01	N
RCA-ASPH-9-B	1.16E-01		6.86E-02	N	6.82E-02		1.28E-01	N
RCA-ASPH-10-B	1.90E-01		1.49E-01	N	1.49E-01		9.13E-02	N
RCA-ASPH-13-B	1.32E-02		1.81E-01	N	6.68E-02		1.85E-01	N
RCA-ASPH-18-B	1.12E-01		5.75E-02	N	2.20E-01		1.18E-01	N
RCA-ASPH-20-B	3.49E-01		8.85E-02	N	6.57E-01		1.18E-01	N
Average	1.37E-01				6.60E-01			
SD	1.09E-01				7.70E-01			
Data Range	1.32E-02	to	3.49E-01		6.68E-02	to	1.97E+00	

Table 2-45 Gamma Analysis Results for RCA Subsurface Soil Samples

Sub-Surface Soil Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**			**Number of Samples:**			**1**	
Initial Classification:	**Class 1**							
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)
RCA-SSUB-5-B	-3.80E-03		6.08E-02	N	3.29E-01		7.84E-02	N
Average								
SD								
Data Range		to				to		

Table 2-46 Gamma Analysis Results for RCA Deep Samples

Deep Composite Soil (DEEP) Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**RCA**			**Number of Samples:**			**4**		
Initial Classification:	**Class 1**								
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	Measured Data (pCi/g)		Achieved MDC Value (pCi/g)	AC Exceeded (Y/N)	
RCA-DEP1-1-B	9.55E-03		9.58E-02	N	3.32E-02		7.42E-02	N	
RCA-DEP1-8-B	7.72E-02		1.45E-01	N	1.02E+00		1.14E-01	N	
RCA-DEP1-11-B	-5.67E-03		6.99E-02	N	1.78E-01		9.62E-02	N	
RCA-DEP1-15-B	1.11E+02		6.29E-01	Y	4.04E+02		1.22E+00	Y	
Average	2.78E+01				1.01E+02				
SD	5.55E+01				2.02E+02				
Data Range	-5.67E-03	to	1.11E+02		3.32E-02	to	4.04E+02		

Table 2-47 Laboratory HTD Results for RCA Samples

Sample Number	Medium	HTD Beta	Measured (pCi/g)	Achieved MDC (pCi/g)	AC Exceeded (Y/N)
RCA-SOIL-08-B	Soil	Sr-90	4.02E-02	6.52E-02	N
		C-14	-2.73E-01	6.39E-01	N
		Fe-55	5.71E+01	1.68E+02	N
		Ni-63	4.16E+00	2.34E+01	N
		Tc-99	4.27E-01	7.60E-01	N
		Pu-241	1.33E+01	4.17E+01	N
RCA-SOIL-13-B-QC	Soil	Sr-90	1.01E-02	6.35E-02	N
		C-14	-3.78E-01	5.93E-01	N
		Fe-55	8.78E+01	2.24E+02	N
		Ni-63	-4.02E+00	2.30E+01	N
		Tc-99	6.36E-01	1.54E+00	N
		Pu-241	6.65E+00	3.73E+01	N
RCA-SOIL-20-B-QC	Soil	Sr-90	9.71E-03	6.40E-02	N
		C-14	-3.96E-02	6.04E-01	N
		Fe-55	9.24E+01	1.44E+02	N
		Ni-63	1.10E+00	2.28E+01	N
		Tc-99	4.85E-01	1.61E+00	N
		Pu-241	9.00E+00	4.59e+01	N

The following conclusions were reached for the RCA survey area:

- The collected data confirms that the RCA is MARSSIM Class 1.
- The Cs-137 and Co-60 concentrations in soil samples from locations 4 and 15 indicate that excavation or remediation is required to meet site release criteria.

2.3.2 Survey Results for Class 1 Structures

2.3.2.1 Radiologically Controlled Area Structures

During 2023, characterization samples were collected to assess the level of remediation that may be required in subgrade structures that may be left behind. Survey and field activities were governed by SAP 11, Radiological Controlled Area. Sample locations were surveyed for loose surface contamination and then cleaned to prevent cross-contamination of the core samples. Existing source terms inhibited direct surveys in these areas. Core samples were collected to a 3" depth to provide a profile of the depth of fixed contamination that may require remediation moving forward. The core samples were segmented into the top 1/8" surface, then 0.5-inch pucks for onsite gamma analysis (i.e., 7 samples per location). Based on the gamma analysis, samples indicating elevated gamma activity were selected as biased samples for HTD analysis by an offsite laboratory.

Approximately 121 core sample locations were identified in the RCA: RXB -50 locations, TURB – 45 locations, Reactor Building Ventilation Tunnel (RXBT)– 3 locations, Turbine Building Ventilation Tunnel (TURT) – 10 locations, BSTK – 4 locations, and New Radwaste Pipe Tunnel (NRWT) – 9 locations. Each sample location had the potential to yield 7 segmented samples to evaluate contamination at depth. The concrete AC for the core samples are based on the Co-60 (327 pCi/g) and Cs-137 (1480 pCi/g). These values are based on the DCGL corresponding to 15 mrem/y and an industrial use scenario assuming that the residual contamination is reasonably distributed through the 0.5-inch pucks. However, if the onsite gamma spectroscopy assay yielded little indication of Co-60 or Cs-137, further assay for HTDs was unlikely to yield statistically meaningful results. Core samples that provided value to the determination of depth of contamination and/or identification of HTDs are included in the tables below. Specific data on core locations within the structures and supplemental analysis may be found in the OCNGS Below Grade Structures Characterization Report (Reference 2-12) if needed.

Table 2-48 Gamma Results for RXB Concrete Core Samples

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	RCA	Survey Building:	RXB	Number of Samples:	50			
Initial Classification:	Class 1	Sample Depth:	0.0					
Result Comparison								
	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXB-CONC-001-0.0-B	1.24E+00	7.21E-02	2.14E-01	N	1.33E+00	9.41E-02	2.16E-01	N
RCA-RXB-CONC-002-0.0-B-QC	8.05E+01	1.51E+00	2.27E-01	N	7.30E+03	2.21E+02	1.52E+00	Y
RCA-RXB-CONC-003-0.0-B-QC	7.70E+01	1.45E+00	2.82E-01	N	3.40E+02	1.03E+01	4.11E-01	N
RCA-RXB-CONC-004-0.0-B-D-QC	4.55E+00	1.12E-01	1.22E-01	N	8.63E+01	2.64E+00	2.06E-01	N
RCA-RXB-CONC-005-0.0-B	3.60E+00	1.05E-01	1.75E-01	N	2.72E+01	8.59E-01	2.04E-01	N
RCA-RXB-CONC-006-0.0-B	2.52E-01	3.07E-02	1.36E-01	N	1.47E-01	3.22E-02	1.25E-01	N
RCA-RXB-CONC-007-0.0-B	7.42E-01	6.46E-02	1.97E-01	N	3.29E+00	1.71E-01	2.38E-01	N
RCA-RXB-CONC-008-0.0-B	2.11E+01	4.22E-01	2.66E-01	N	7.51E+02	2.28E+01	5.04E-01	N
RCA-RXB-CONC-009-0.0-B-QC	1.26E+00	6.03E-02	1.10E-01	N	1.69E+02	5.18E+00	3.72E-01	N
RCA-RXB-CONC-010-0.0-B	3.17E-01	4.37E-02	1.81E-01	N	8.47E-01	7.94E-02	2.16E-01	N
RCA-RXB-CONC-011-0.0-B-QC	3.38E-01	2.89E-02	1.01E-01	N	4.77E+01	1.48E+00	2.10E-01	N
RCA-RXB-CONC-012-0.0-B-D-QC	2.23E+01	4.34E-01	1.74E-01	N	1.08E+03	3.27E+01	4.82E-01	N
RCA-RXB-CONC-013-0.0-B	8.03E-01	5.72E-02	2.07E-01	N	6.40E+00	2.49E-01	1.85E-01	N
RCA-RXB-CONC-014-0.0-B-QC	7.07E+00	1.51E-01	1.15E-01	N	4.56E+02	1.38E+01	3.71E-01	N
RCA-RXB-CONC-015-0.0-B	1.39E-01	4.53E-02	1.69E-01	N	6.81E-01	7.26E-02	2.04E-01	N
RCA-RXB-CONC-016-0.0-B	1.01E-01	2.64E-02	1.37E-01	N	8.03E-01	7.39E-02	2.14E-01	N
RCA-RXB-CONC-017-0.0-B	1.53E-01	4.48E-02	1.71E-01	N	2.59E-01	5.09E-02	1.90E-01	N
RCA-RXB-CONC-018-0.0-B	1.34E-01	3.18E-02	1.72E-01	N	3.92E-01	5.29E-02	1.72E-01	N
RCA-RXB-CONC-019-0.0-B-QC	2.19E+00	8.06E-02	1.56E-01	N	1.87E+02	5.71E+00	3.63E-01	N
RCA-RXB-CONC-020-0.0-B-QC	1.20E+00	5.31E-02	1.59E-01	N	5.19E+01	1.60E+00	2.22E-01	N
RCA-RXB-CONC-021-0.0-B	1.44E-01	2.67E-02	1.33E-01	N	4.59E-01	5.62E-02	1.94E-01	N
RCA-RXB-CONC-022-0.0-B	3.11E-01	4.42E-02	2.13E-01	N	4.34E+00	1.98E-01	2.35E-01	N
RCA-RXB-CONC-023-0.0-B-QC	6.42E+01	1.25E+00	4.68E-01	N	6.76E+02	2.06E+01	8.61E-01	N

RCA-RXB-CONC-024-0.0-B-QC	5.88E+01	1.14E+00	4.18E-01	N	1.14E+03	3.46E+01	8.88E-01	N
RCA-RXB-CONC-025-0.0-B-QC	6.91E+01	1.30E+00	2.89E-01	N	7.58E+02	2.30E+01	5.74E-01	N
RCA-RXB-CONC-026-0.0-B-D-QC	4.20E+01	8.34E-01	3.21E-01	N	4.65E+02	1.42E+01	6.62E-01	N
RCA-RXB-CONC-027-0.0-B-QC	1.08E+02	2.02E+00	3.45E-01	N	2.87E+02	8.71E+00	4.61E-01	N
RCA-RXB-CONC-028-0.0-B-QC	8.93E+01	1.68E+00	3.48E-01	N	3.13E+02	9.50E+00	4.82E-01	N
RCA-RXB-CONC-029-0.0-B-QC	1.25E+02	2.34E+00	3.69E-01	N	4.23E+02	1.28E+01	5.17E-01	N
RCA-RXB-CONC-030-0.0-B-QC	2.92E+01	5.77E-01	2.65E-01	N	1.14E+03	3.46E+01	7.63E-01	N
RCA-RXB-CONC-031-0.0-B	1.79E+01	3.80E-01	2.51E-01	N	3.77E+00	1.59E-01	2.78E-01	N
RCA-RXB-CONC-032-0.0-B-QC	6.78E+01	1.33E+00	5.51E-01	N	3.72E+03	1.13E+02	1.90E+00	Y
RCA-RXB-CONC-033-0.0-B	2.46E+00	8.22E-02	1.74E-01	N	2.04E+01	6.55E-01	1.94E-01	N
RCA-RXB-CONC-034-0.0-B-QC	9.12E+01	1.77E+00	6.19E-01	N	6.61E+03	2.01E+02	2.34E+00	Y
RCA-RXB-CONC-035-0.0-B-QC	1.55E+02	2.95E+00	8.26E-01	N	6.16E+02	1.87E+01	1.19E+00	N
RCA-RXB-CONC-036-0.0-B-QC	2.64E+02	4.92E+00	6.27E-01	N	1.03E+03	3.11E+01	8.92E-01	N
RCA-RXB-CONC-037-0.0-B-QC	3.45E+01	6.63E-01	2.62E-01	N	6.28E+01	1.92E+00	2.84E-01	N
RCA-RXB-CONC-038-0.0-B-QC	8.95E+01	1.72E+00	5.38E-01	N	4.29E+02	1.31E+01	8.18E-01	N
RCA-RXB-CONC-039-0.0-B	1.32E+00	6.26E-02	1.26E-01	N	2.16E+01	6.98E-01	1.79E-01	N
RCA-RXB-CONC-040-0.0-B-QC	6.33E+00	1.61E-01	1.74E-01	N	8.49E+02	2.58E+01	7.14E-01	N
RCA-RXB-CONC-041-0.0-B-QC	1.18E+01	2.70E-01	2.43E-01	N	3.23E+02	9.85E+00	5.75E-01	N
RCA-RXB-CONC-042-0.0-B-D	7.95E+00	2.00E-01	2.56E-01	N	3.40E+02	1.04E+01	5.15E-01	N
RCA-RXB-CONC-043-0.0-B-QC	6.72E+01	1.31E+00	5.31E-01	N	8.93E+02	2.72E+01	9.24E-01	N
RCA-RXB-CONC-044-0.0-B	7.30E-01	5.88E-02	1.96E-01	N	1.50E+00	1.10E-01	2.80E-01	N
RCA-RXB-CONC-045-0.0-B	1.65E+01	3.23E-01	1.19E-01	N	1.98E+03	6.01E+01	5.98E-01	Y
RCA-RXB-CONC-046-0.0-B-QC	3.07E+01	6.36E-01	4.02E-01	N	2.39E+03	7.25E+01	1.40E+00	Y
RCA-RXB-CONC-047-0.0-B	2.28E+00	1.07E-01	2.08E-01	N	6.66E+00	2.72E-01	2.49E-01	N
RCA-RXB-CONC-048-0.0-B-QC	6.55E+01	1.27E+00	4.65E-01	N	1.24E+03	3.78E+01	1.07E+00	N
RCA-RXB-CONC-049-0.0-B-D	4.28E+00	1.31E-01	1.91E-01	N	1.26E+02	3.88E+00	3.54E-01	N
RCA-RXB-CONC-050-0.0-B	8.59E+00	1.90E-01	2.13E-01	N	1.16E+01	3.79E-01	2.14E-01	N
Average Activity	3.51E+01				7.28E+02			
Activity Standard Deviation	5.12E+01				1.47E+03			
Activity Range	1.01E-01	to	2.64E+02		1.47E-01	to	7.30E+03	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**	**Survey Building:**	**RXB**	**Number of Samples:**	**50**			
Initial Classification:	**Class 1**	**Sample Depth:**	**0.5**					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXB-CONC-001-0.5-B	7.95E-02	3.24E-02	1.38E-01	N	1.66E-01	0.00E+00	1.66E-01	N
RCA-RXB-CONC-002-0.5-B	2.29E-01	0.00E+00	2.29E-01	N	8.03E-01	8.06E-02	1.84E-01	N
RCA-RXB-CONC-003-0.5-B	9.70E+00	3.15E-01	3.78E-01	N	2.29E+00	1.72E-01	4.13E-01	N
RCA-RXB-CONC-004-0.5-B-D	1.84E-01	0.00E+00	1.84E-01	N	1.91E-01	0.00E+00	1.91E-01	N
RCA-RXB-CONC-005-0.5-B	2.32E-01	0.00E+00	2.32E-01	N	1.88E-01	0.00E+00	1.88E-01	N
RCA-RXB-CONC-006-0.5-B	2.38E-01	0.00E+00	2.38E-01	N	1.78E-01	0.00E+00	1.78E-01	N
RCA-RXB-CONC-007-0.5-B	1.07E-01	3.43E-02	1.21E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-RXB-CONC-008-0.5-B	4.49E-01	4.00E-02	8.72E-02	N	6.39E+00	2.49E-01	2.11E-01	N
RCA-RXB-CONC-009-0.5-B	1.59E-01	3.96E-02	1.47E-01	N	9.02E+00	3.23E-01	2.00E-01	N
RCA-RXB-CONC-010-0.5-B	2.25E-01	0.00E+00	2.25E-01	N	2.02E-01	0.00E+00	2.02E-01	N
RCA-RXB-CONC-011-0.5-B	2.25E-01	0.00E+00	2.25E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-RXB-CONC-012-0.5-B-D	8.43E-01	3.20E-02	7.69E-02	N	6.00E+02	1.82E+01	3.52E-01	N
RCA-RXB-CONC-013-0.5-B	2.23E-01	0.00E+00	2.23E-01	N	1.89E-01	3.95E-02	1.49E-01	N
RCA-RXB-CONC-014-0.5-B-QC	2.36E-01	0.00E+00	2.36E-01	N	6.65E+01	2.07E+00	2.75E-01	N
RCA-RXB-CONC-015-0.5-B	2.22E-01	0.00E+00	2.22E-01	N	2.44E-01	0.00E+00	2.44E-01	N
RCA-RXB-CONC-016-0.5-B	2.07E-01	0.00E+00	2.07E-01	N	2.31E-01	0.00E+00	2.31E-01	N
RCA-RXB-CONC-017-0.5-B	2.07E-01	0.00E+00	2.07E-01	N	2.13E-01	0.00E+00	2.13E-01	N
RCA-RXB-CONC-018-0.5-B	2.22E-01	0.00E+00	2.22E-01	N	2.48E-01	0.00E+00	2.48E-01	N
RCA-RXB-CONC-019-0.5-B	2.11E-01	0.00E+00	2.11E-01	N	6.89E+00	2.62E-01	1.25E-01	N
RCA-RXB-CONC-020-0.5-B-QC	6.12E-01	3.85E-02	1.10E-01	N	1.32E+02	4.04E+00	3.16E-01	N
RCA-RXB-CONC-021-0.5-B	2.12E-01	0.00E+00	2.12E-01	N	1.84E-01	0.00E+00	1.84E-01	N
RCA-RXB-CONC-022-0.5-B	2.42E-01	0.00E+00	2.42E-01	N	2.41E-01	0.00E+00	2.41E-01	N
RCA-RXB-CONC-023-0.5-B-QC	4.14E-01	2.55E-02	8.58E-02	N	7.01E+01	2.15E+00	1.97E-01	N

RCA-RXB-CONC-024-0.5-B-QC	6.88E-01	4.70E-02	1.16E-01	N	7.65E+01	2.37E+00	2.82E-01	N
RCA-RXB-CONC-025-0.5-B	3.21E-01	3.60E-02	1.14E-01	N	1.70E+01	5.78E-01	1.85E-01	N
RCA-RXB-CONC-026-0.5-B-D	2.26E-01	0.00E+00	2.26E-01	N	2.49E-01	0.00E+00	2.49E-01	N
RCA-RXB-CONC-027-0.5-B	1.81E-01	5.34E-02	1.80E-01	N	3.85E-01	6.27E-02	1.93E-01	N
RCA-RXB-CONC-028-0.5-B	1.19E-01	1.64E-02	8.05E-02	N	2.41E+00	9.47E-02	9.76E-02	N
RCA-RXB-CONC-029-0.5-B	2.08E-01	2.38E-02	9.67E-02	N	3.01E+01	9.48E-01	2.73E-01	N
RCA-RXB-CONC-030-0.5-B-QC	5.29E-01	3.32E-02	7.61E-02	N	2.60E+02	7.93E+00	3.57E-01	N
RCA-RXB-CONC-031-0.5-B	2.23E-01	0.00E+00	2.23E-01	N	1.78E-01	0.00E+00	1.78E-01	N
RCA-RXB-CONC-032-0.5-B	1.32E-01	4.12E-02	1.38E-01	N	4.10E+00	1.96E-01	2.12E-01	N
RCA-RXB-CONC-033-0.5-B	2.22E-01	0.00E+00	2.22E-01	N	5.69E-01	6.53E-02	1.45E-01	N
RCA-RXB-CONC-034-0.5-B	1.40E-01	2.15E-02	7.84E-02	N	2.07E+01	6.72E-01	2.10E-01	N
RCA-RXB-CONC-035-0.5-B-QC	2.01E+00	5.46E-02	1.01E-01	N	1.12E+02	3.42E+00	1.82E-01	N
RCA-RXB-CONC-036-0.5-B	2.30E-01	5.46E-02	1.27E-01	N	3.74E+01	1.23E+00	3.76E-01	N
RCA-RXB-CONC-037-0.5-B	1.09E-01	2.16E-02	1.06E-01	N	1.64E-01	3.42E-02	1.31E-01	N
RCA-RXB-CONC-038-0.5-B	3.09E-01	2.41E-02	9.19E-02	N	5.10E+01	1.57E+00	2.63E-01	N
RCA-RXB-CONC-039-0.5-B	1.36E-01	3.85E-02	1.33E-01	N	7.22E-01	6.73E-02	1.52E-01	N
RCA-RXB-CONC-040-0.5-B	2.04E-01	2.33E-02	1.04E-01	N	3.58E+01	1.12E+00	2.74E-01	N
RCA-RXB-CONC-041-0.5-B	1.80E-01	2.82E-02	1.22E-01	N	1.01E+01	3.60E-01	2.12E-01	N
RCA-RXB-CONC-042-0.5-B-D	1.62E-01	3.63E-02	1.17E-01	N	7.12E+01	2.21E+00	2.59E-01	N
RCA-RXB-CONC-043-0.5-B	3.20E-01	2.00E-02	7.47E-02	N	1.21E+02	3.69E+00	2.97E-01	N
RCA-RXB-CONC-044-0.5-B	2.32E-01	0.00E+00	2.32E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-RXB-CONC-045-0.5-B	1.67E-01	0.00E+00	1.67E-01	N	3.02E+01	9.61E-01	2.23E-01	N
RCA-RXB-CONC-046-0.5-B	1.28E-01	1.41E-02	7.42E-02	N	6.05E+02	1.83E+01	3.83E-01	N
RCA-RXB-CONC-047-0.5-B	2.36E-01	0.00E+00	2.36E-01	N	1.37E-01	3.92E-02	1.49E-01	N
RCA-RXB-CONC-048-0.5-B	2.28E-01	2.36E-02	9.90E-02	N	7.33E+01	2.25E+00	3.32E-01	N
RCA-RXB-CONC-049-0.5-B-D	2.22E-01	0.00E+00	2.22E-01	N	5.10E+00	2.17E-01	1.82E-01	N
RCA-RXB-CONC-050-0.5-B	2.38E-01	0.00E+00	2.38E-01	N	2.08E-01	0.00E+00	2.08E-01	N
Average Activity	4.76E-01				4.93E+01			
Activity Standard Deviation	1.36E+00				1.24E+02			
Activity Range	7.95E-02	to	9.70E+00		1.37E-01	to	6.05E+02	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**RXB**	**Number of Samples:**	**50**
Initial Classification:	**Class 1**	**Sample Depth:**	**1.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXB-CONC-001-1.0-B	2.13E-01	0.00E+00	2.13E-01	N	1.76E-01	0.00E+00	1.76E-01	N
RCA-RXB-CONC-002-1.0-B	2.43E-01	0.00E+00	2.43E-01	N	2.23E-01	0.00E+00	2.23E-01	N
RCA-RXB-CONC-003-1.0-B	1.03E+01	2.42E-01	3.30E-01	N	1.05E-01	3.86E-02	1.69E-01	N
RCA-RXB-CONC-004-1.0-B-D	2.05E-01	0.00E+00	2.05E-01	N	1.67E-01	0.00E+00	1.67E-01	N
RCA-RXB-CONC-005-1.0-B	1.91E-01	0.00E+00	1.91E-01	N	1.98E-01	0.00E+00	1.98E-01	N
RCA-RXB-CONC-006-1.0-B	9.80E-02	3.32E-02	1.30E-01	N	1.49E-01	0.00E+00	1.49E-01	N
RCA-RXB-CONC-007-1.0-B	2.24E-01	0.00E+00	2.24E-01	N	1.76E-01	0.00E+00	1.76E-01	N
RCA-RXB-CONC-008-1.0-B	2.22E-01	0.00E+00	2.22E-01	N	5.64E-01	5.39E-02	1.21E-01	N
RCA-RXB-CONC-009-1.0-B	2.12E-01	0.00E+00	2.12E-01	N	1.89E+00	1.01E-01	1.38E-01	N
RCA-RXB-CONC-010-1.0-B	2.41E-01	0.00E+00	2.41E-01	N	1.97E-01	0.00E+00	1.97E-01	N
RCA-RXB-CONC-011-1.0-B	2.33E-01	0.00E+00	2.33E-01	N	1.88E-01	0.00E+00	1.88E-01	N
RCA-RXB-CONC-012-1.0-B-D-QC	1.49E-01	0.00E+00	1.49E-01	N	1.28E+02	3.90E+00	2.82E-01	N
RCA-RXB-CONC-013-1.0-B	2.21E-01	0.00E+00	2.21E-01	N	1.59E-01	0.00E+00	1.59E-01	N
RCA-RXB-CONC-014-1.0-B	1.19E-01	3.52E-02	1.33E-01	N	1.77E+01	5.87E-01	2.62E-01	N
RCA-RXB-CONC-015-1.0-B	2.12E-01	0.00E+00	2.12E-01	N	2.18E-01	0.00E+00	2.18E-01	N
RCA-RXB-CONC-016-1.0-B	2.39E-01	0.00E+00	2.39E-01	N	1.63E-01	0.00E+00	1.63E-01	N
RCA-RXB-CONC-017-1.0-B	2.05E-01	0.00E+00	2.05E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-RXB-CONC-018-1.0-B	2.17E-01	0.00E+00	2.17E-01	N	2.04E-01	0.00E+00	2.04E-01	N
RCA-RXB-CONC-019-1.0-B	2.12E-01	0.00E+00	2.12E-01	N	3.18E+00	1.42E-01	1.53E-01	N
RCA-RXB-CONC-020-1.0-B	2.22E-01	0.00E+00	2.22E-01	N	9.17E+00	3.64E-01	1.88E-01	N
RCA-RXB-CONC-021-1.0-B	2.27E-01	0.00E+00	2.27E-01	N	1.54E-01	0.00E+00	1.54E-01	N
RCA-RXB-CONC-022-1.0-B	2.03E-01	0.00E+00	2.03E-01	N	1.91E-01	0.00E+00	1.91E-01	N
RCA-RXB-CONC-023-1.0-B	2.40E-01	0.00E+00	2.40E-01	N	6.05E+00	2.41E-01	1.28E-01	N

RCA-RXB-CONC-024-1.0-B	4.33E-01	3.97E-02	1.47E-01	N	1.51E+01	5.11E-01	2.95E-01	N
RCA-RXB-CONC-025-1.0-B	9.95E-02	1.85E-02	8.67E-02	N	7.23E+00	2.60E-01	1.47E-01	N
RCA-RXB-CONC-026-1.0-B-D	1.45E-01	0.00E+00	1.45E-01	N	2.02E-01	0.00E+00	2.02E-01	N
RCA-RXB-CONC-027-1.0-B	2.29E-01	0.00E+00	2.29E-01	N	1.99E-01	0.00E+00	1.99E-01	N
RCA-RXB-CONC-028-1.0-B	1.76E-01	0.00E+00	1.76E-01	N	1.74E-01	0.00E+00	1.74E-01	N
RCA-RXB-CONC-029-1.0-B	1.98E-01	0.00E+00	1.98E-01	N	3.74E+00	1.65E-01	1.23E-01	N
RCA-RXB-CONC-030-1.0-B	1.98E-01	0.00E+00	1.98E-01	N	2.85E+00	1.51E-01	2.34E-01	N
RCA-RXB-CONC-031-1.0-B	2.39E-01	0.00E+00	2.39E-01	N	2.10E-01	0.00E+00	2.10E-01	N
RCA-RXB-CONC-032-1.0-B	1.20E-01	2.67E-02	1.40E-01	N	1.60E-01	0.00E+00	1.60E-01	N
RCA-RXB-CONC-033-1.0-B	2.16E-01	0.00E+00	2.16E-01	N	1.61E-01	0.00E+00	1.61E-01	N
RCA-RXB-CONC-034-1.0-B	1.81E-01	0.00E+00	1.81E-01	N	4.90E-01	4.84E-02	1.29E-01	N
RCA-RXB-CONC-035-1.0-B	2.39E-01	0.00E+00	2.39E-01	N	2.45E-01	4.09E-02	1.42E-01	N
RCA-RXB-CONC-036-1.0-B	2.03E-01	0.00E+00	2.03E-01	N	9.03E-02	2.50E-02	9.44E-02	N
RCA-RXB-CONC-037-1.0-B	2.03E-01	0.00E+00	2.03E-01	N	1.46E-01	0.00E+00	1.46E-01	N
RCA-RXB-CONC-038-1.0-B	2.02E-01	0.00E+00	2.02E-01	N	2.33E-01	0.00E+00	2.33E-01	N
RCA-RXB-CONC-039-1.0-B	2.09E-01	0.00E+00	2.09E-01	N	1.72E-01	0.00E+00	1.72E-01	N
RCA-RXB-CONC-040-1.0-B	1.81E-01	0.00E+00	1.81E-01	N	2.54E-01	0.00E+00	2.54E-01	N
RCA-RXB-CONC-041-1.0-B	1.17E-01	0.00E+00	1.17E-01	N	4.75E+00	1.74E-01	1.07E-01	N
RCA-RXB-CONC-042-1.0-B-D	1.60E-01	2.66E-02	1.06E-01	N	1.62E+01	5.47E-01	3.10E-01	N
RCA-RXB-CONC-043-1.0-B	2.23E-01	0.00E+00	2.23E-01	N	1.19E+01	4.38E-01	1.67E-01	N
RCA-RXB-CONC-044-1.0-B	2.04E-01	0.00E+00	2.04E-01	N	1.90E-01	0.00E+00	1.90E-01	N
RCA-RXB-CONC-045-1.0-B	2.07E-01	0.00E+00	2.07E-01	N	2.43E-01	0.00E+00	2.43E-01	N
RCA-RXB-CONC-046-1.0-B	1.89E-01	0.00E+00	1.89E-01	N	9.25E+00	3.22E-01	1.71E-01	N
RCA-RXB-CONC-047-1.0-B	1.87E-01	0.00E+00	1.87E-01	N	1.84E-01	0.00E+00	1.84E-01	N
RCA-RXB-CONC-048-1.0-B	2.24E-01	0.00E+00	2.24E-01	N	2.90E+01	9.38E-01	2.40E-01	N
RCA-RXB-CONC-049-1.0-B-D	2.21E-01	0.00E+00	2.21E-01	N	1.86E-01	0.00E+00	1.86E-01	N
RCA-RXB-CONC-050-1.0-B	2.01E-01	0.00E+00	2.01E-01	N	1.46E-01	0.00E+00	1.46E-01	N
Average Activity	4.05E-01				5.46E+00			
Activity Standard Deviation	1.43E+00				1.86E+01			
Activity Range	9.80E-02	to	1.03E+01		9.03E-02	to	1.28E+02	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**RXB**	**Number of Samples:**	**50**
Initial Classification:	**Class 1**	**Sample Depth:**	**1.5**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXB-CONC-001-1.5-B	8.35E-02	2.91E-02	1.11E-01	N	1.51E-01	0.00E+00	1.51E-01	N
RCA-RXB-CONC-002-1.5-B	1.97E-01	0.00E+00	1.97E-01	N	1.88E-01	0.00E+00	1.88E-01	N
RCA-RXB-CONC-003-1.5-B	2.09E-01	0.00E+00	2.09E-01	N	1.73E-01	0.00E+00	1.73E-01	N
RCA-RXB-CONC-004-1.5-B-D	1.86E-01	0.00E+00	1.86E-01	N	2.09E-01	0.00E+00	2.09E-01	N
RCA-RXB-CONC-005-1.5-B	1.13E-01	3.77E-02	1.46E-01	N	1.80E-01	0.00E+00	1.80E-01	N
RCA-RXB-CONC-006-1.5-B	2.37E-01	0.00E+00	2.37E-01	N	7.08E-02	2.74E-02	1.11E-01	N
RCA-RXB-CONC-007-1.5-B	2.16E-01	0.00E+00	2.16E-01	N	1.61E-01	0.00E+00	1.61E-01	N
RCA-RXB-CONC-008-1.5-B	4.31E-02	2.33E-02	1.00E-01	N	5.00E-02	2.22E-02	9.44E-02	N
RCA-RXB-CONC-009-1.5-B	2.12E-01	0.00E+00	2.12E-01	N	9.05E-01	8.20E-02	1.29E-01	N
RCA-RXB-CONC-010-1.5-B	2.10E-01	0.00E+00	2.10E-01	N	1.62E-01	0.00E+00	1.62E-01	N
RCA-RXB-CONC-011-1.5-B	1.47E-01	4.42E-02	1.70E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-RXB-CONC-012-1.5-B-D	1.47E-01	0.00E+00	1.47E-01	N	4.74E+01	1.48E+00	2.27E-01	N
RCA-RXB-CONC-013-1.5-B	9.43E-02	2.51E-02	1.36E-01	N	1.75E-01	0.00E+00	1.75E-01	N
RCA-RXB-CONC-014-1.5-B	1.57E-01	0.00E+00	1.57E-01	N	4.33E+00	2.06E-01	1.54E-01	N
RCA-RXB-CONC-015-1.5-B	2.40E-01	0.00E+00	2.40E-01	N	2.10E-01	0.00E+00	2.10E-01	N
RCA-RXB-CONC-016-1.5-B	2.08E-01	0.00E+00	2.08E-01	N	1.90E-01	0.00E+00	1.90E-01	N
RCA-RXB-CONC-017-1.5-B	2.23E-01	0.00E+00	2.23E-01	N	1.51E-01	0.00E+00	1.51E-01	N
RCA-RXB-CONC-018-1.5-B	2.42E-01	0.00E+00	2.42E-01	N	2.05E-01	0.00E+00	2.05E-01	N
RCA-RXB-CONC-019-1.5-B	2.18E-01	0.00E+00	2.18E-01	N	1.21E+00	7.93E-02	1.43E-01	N
RCA-RXB-CONC-020-1.5-B	2.37E-01	0.00E+00	2.37E-01	N	2.16E+00	1.28E-01	1.85E-01	N
RCA-RXB-CONC-021-1.5-B	2.28E-01	0.00E+00	2.28E-01	N	1.71E-01	0.00E+00	1.71E-01	N
RCA-RXB-CONC-022-1.5-B	2.07E-01	0.00E+00	2.07E-01	N	1.85E-01	0.00E+00	1.85E-01	N
RCA-RXB-CONC-023-1.5-B	2.43E-01	0.00E+00	2.43E-01	N	1.27E+00	8.90E-02	1.82E-01	N

RCA-RXB-CONC-024-1.5-B	2.23E-01	2.96E-02	1.19E-01	N	7.66E+00	2.83E-01	2.12E-01	N
RCA-RXB-CONC-025-1.5-B	2.13E-01	0.00E+00	2.13E-01	N	1.63E+00	9.09E-02	1.33E-01	N
RCA-RXB-CONC-026-1.5-B-D	2.29E-01	0.00E+00	2.29E-01	N	1.86E-01	0.00E+00	1.86E-01	N
RCA-RXB-CONC-027-1.5-B	1.88E-01	0.00E+00	1.88E-01	N	1.71E-01	0.00E+00	1.71E-01	N
RCA-RXB-CONC-028-1.5-B	1.41E-01	0.00E+00	1.41E-01	N	1.63E-01	0.00E+00	1.63E-01	N
RCA-RXB-CONC-029-1.5-B	1.48E-01	0.00E+00	1.48E-01	N	2.84E-01	3.25E-02	9.38E-02	N
RCA-RXB-CONC-030-1.5-B	1.97E-01	0.00E+00	1.97E-01	N	1.67E-01	3.38E-02	1.25E-01	N
RCA-RXB-CONC-031-1.5-B	1.03E-01	3.21E-02	1.21E-01	N	1.54E-01	0.00E+00	1.54E-01	N
RCA-RXB-CONC-032-1.5-B	2.02E-01	0.00E+00	2.02E-01	N	1.75E-01	0.00E+00	1.75E-01	N
RCA-RXB-CONC-033-1.5-B	2.30E-01	0.00E+00	2.30E-01	N	1.85E-01	0.00E+00	1.85E-01	N
RCA-RXB-CONC-034-1.5-B	2.34E-01	0.00E+00	2.34E-01	N	2.36E-01	0.00E+00	2.36E-01	N
RCA-RXB-CONC-035-1.5-B	1.93E-01	0.00E+00	1.93E-01	N	1.42E-01	0.00E+00	1.42E-01	N
RCA-RXB-CONC-036-1.5-B	1.33E-01	0.00E+00	1.33E-01	N	1.37E-01	0.00E+00	1.37E-01	N
RCA-RXB-CONC-037-1.5-B	2.03E-01	0.00E+00	2.03E-01	N	2.25E-01	0.00E+00	2.25E-01	N
RCA-RXB-CONC-038-1.5-B	2.02E-01	0.00E+00	2.02E-01	N	1.78E-01	0.00E+00	1.78E-01	N
RCA-RXB-CONC-039-1.5-B	2.28E-01	0.00E+00	2.28E-01	N	1.83E-01	0.00E+00	1.83E-01	N
RCA-RXB-CONC-040-1.5-B	2.16E-01	0.00E+00	2.16E-01	N	1.90E-01	0.00E+00	1.90E-01	N
RCA-RXB-CONC-041-1.5-B	1.70E-01	0.00E+00	1.70E-01	N	2.02E+00	9.57E-02	1.11E-01	N
RCA-RXB-CONC-042-1.5-B-D	2.00E-01	0.00E+00	2.00E-01	N	8.72E+00	3.25E-01	1.80E-01	N
RCA-RXB-CONC-043-1.5-B	1.95E-01	0.00E+00	1.95E-01	N	1.59E+00	1.05E-01	1.66E-01	N
RCA-RXB-CONC-044-1.5-B	2.19E-01	0.00E+00	2.19E-01	N	1.49E-01	0.00E+00	1.49E-01	N
RCA-RXB-CONC-045-1.5-B	2.17E-01	0.00E+00	2.17E-01	N	1.64E-01	0.00E+00	1.64E-01	N
RCA-RXB-CONC-046-1.5-B	2.04E-01	0.00E+00	2.04E-01	N	1.60E+00	1.10E-01	1.82E-01	N
RCA-RXB-CONC-047-1.5-B	2.17E-01	0.00E+00	2.17E-01	N	1.98E-01	0.00E+00	1.98E-01	N
RCA-RXB-CONC-048-1.5-B	1.02E-01	3.10E-02	1.11E-01	N	1.27E+01	4.39E-01	2.35E-01	N
RCA-RXB-CONC-049-1.5-B-D	2.17E-01	0.00E+00	2.17E-01	N	1.94E-01	0.00E+00	1.94E-01	N
RCA-RXB-CONC-050-1.5-B	1.58E-01	0.00E+00	1.58E-01	N	2.05E-01	0.00E+00	2.05E-01	N
Average Activity	1.90E-01				1.99E+00			
Activity Standard Deviation	4.69E-02				6.98E+00			
Activity Range	4.31E-02	to	2.43E-01		5.00E-02	to	4.74E+01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**RXB**	**Number of Samples:**	**50**
Initial Classification:	**Class 1**	**Sample Depth:**	**2.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXB-CONC-001-2.0-B	2.22E-01	0.00E+00	2.22E-01	N	1.88E-01	0.00E+00	1.88E-01	N
RCA-RXB-CONC-002-2.0-B	2.04E-01	0.00E+00	2.04E-01	N	2.24E-01	0.00E+00	2.24E-01	N
RCA-RXB-CONC-003-2.0-B	1.88E-01	0.00E+00	1.88E-01	N	1.94E-01	0.00E+00	1.94E-01	N
RCA-RXB-CONC-004-2.0-B-D	1.64E-01	0.00E+00	1.64E-01	N	1.64E-01	0.00E+00	1.64E-01	N
RCA-RXB-CONC-005-2.0-B	1.76E-01	0.00E+00	1.76E-01	N	1.91E-01	0.00E+00	1.91E-01	N
RCA-RXB-CONC-006-2.0-B	2.10E-01	0.00E+00	2.10E-01	N	1.42E-01	0.00E+00	1.42E-01	N
RCA-RXB-CONC-007-2.0-B	2.13E-01	0.00E+00	2.13E-01	N	1.32E-01	0.00E+00	1.32E-01	N
RCA-RXB-CONC-008-2.0-B	1.95E-01	0.00E+00	1.95E-01	N	1.39E-01	0.00E+00	1.39E-01	N
RCA-RXB-CONC-009-2.0-B	1.88E-01	0.00E+00	1.88E-01	N	4.42E-01	5.79E-02	1.35E-01	N
RCA-RXB-CONC-010-2.0-B	2.23E-01	0.00E+00	2.23E-01	N	1.67E-01	0.00E+00	1.67E-01	N
RCA-RXB-CONC-011-2.0-B	2.10E-01	0.00E+00	2.10E-01	N	1.57E-01	0.00E+00	1.57E-01	N
RCA-RXB-CONC-012-2.0-B-D	2.11E-01	0.00E+00	2.11E-01	N	7.73E+00	2.93E-01	1.93E-01	N
RCA-RXB-CONC-013-2.0-B	8.78E-02	4.53E-02	1.98E-01	N	1.68E-01	0.00E+00	1.68E-01	N
RCA-RXB-CONC-014-2.0-B	2.07E-01	0.00E+00	2.07E-01	N	7.67E-01	6.43E-02	1.41E-01	N
RCA-RXB-CONC-015-2.0-B	2.22E-01	0.00E+00	2.22E-01	N	2.04E-01	0.00E+00	2.04E-01	N
RCA-RXB-CONC-016-2.0-B	2.33E-01	0.00E+00	2.33E-01	N	1.83E-01	0.00E+00	1.83E-01	N
RCA-RXB-CONC-017-2.0-B	2.42E-01	0.00E+00	2.42E-01	N	1.72E-01	0.00E+00	1.72E-01	N
RCA-RXB-CONC-018-2.0-B	2.23E-01	0.00E+00	2.23E-01	N	1.99E-01	0.00E+00	1.99E-01	N
RCA-RXB-CONC-019-2.0-B	2.25E-01	0.00E+00	2.25E-01	N	5.40E-01	6.66E-02	1.86E-01	N
RCA-RXB-CONC-020-2.0-B	2.24E-01	0.00E+00	2.24E-01	N	9.01E-01	7.34E-02	1.68E-01	N
RCA-RXB-CONC-021-2.0-B	2.35E-01	0.00E+00	2.35E-01	N	1.54E-01	0.00E+00	1.54E-01	N
RCA-RXB-CONC-022-2.0-B	2.21E-01	0.00E+00	2.21E-01	N	2.15E-01	0.00E+00	2.15E-01	N
RCA-RXB-CONC-023-2.0-B	1.73E-01	0.00E+00	1.73E-01	N	3.03E-01	5.09E-02	1.66E-01	N

RCA-RXB-CONC-024-2.0-B	2.38E-01	0.00E+00	2.38E-01	N	1.12E+00	8.09E-02	1.57E-01	N
RCA-RXB-CONC-025-2.0-B	1.97E-01	4.25E-01	2.02E-01	N	1.48E-01	0.00E+00	1.48E-01	N
RCA-RXB-CONC-026-2.0-B-D	1.97E-01	0.00E+00	1.97E-01	N	2.04E-01	0.00E+00	2.04E-01	N
RCA-RXB-CONC-027-2.0-B	2.13E-01	0.00E+00	2.13E-01	N	1.69E-01	0.00E+00	1.69E-01	N
RCA-RXB-CONC-028-2.0-B	2.07E-01	0.00E+00	2.07E-01	N	1.64E-01	0.00E+00	1.64E-01	N
RCA-RXB-CONC-029-2.0-B	1.67E-01	0.00E+00	1.67E-01	N	1.49E-01	0.00E+00	1.49E-01	N
RCA-RXB-CONC-030-2.0-B	2.18E-01	0.00E+00	2.18E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-RXB-CONC-031-2.0-B	2.16E-01	0.00E+00	2.16E-01	N	1.74E-01	0.00E+00	1.74E-01	N
RCA-RXB-CONC-032-2.0-B	1.86E-01	0.00E+00	1.86E-01	N	1.98E-01	0.00E+00	1.98E-01	N
RCA-RXB-CONC-033-2.0-B	2.33E-01	0.00E+00	2.33E-01	N	1.84E-01	0.00E+00	1.84E-01	N
RCA-RXB-CONC-034-2.0-B	2.05E-01	0.00E+00	2.05E-01	N	2.08E-01	0.00E+00	2.08E-01	N
RCA-RXB-CONC-035-2.0-B	1.72E-01	0.00E+00	1.72E-01	N	2.17E-01	0.00E+00	2.17E-01	N
RCA-RXB-CONC-036-2.0-B	2.10E-01	0.00E+00	2.10E-01	N	1.54E-01	0.00E+00	1.54E-01	N
RCA-RXB-CONC-037-2.0-B	2.18E-01	0.00E+00	2.18E-01	N	1.82E-01	0.00E+00	1.82E-01	N
RCA-RXB-CONC-038-2.0-B	9.43E-02	3.38E-02	1.28E-01	N	2.02E-01	0.00E+00	2.02E-01	N
RCA-RXB-CONC-039-2.0-B	2.25E-01	0.00E+00	2.25E-01	N	1.61E-01	0.00E+00	1.61E-01	N
RCA-RXB-CONC-040-2.0-B	1.92E-01	0.00E+00	1.92E-01	N	2.26E-01	0.00E+00	2.26E-01	N
RCA-RXB-CONC-041-2.0-B	1.32E-01	0.00E+00	1.32E-01	N	1.37E+00	7.14E-02	1.24E-01	N
RCA-RXB-CONC-042-2.0-B-D	8.99E-02	3.40E-02	1.22E-01	N	4.87E+00	2.15E-01	2.14E-01	N
RCA-RXB-CONC-043-2.0-B	2.01E-01	0.00E+00	2.01E-01	N	2.56E-01	4.78E-02	1.38E-01	N
RCA-RXB-CONC-044-2.0-B	2.04E-01	0.00E+00	2.04E-01	N	1.72E-01	0.00E+00	1.72E-01	N
RCA-RXB-CONC-045-2.0-B	1.91E-01	0.00E+00	1.91E-01	N	1.53E-01	0.00E+00	1.53E-01	N
RCA-RXB-CONC-046-2.0-B	2.19E-01	0.00E+00	2.19E-01	N	3.92E-01	5.68E-02	1.39E-01	N
RCA-RXB-CONC-047-2.0-B	2.10E-01	0.00E+00	2.10E-01	N	1.69E-01	0.00E+00	1.69E-01	N
RCA-RXB-CONC-048-2.0-B	2.15E-01	0.00E+00	2.15E-01	N	6.71E+00	2.71E-01	2.56E-01	N
RCA-RXB-CONC-049-2.0-B-D	2.07E-01	0.00E+00	2.07E-01	N	1.66E-01	0.00E+00	1.66E-01	N
RCA-RXB-CONC-050-2.0-B	1.97E-01	0.00E+00	1.97E-01	N	2.01E-01	0.00E+00	2.01E-01	N
Average Activity	1.99E-01				6.44E-01			
Activity Standard Deviation	3.47E-02				1.53E+00			
Activity Range	8.78E-02	to	2.42E-01		1.32E-01	to	7.73E+00	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	RCA	**Survey Building:**	RXB	**Number of Samples:**	50			
Initial Classification:	Class 1	**Sample Depth:**	2.5					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXB-CONC-001-2.5-B	2.31E-01	0.00E+00	2.31E-01	N	1.32E-01	0.00E+00	1.32E-01	N
RCA-RXB-CONC-002-2.5-B	2.43E-01	0.00E+00	2.43E-01	N	2.03E-01	0.00E+00	2.03E-01	N
RCA-RXB-CONC-003-2.5-B	1.79E-01	0.00E+00	1.79E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-RXB-CONC-004-2.5-B-D	1.11E-01	2.40E-02	1.12E-01	N	1.83E-01	0.00E+00	1.83E-01	N
RCA-RXB-CONC-005-2.5-B	2.06E-01	0.00E+00	2.06E-01	N	1.65E-01	0.00E+00	1.65E-01	N
RCA-RXB-CONC-006-2.5-B	2.33E-01	0.00E+00	2.33E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-RXB-CONC-007-2.5-B	2.10E-01	0.00E+00	2.10E-01	N	1.54E-01	0.00E+00	1.54E-01	N
RCA-RXB-CONC-008-2.5-B	9.31E-02	3.75E-02	1.53E-01	N	1.90E-01	0.00E+00	1.90E-01	N
RCA-RXB-CONC-009-2.5-B	2.14E-01	0.00E+00	2.14E-01	N	3.02E-01	0.00E+00	3.02E-01	N
RCA-RXB-CONC-010-2.5-B	1.63E-01	0.00E+00	1.63E-01	N	1.58E-01	0.00E+00	1.58E-01	N
RCA-RXB-CONC-011-2.5-B	8.71E-02	0.00E+00	8.71E-02	N	1.61E-01	0.00E+00	1.61E-01	N
RCA-RXB-CONC-012-2.5-B-D	1.96E-01	0.00E+00	1.96E-01	N	2.53E+00	1.49E-01	1.93E-01	N
RCA-RXB-CONC-013-2.5-B	2.06E-01	0.00E+00	2.06E-01	N	1.84E-01	0.00E+00	1.84E-01	N
RCA-RXB-CONC-014-2.5-B	1.91E-01	0.00E+00	1.91E-01	N	1.27E-01	3.79E-02	1.48E-01	N
RCA-RXB-CONC-015-2.5-B	7.23E-02	3.25E-02	1.37E-01	N	1.74E-01	0.00E+00	1.74E-01	N
RCA-RXB-CONC-016-2.5-B	2.08E-01	0.00E+00	2.08E-01	N	1.77E-01	0.00E+00	1.77E-01	N
RCA-RXB-CONC-017-2.5-B	2.00E-01	0.00E+00	2.00E-01	N	2.11E-01	0.00E+00	2.11E-01	N
RCA-RXB-CONC-018-2.5-B	2.33E-01	0.00E+00	2.33E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-RXB-CONC-019-2.5-B	1.06E-01	3.44E-02	1.30E-01	N	2.30E-01	0.00E+00	2.30E-01	N
RCA-RXB-CONC-020-2.5-B	2.15E-01	0.00E+00	2.15E-01	N	2.45E-01	0.00E+00	2.45E-01	N
RCA-RXB-CONC-021-2.5-B	2.36E-01	0.00E+00	2.36E-01	N	1.92E-01	0.00E+00	1.92E-01	N
RCA-RXB-CONC-022-2.5-B	2.32E-01	0.00E+00	2.32E-01	N	1.61E-01	0.00E+00	1.61E-01	N
RCA-RXB-CONC-023-2.5-B	2.13E-01	0.00E+00	2.13E-01	N	6.40E-02	2.62E-02	9.87E-02	N

RCA-RXB-CONC-024-2.5-B	2.27E-01	0.00E+00	2.27E-01	N	3.11E-01	5.35E-02	1.64E-01	N
RCA-RXB-CONC-025-2.5-B	2.36E-01	0.00E+00	2.36E-01	N	9.03E-02	3.02E-02	1.19E-01	N
RCA-RXB-CONC-026-2.5-B-D	2.34E-01	0.00E+00	2.34E-01	N	1.95E-01	0.00E+00	1.95E-01	N
RCA-RXB-CONC-027-2.5-B	2.13E-01	0.00E+00	2.13E-01	N	1.90E-01	0.00E+00	1.90E-01	N
RCA-RXB-CONC-028-2.5-B	2.16E-01	0.00E+00	2.16E-01	N	1.65E-01	0.00E+00	1.65E-01	N
RCA-RXB-CONC-029-2.5-B	2.11E-01	0.00E+00	2.11E-01	N	1.57E-01	0.00E+00	1.57E-01	N
RCA-RXB-CONC-030-2.5-B	2.23E-01	0.00E+00	2.23E-01	N	2.16E-01	0.00E+00	2.16E-01	N
RCA-RXB-CONC-031-2.5-B	1.94E-01	0.00E+00	1.94E-01	N	1.64E-01	0.00E+00	1.64E-01	N
RCA-RXB-CONC-032-2.5-B	1.94E-01	0.00E+00	1.94E-01	N	1.85E-01	0.00E+00	1.85E-01	N
RCA-RXB-CONC-033-2.5-B	1.15E-01	4.10E-02	1.61E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-RXB-CONC-034-2.5-B	2.21E-01	0.00E+00	2.21E-01	N	1.66E-01	0.00E+00	1.66E-01	N
RCA-RXB-CONC-035-2.5-B	2.22E-01	0.00E+00	2.22E-01	N	1.94E-01	0.00E+00	1.94E-01	N
RCA-RXB-CONC-036-2.5-B	1.72E-01	0.00E+00	1.72E-01	N	1.78E-01	0.00E+00	1.78E-01	N
RCA-RXB-CONC-037-2.5-B	2.28E-01	0.00E+00	2.28E-01	N	1.92E-01	0.00E+00	1.92E-01	N
RCA-RXB-CONC-038-2.5-B	2.36E-01	0.00E+00	2.36E-01	N	2.15E-01	0.00E+00	2.15E-01	N
RCA-RXB-CONC-039-2.5-B	2.23E-01	0.00E+00	2.23E-01	N	1.80E-01	0.00E+00	1.80E-01	N
RCA-RXB-CONC-040-2.5-B	2.27E-01	0.00E+00	2.27E-01	N	1.45E-01	0.00E+00	1.45E-01	N
RCA-RXB-CONC-041-2.5-B	8.22E-02	3.17E-02	1.34E-01	N	1.24E+00	7.15E-02	1.20E-01	N
RCA-RXB-CONC-042-2.5-B-D	2.36E-01	0.00E+00	2.36E-01	N	2.27E+00	1.34E-01	1.61E-01	N
RCA-RXB-CONC-043-2.5-B	1.91E-01	0.00E+00	1.91E-01	N	2.15E-01	0.00E+00	2.15E-01	N
RCA-RXB-CONC-044-2.5-B	2.18E-01	0.00E+00	2.18E-01	N	2.17E-01	0.00E+00	2.17E-01	N
RCA-RXB-CONC-045-2.5-B	9.42E-02	3.39E-02	1.27E-01	N	1.47E-01	0.00E+00	1.47E-01	N
RCA-RXB-CONC-046-2.5-B	2.21E-01	0.00E+00	2.21E-01	N	2.04E-01	0.00E+00	2.04E-01	N
RCA-RXB-CONC-047-2.5-B	1.65E-01	0.00E+00	1.65E-01	N	1.55E-01	0.00E+00	1.55E-01	N
RCA-RXB-CONC-048-2.5-B	1.75E-01	0.00E+00	1.75E-01	N	2.86E+00	1.53E-01	2.31E-01	N
RCA-RXB-CONC-049-2.5-B-D	2.34E-01	0.00E+00	2.34E-01	N	2.10E-01	0.00E+00	2.10E-01	N
RCA-RXB-CONC-050-2.5-B	2.18E-01	0.00E+00	2.18E-01	N	1.83E-01	0.00E+00	1.83E-01	N
Average Activity	1.94E-01				3.46E-01			
Activity Standard Deviation	4.80E-02				5.87E-01			
Activity Range	7.23E-02	to	2.43E-01		6.40E-02	to	2.86E+00	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**RXB**	**Number of Samples:**	**50**
Initial Classification:	**Class 1**	**Sample Depth:**	**3.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXB-CONC-001-3.0-B	1.94E-01	0.00E+00	1.94E-01	N	1.69E-01	0.00E+00	1.69E-01	N
RCA-RXB-CONC-002-3.0-B	2.09E-01	0.00E+00	2.09E-01	N	1.74E-01	0.00E+00	1.74E-01	N
RCA-RXB-CONC-003-3.0-B	1.77E-01	0.00E+00	1.77E-01	N	1.84E-01	0.00E+00	1.84E-01	N
RCA-RXB-CONC-004-3.0-B-D	2.26E-01	0.00E+00	2.26E-01	N	2.03E-01	0.00E+00	2.03E-01	N
RCA-RXB-CONC-005-3.0-B	2.32E-01	0.00E+00	2.32E-01	N	1.86E-01	0.00E+00	1.86E-01	N
RCA-RXB-CONC-006-3.0-B	2.44E-01	0.00E+00	2.44E-01	N	1.86E-01	0.00E+00	1.86E-01	N
RCA-RXB-CONC-007-3.0-B	2.17E-01	0.00E+00	2.17E-01	N	1.77E-01	0.00E+00	1.77E-01	N
RCA-RXB-CONC-008-3.0-B	9.33E-02	2.01E-02	9.42E-02	N	1.43E-01	0.00E+00	1.43E-01	N
RCA-RXB-CONC-009-3.0-B	1.59E-01	0.00E+00	1.59E-01	N	2.37E-01	0.00E+00	2.37E-01	N
RCA-RXB-CONC-010-3.0-B	2.09E-01	0.00E+00	2.09E-01	N	1.60E-01	0.00E+00	1.60E-01	N
RCA-RXB-CONC-011-3.0-B	2.06E-01	0.00E+00	2.06E-01	N	1.94E-01	0.00E+00	1.94E-01	N
RCA-RXB-CONC-012-3.0-B-D	2.42E-01	0.00E+00	2.42E-01	N	6.58E-01	6.08E-02	1.32E-01	N
RCA-RXB-CONC-013-3.0-B	2.35E-01	0.00E+00	2.35E-01	N	1.87E-01	0.00E+00	1.87E-01	N
RCA-RXB-CONC-014-3.0-B	2.30E-01	0.00E+00	2.30E-01	N	1.74E-01	0.00E+00	1.74E-01	N
RCA-RXB-CONC-015-3.0-B	2.21E-01	0.00E+00	2.21E-01	N	1.95E-01	0.00E+00	1.95E-01	N
RCA-RXB-CONC-016-3.0-B	1.46E-01	4.26E-02	1.60E-01	N	1.88E-01	0.00E+00	1.88E-01	N
RCA-RXB-CONC-017-3.0-B	2.21E-01	0.00E+00	2.21E-01	N	1.83E-01	0.00E+00	1.83E-01	N
RCA-RXB-CONC-018-3.0-B	2.15E-01	0.00E+00	2.15E-01	N	2.36E-01	0.00E+00	2.36E-01	N
RCA-RXB-CONC-019-3.0-B	2.36E-01	0.00E+00	2.36E-01	N	2.40E-01	0.00E+00	2.40E-01	N
RCA-RXB-CONC-020-3.0-B	1.86E-01	0.00E+00	1.86E-01	N	1.81E-01	0.00E+00	1.81E-01	N
RCA-RXB-CONC-021-3.0-B	1.07E-01	3.61E-02	1.43E-01	N	1.77E-01	0.00E+00	1.77E-01	N
RCA-RXB-CONC-022-3.0-B	2.08E-01	0.00E+00	2.08E-01	N	2.00E-01	0.00E+00	2.00E-01	N
RCA-RXB-CONC-023-3.0-B	1.84E-01	0.00E+00	1.84E-01	N	2.10E-01	0.00E+00	2.10E-01	N

RCA-RXB-CONC-024-3.0-B	1.49E-01	0.00E+00	1.49E-01	N	7.12E-02	2.53E-02	1.07E-01	N
RCA-RXB-CONC-025-3.0-B	1.56E-01	0.00E+00	1.56E-01	N	1.93E-01	0.00E+00	1.93E-01	N
RCA-RXB-CONC-026-3.0-B-D	2.36E-01	0.00E+00	2.36E-01	N	1.85E-01	0.00E+00	1.85E-01	N
RCA-RXB-CONC-027-3.0-B	1.17E-01	5.16E-02	2.18E-01	N	2.39E-01	0.00E+00	2.39E-01	N
RCA-RXB-CONC-028-3.0-B	1.70E-01	0.00E+00	1.70E-01	N	1.55E-01	0.00E+00	1.55E-01	N
RCA-RXB-CONC-029-3.0-B	2.33E-01	0.00E+00	2.33E-01	N	2.49E-01	0.00E+00	2.49E-01	N
RCA-RXB-CONC-030-3.0-B	2.18E-01	0.00E+00	2.18E-01	N	2.25E-01	0.00E+00	2.25E-01	N
RCA-RXB-CONC-031-3.0-B	2.27E-01	0.00E+00	2.27E-01	N	1.67E-01	0.00E+00	1.67E-01	N
RCA-RXB-CONC-032-3.0-B	1.83E-01	0.00E+00	1.83E-01	N	1.97E-01	0.00E+00	1.97E-01	N
RCA-RXB-CONC-033-3.0-B	2.25E-01	0.00E+00	2.25E-01	N	1.86E-01	0.00E+00	1.86E-01	N
RCA-RXB-CONC-034-3.0-B	2.06E-01	0.00E+00	2.06E-01	N	1.68E-01	0.00E+00	1.68E-01	N
RCA-RXB-CONC-035-3.0-B	2.26E-01	0.00E+00	2.26E-01	N	2.19E-01	0.00E+00	2.19E-01	N
RCA-RXB-CONC-036-3.0-B	2.04E-01	0.00E+00	2.04E-01	N	1.91E-01	0.00E+00	1.91E-01	N
RCA-RXB-CONC-037-3.0-B	1.48E-01	0.00E+00	1.48E-01	N	1.75E-01	0.00E+00	1.75E-01	N
RCA-RXB-CONC-038-3.0-B	2.17E-01	0.00E+00	2.17E-01	N	1.75E-01	0.00E+00	1.75E-01	N
RCA-RXB-CONC-039-3.0-B	2.29E-01	0.00E+00	2.29E-01	N	1.81E-01	0.00E+00	1.81E-01	N
RCA-RXB-CONC-040-3.0-B	1.90E-01	0.00E+00	1.90E-01	N	2.22E-01	0.00E+00	2.22E-01	N
RCA-RXB-CONC-041-3.0-B	1.95E-01	0.00E+00	1.95E-01	N	1.26E+00	7.44E-02	1.21E-01	N
RCA-RXB-CONC-042-3.0-B-D	2.36E-01	0.00E+00	2.36E-01	N	7.93E-01	7.47E-02	1.55E-01	N
RCA-RXB-CONC-043-3.0-B	2.12E-01	0.00E+00	2.12E-01	N	2.14E-01	0.00E+00	2.14E-01	N
RCA-RXB-CONC-044-3.0-B	1.83E-01	0.00E+00	1.83E-01	N	1.63E-01	0.00E+00	1.63E-01	N
RCA-RXB-CONC-045-3.0-B	2.36E-01	0.00E+00	2.36E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-RXB-CONC-046-3.0-B	2.23E-01	0.00E+00	2.23E-01	N	1.84E-01	0.00E+00	1.84E-01	N
RCA-RXB-CONC-047-3.0-B	2.28E-01	0.00E+00	2.28E-01	N	1.83E-01	0.00E+00	1.83E-01	N
RCA-RXB-CONC-048-3.0-B	2.15E-01	0.00E+00	2.15E-01	N	1.46E+00	9.46E-02	1.53E-01	N
RCA-RXB-CONC-049-3.0-B-D	2.34E-01	0.00E+00	2.34E-01	N	1.41E-01	0.00E+00	1.41E-01	N
RCA-RXB-CONC-050-3.0-B	1.82E-01	0.00E+00	1.82E-01	N	2.00E-01	0.00E+00	2.00E-01	N
Average Activity	2.02E-01				2.56E-01			
Activity Standard Deviation	3.60E-02				2.54E-01			
Activity Range	9.33E-02	to	2.44E-01		7.12E-02	to	1.46E+00	

Note: Measurement Uncertainty values of 0.00E+00 indicate no detected activity.

Duplicate gamma spectroscopy analysis was performed onsite for each sample with a "D" designator in the sample number. Samples with a "QC" designator were analyzed onsite by gamma spectroscopy and sent offsite for gamma analysis, radiochemical separation, HTD beta emitters, and alpha spectroscopy evaluation. Onsite gamma spectroscopy analysis for "D" and "QC" samples greater than MDC was evaluated as part of the ongoing quality assessment of the onsite laboratory. The results were within an acceptable margin of error for the analysis. The offsite laboratory reports indicate no beta HTDs or alpha HTDs exceeded the AC.

The following conclusions were reached for the RXB:

- MARSSIM Class 1 designation is appropriate for the RXB survey area.
- Excavation or remediation of concrete in the below-ground structure of the RXB may be required to a depth of 0.5 inches for exterior walls and floor surfaces to meet the site release criteria.
- Future surveys will be required in the drywell and sump areas.

Table 2-49 Gamma Results for TURB Concrete Core Samples

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	RCA	Survey Building:	TURB	Number of Samples:	45			
Initial Classification:	Class 1	Sample Depth:	0.0					
Result Comparison								
	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-TURB-CONC-001-0.0-B-D	4.57E-02	3.26E-02	1.46E-01	N	2.91E-01	0.00E+00	2.91E-01	N
RCA-TURB-CONC-002-0.0-B	2.28E-01	0.00E+00	2.28E-01	N	2.04E-01	0.00E+00	2.04E-01	N
RCA-TURB-CONC-003-0.0-B	2.26E-01	0.00E+00	2.26E-01	N	2.26E-01	0.00E+00	2.26E-01	N
RCA-TURB-CONC-004-0.0-B-QC	1.17E+00	8.38E-02	2.76E-01	N	6.34E-01	6.98E-02	1.77E-01	N
RCA-TURB-CONC-005-0.0-B-QC	1.78E+00	7.17E-02	1.72E-01	N	8.55E-01	6.03E-02	1.47E-01	N
RCA-TURB-CONC-006-0.0-B	7.99E-01	5.51E-02	1.72E-01	N	1.48E+00	9.20E-02	1.76E-01	N
RCA-TURB-CONC-007-0.0-B	1.73E+00	8.46E-02	2.33E-01	N	3.95E+00	1.79E-01	2.48E-01	N
RCA-TURB-CONC-008-0.0-B	1.92E-01	0.00E+00	1.92E-01	N	1.96E-01	3.56E-02	1.30E-01	N
RCA-TURB-CONC-009-0.0-B	2.34E-01	0.00E+00	2.34E-01	N	2.16E-01	0.00E+00	2.16E-01	N
RCA-TURB-CONC-010-0.0-B-QC	2.29E-01	0.00E+00	2.29E-01	N	9.19E-01	7.90E-02	1.97E-01	N
RCA-TURB-CONC-011-0.0-B	6.07E-02	3.72E-02	1.68E-01	N	2.06E-01	4.22E-02	1.64E-01	N
RCA-TURB-CONC-012-0.0-B	4.89E+01	9.67E-01	4.21E-01	N	1.10E+03	3.35E+01	1.01E+00	N
RCA-TURB-CONC-013-0.0-B-QC	2.43E+00	1.01E-01	2.11E-01	N	4.03E+00	1.84E-01	2.40E-01	N
RCA-TURB-CONC-014-0.0-B-QC	7.70E+00	1.99E-01	2.32E-01	N	2.07E+01	6.77E-01	2.73E-01	N
RCA-TURB-CONC-015-0.0-B	5.79E-02	3.22E-02	1.38E-01	N	7.12E-02	4.61E-02	2.10E-01	N
RCA-TURB-CONC-016-0.0-B	2.38E-01	0.00E+00	2.38E-01	N	8.14E-02	3.30E-02	1.42E-01	N
RCA-TURB-CONC-017-0.0-B-QC	5.54E+00	1.26E-01	1.24E-01	N	1.79E+03	5.42E+01	6.70E-01	Y
RCA-TURB-CONC-018-0.0-B	3.44E+00	8.22E-02	1.08E-01	N	1.12E+03	3.39E+01	5.16E-01	N
RCA-TURB-CONC-019-0.0-B	2.37E-01	0.00E+00	2.37E-01	N	1.70E-01	3.83E-02	1.70E-01	N
RCA-TURB-CONC-020-0.0-B-D	1.09E-01	2.04E-02	1.13E-01	N	6.13E-02	2.81E-02	1.26E-01	N
RCA-TURB-CONC-021-0.0-B	2.32E-01	4.06E-02	1.86E-01	N	1.85E-01	3.80E-02	1.31E-01	N
RCA-TURB-CONC-022-0.0-B	3.78E-01	4.49E-02	1.15E-01	N	5.29E-01	6.57E-02	1.77E-01	N
RCA-TURB-CONC-023-0.0-B	3.37E+02	6.25E+00	3.46E-01	Y	5.15E+02	1.56E+01	4.39E-01	N

RCA-TURB-CONC-024-0.0-B-D	6.81E+01	1.28E+00	3.08E-01	N	8.31E+02	2.52E+01	4.10E-01	N
RCA-TURB-CONC-025-0.0-B-D-QC	1.63E+00	7.03E-02	1.62E-01	N	9.07E+01	2.79E+00	2.62E-01	N
RCA-TURB-CONC-026-0.0-B-QC	7.13E+01	1.34E+00	2.32E-01	N	2.49E+02	7.56E+00	3.17E-01	N
RCA-TURB-CONC-027-0.0-B	3.40E+01	6.51E-01	1.96E-01	N	3.63E+02	1.10E+01	3.61E-01	N
RCA-TURB-CONC-028-0.0-B	8.24E-01	5.65E-02	1.80E-01	N	4.38E+00	1.89E-01	2.06E-01	N
RCA-TURB-CONC-029-0.0-B	7.56E-01	5.27E-02	1.56E-01	N	2.90E+00	1.41E-01	1.87E-01	N
RCA-TURB-CONC-030-0.0-B	1.56E+01	3.12E-01	1.86E-01	N	1.07E+02	3.26E+00	2.47E-01	N
RCA-TURB-CONC-031-0.0-B	1.61E+01	3.17E-01	1.45E-01	N	2.56E+02	7.77E+00	2.87E-01	N
RCA-TURB-CONC-032-0.0-B-D	1.33E+01	2.93E-01	2.72E-01	N	2.68E+02	8.18E+00	4.67E-01	N
RCA-TURB-CONC-033-0.0-B	6.13E+00	1.42E-01	1.78E-01	N	1.48E+02	4.51E+00	4.26E-01	N
RCA-TURB-CONC-034-0.0-B	9.08E+00	1.94E-01	1.54E-01	N	1.04E+02	3.17E+00	2.40E-01	N
RCA-TURB-CONC-035-0.0-B	5.29E+01	1.00E+00	1.76E-01	N	1.50E+03	4.55E+01	6.47E-01	Y
RCA-TURB-CONC-036-0.0-B	1.93E+02	3.60E+00	4.45E-01	N	3.19E+03	9.67E+01	9.26E-01	Y
RCA-TURB-CONC-037-0.0-B	2.25E+02	4.20E+00	7.50E-01	N	5.13E+02	1.56E+01	6.03E-01	N
RCA-TURB-CONC-038-0.0-B-QC	1.34E+01	2.92E-01	2.02E-01	N	8.37E+01	2.57E+00	3.13E-01	N
RCA-TURB-CONC-039-0.0-B	2.73E+01	5.23E-01	1.66E-01	N	2.26E+02	6.86E+00	2.85E-01	N
RCA-TURB-CONC-040-0.0-B	1.44E+01	2.88E-01	1.58E-01	N	1.14E+02	3.46E+00	2.23E-01	N
RCA-TURB-CONC-041-0.0-B	2.99E+01	5.71E-01	1.71E-01	N	2.19E+02	6.66E+00	2.88E-01	N
RCA-TURB-CONC-042-0.0-B	1.48E+02	2.75E+00	3.39E-01	N	1.89E+03	5.72E+01	7.39E-01	Y
RCA-TURB-CONC-043-0.0-B	9.72E+00	1.98E-01	1.22E-01	N	3.87E+02	1.17E+01	2.94E-01	N
RCA-TURB-CONC-044-0.0-B	3.03E+02	5.63E+00	5.63E-01	N	1.74E+03	5.27E+01	9.19E-01	Y
RCA-TURB-CONC-045-0.0-B	3.29E+02	6.13E+00	8.98E-01	Y	6.66E+02	2.02E+01	6.66E-01	N
Average Activity	4.43E+01				3.89E+02			
Activity Standard Deviation	8.97E+01				6.77E+02			
Activity Range	4.57E-02	to	3.37E+02		6.13E-02	to	3.19E+03	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**TURB**	**Number of Samples:**	**45**
Initial Classification:	**Class 1**	**Sample Depth:**	**0.5**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-TURB-CONC-001-0.5-B-D	2.29E-01	0.00E+00	2.29E-01	N	2.04E-01	0.00E+00	2.04E-01	N
RCA-TURB-CONC-002-0.5-B	2.15E-01	0.00E+00	2.15E-01	N	2.02E-01	0.00E+00	2.02E-01	N
RCA-TURB-CONC-003-0.5-B	6.73E-02	2.32E-02	1.19E-01	N	2.10E-01	0.00E+00	2.10E-01	N
RCA-TURB-CONC-004-0.5-B	2.16E-01	0.00E+00	2.16E-01	N	4.12E-02	2.47E-02	1.12E-01	N
RCA-TURB-CONC-005-0.5-B	2.03E-01	0.00E+00	2.03E-01	N	3.41E-01	3.86E-02	1.17E-01	N
RCA-TURB-CONC-006-0.5-B	2.33E-01	0.00E+00	2.33E-01	N	1.75E-01	0.00E+00	1.75E-01	N
RCA-TURB-CONC-007-0.5-B	2.09E-01	0.00E+00	2.09E-01	N	2.46E-01	4.07E-02	1.36E-01	N
RCA-TURB-CONC-008-0.5-B	2.03E-01	0.00E+00	2.03E-01	N	1.94E-01	0.00E+00	1.94E-01	N
RCA-TURB-CONC-009-0.5-B	2.25E-01	0.00E+00	2.25E-01	N	1.77E-01	0.00E+00	1.77E-01	N
RCA-TURB-CONC-010-0.5-B	2.39E-01	0.00E+00	2.39E-01	N	2.11E-01	0.00E+00	2.11E-01	N
RCA-TURB-CONC-011-0.5-B	2.06E-01	0.00E+00	2.06E-01	N	1.69E-01	0.00E+00	1.69E-01	N
RCA-TURB-CONC-012-0.5-B	1.36E-01	4.86E-02	1.89E-01	N	4.30E-01	5.92E-02	1.77E-01	N
RCA-TURB-CONC-013-0.5-B	2.27E-01	0.00E+00	2.27E-01	N	1.98E-01	0.00E+00	1.98E-01	N
RCA-TURB-CONC-014-0.5-B	2.43E-01	0.00E+00	2.43E-01	N	2.32E-01	0.00E+00	2.32E-01	N
RCA-TURB-CONC-015-0.5-B	2.16E-01	0.00E+00	2.16E-01	N	1.94E-01	0.00E+00	1.94E-01	N
RCA-TURB-CONC-016-0.5-B	2.26E-01	0.00E+00	2.26E-01	N	1.59E-01	0.00E+00	1.59E-01	N
RCA-TURB-CONC-017-0.5-B	5.59E-02	2.07E-02	8.46E-02	N	1.14E+02	3.47E+00	2.39E-01	N
RCA-TURB-CONC-018-0.5-B	3.15E-01	3.78E-02	1.55E-01	N	4.75E+00	2.00E-01	1.93E-01	N
RCA-TURB-CONC-019-0.5-B	2.35E-01	0.00E+00	2.35E-01	N	2.24E-01	0.00E+00	2.24E-01	N
RCA-TURB-CONC-020-0.5-B-D	2.11E-01	0.00E+00	2.11E-01	N	1.52E-01	0.00E+00	1.52E-01	N
RCA-TURB-CONC-021-0.5-B	2.12E-01	0.00E+00	2.12E-01	N	2.17E-01	0.00E+00	2.17E-01	N
RCA-TURB-CONC-022-0.5-B	2.30E-01	0.00E+00	2.30E-01	N	2.02E-01	0.00E+00	2.02E-01	N
RCA-TURB-CONC-023-0.5-B-QC	1.02E+00	6.52E-02	2.11E-01	N	3.64E+01	1.16E+00	3.64E-01	N

RCA-TURB-CONC-024-0.5-B-D	2.30E-01	0.00E+00	2.30E-01	N	2.04E-01	0.00E+00	2.04E-01	N
RCA-TURB-CONC-025-0.5-B-D-QC	2.25E-01	0.00E+00	2.25E-01	N	2.84E+01	9.70E-01	3.61E-01	N
RCA-TURB-CONC-026-0.5-B-QC	1.82E-01	0.00E+00	1.82E-01	N	7.52E+00	2.73E-01	1.60E-01	N
RCA-TURB-CONC-027-0.5-B-QC	2.05E-01	4.78E-02	1.49E-01	N	7.65E+00	3.08E-01	2.12E-01	N
RCA-TURB-CONC-028-0.5-B	1.98E-01	0.00E+00	1.98E-01	N	8.43E-02	2.75E-02	1.07E-01	N
RCA-TURB-CONC-029-0.5-B	1.51E-01	2.79E-02	1.21E-01	N	1.18E-01	3.20E-02	1.23E-01	N
RCA-TURB-CONC-030-0.5-B	2.23E-01	0.00E+00	2.23E-01	N	2.34E+01	8.09E-01	2.52E-01	N
RCA-TURB-CONC-031-0.5-B-QC	2.66E-01	7.32E-02	2.42E-01	N	5.79E+00	2.70E-01	2.04E-01	N
RCA-TURB-CONC-032-0.5-B-D-QC	2.34E-01	0.00E+00	2.34E-01	N	1.25E+01	4.71E-01	2.64E-01	N
RCA-TURB-CONC-033-0.5-B-I-QC	1.53E-01	2.89E-02	1.38E-01	N	9.15E-01	7.02E-02	1.45E-01	N
RCA-TURB-CONC-034-0.5-B	1.99E-01	0.00E+00	1.99E-01	N	1.51E+01	5.46E-01	2.16E-01	N
RCA-TURB-CONC-035-0.5-B	1.92E+00	5.97E-02	1.32E-01	N	1.97E+02	5.99E+00	4.63E-01	N
RCA-TURB-CONC-036-0.5-B	2.40E+01	4.68E-01	2.27E-01	N	2.22E+02	6.75E+00	2.62E-01	N
RCA-TURB-CONC-037-0.5-B-QC	1.43E-01	4.06E-02	1.34E-01	N	2.25E+01	7.57E-01	2.32E-01	N
RCA-TURB-CONC-038-0.5-B-QC	1.76E-01	5.01E-02	1.25E-01	N	1.12E+01	4.39E-01	1.55E-01	N
RCA-TURB-CONC-039-0.5-B	2.32E-01	4.03E-02	1.76E-01	N	2.49E+00	1.40E-01	2.02E-01	N
RCA-TURB-CONC-040-0.5-B	2.23E-01	0.00E+00	2.23E-01	N	6.46E-01	7.64E-02	1.98E-01	N
RCA-TURB-CONC-041-0.5-B	1.16E-01	4.15E-02	1.48E-01	N	1.06E+00	9.38E-02	2.25E-01	N
RCA-TURB-CONC-042-0.5-B	1.50E-01	1.74E-02	6.99E-02	N	5.71E+02	1.74E+01	5.06E-01	N
RCA-TURB-CONC-043-0.5-B	3.42E+00	1.07E-01	2.05E-01	N	1.56E+01	5.15E-01	2.60E-01	N
RCA-TURB-CONC-044-0.5-B	7.51E+00	1.57E-01	1.45E-01	N	3.77E+02	1.14E+01	4.84E-01	N
RCA-TURB-CONC-045-0.5-B	4.60E+00	1.18E-01	1.28E-01	N	2.05E+02	6.24E+00	3.33E-01	N
Average Activity	1.12E+00				4.19E+01			
Activity Standard Deviation	3.74E+00				1.10E+02			
Activity Range	5.59E-02	to	2.40E+01		4.12E-02	to	5.71E+02	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**TURB**	**Number of Samples:**	**45**
Initial Classification:	**Class 1**	**Sample Depth:**	**1.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-TURB-CONC-001-1.0-B-D	2.30E-01	0.00E+00	2.30E-01	N	1.54E-01	0.00E+00	1.54E-01	N
RCA-TURB-CONC-002-1.0-B	1.87E-01	0.00E+00	1.87E-01	N	2.00E-01	0.00E+00	2.00E-01	N
RCA-TURB-CONC-003-1.0-B	2.12E-01	0.00E+00	2.12E-01	N	1.73E-01	0.00E+00	1.73E-01	N
RCA-TURB-CONC-004-1.0-B	2.10E-01	0.00E+00	2.10E-01	N	1.69E-01	0.00E+00	1.69E-01	N
RCA-TURB-CONC-005-1.0-B	1.95E-01	0.00E+00	1.95E-01	N	2.24E-01	0.00E+00	2.24E-01	N
RCA-TURB-CONC-006-1.0-B	2.24E-01	0.00E+00	2.24E-01	N	1.67E-01	0.00E+00	1.67E-01	N
RCA-TURB-CONC-007-1.0-B	2.02E-01	0.00E+00	2.02E-01	N	1.46E-01	0.00E+00	1.46E-01	N
RCA-TURB-CONC-008-1.0-B	1.70E-01	0.00E+00	1.70E-01	N	1.17E-01	0.00E+00	1.17E-01	N
RCA-TURB-CONC-009-1.0-B	2.05E-01	0.00E+00	2.05E-01	N	1.66E-01	0.00E+00	1.66E-01	N
RCA-TURB-CONC-010-1.0-B	2.21E-01	0.00E+00	2.21E-01	N	1.65E-01	0.00E+00	1.65E-01	N
RCA-TURB-CONC-011-1.0-B	1.81E-01	0.00E+00	1.81E-01	N	1.68E-01	0.00E+00	1.68E-01	N
RCA-TURB-CONC-012-1.0-B	2.10E-01	0.00E+00	2.10E-01	N	1.83E-01	0.00E+00	1.83E-01	N
RCA-TURB-CONC-013-1.0-B	1.84E-01	0.00E+00	1.84E-01	N	1.80E-01	0.00E+00	1.80E-01	N
RCA-TURB-CONC-014-1.0-B	1.95E-01	0.00E+00	1.95E-01	N	1.67E-01	0.00E+00	1.67E-01	N
RCA-TURB-CONC-015-1.0-B	2.37E-01	0.00E+00	2.37E-01	N	1.76E-01	0.00E+00	1.76E-01	N
RCA-TURB-CONC-016-1.0-B	2.16E-01	0.00E+00	2.16E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-TURB-CONC-017-1.0-B	2.13E-01	0.00E+00	2.13E-01	N	6.10E-01	6.48E-02	1.47E-01	N
RCA-TURB-CONC-018-1.0-B	2.46E-01	0.00E+00	2.46E-01	N	7.08E+00	2.75E-01	1.77E-01	N
RCA-TURB-CONC-019-1.0-B	2.21E-01	0.00E+00	2.21E-01	N	2.25E-01	0.00E+00	2.25E-01	N
RCA-TURB-CONC-020-1.0-B-D	2.24E-01	0.00E+00	2.24E-01	N	2.18E-01	0.00E+00	2.18E-01	N
RCA-TURB-CONC-021-1.0-B	2.00E-01	0.00E+00	2.00E-01	N	1.64E-01	0.00E+00	1.64E-01	N
RCA-TURB-CONC-022-1.0-B	2.12E-01	0.00E+00	2.12E-01	N	1.64E-01	0.00E+00	1.64E-01	N

RCA-TURB-CONC-023-1.0-B-QC	1.84E-01	3.22E-02	1.34E-01	N	6.65E+00	2.69E-01	1.84E-01	N
RCA-TURB-CONC-024-1.0-B-D	2.42E-01	0.00E+00	2.42E-01	N	1.83E-01	0.00E+00	1.83E-01	N
RCA-TURB-CONC-025-1.0-B-D-QC	2.21E-01	0.00E+00	2.21E-01	N	6.15E+00	2.37E-01	2.09E-01	N
RCA-TURB-CONC-026-1.0-B-QC	2.27E-01	0.00E+00	2.27E-01	N	9.09E-01	8.42E-02	1.57E-01	N
RCA-TURB-CONC-027-1.0-B	1.78E-01	0.00E+00	1.78E-01	N	4.07E-01	5.69E-02	1.68E-01	N
RCA-TURB-CONC-028-1.0-B	1.91E-01	0.00E+00	1.91E-01	N	2.08E-01	0.00E+00	2.08E-01	N
RCA-TURB-CONC-029-1.0-B	1.96E-01	0.00E+00	1.96E-01	N	2.24E-01	0.00E+00	2.24E-01	N
RCA-TURB-CONC-030-1.0-B	1.63E-01	0.00E+00	1.63E-01	N	1.74E+01	6.10E-01	2.26E-01	N
RCA-TURB-CONC-031-1.0-B	2.14E-01	0.00E+00	2.14E-01	N	3.07E-01	3.99E-02	1.17E-01	N
RCA-TURB-CONC-032-1.0-B-D-QC	1.74E-01	0.00E+00	1.74E-01	N	5.34E+00	2.32E-01	1.57E-01	N
RCA-TURB-CONC-033-1.0-B-I-QC	2.05E-01	0.00E+00	2.05E-01	N	2.31E-01	4.12E-02	9.54E-02	N
RCA-TURB-CONC-034-1.0-B	7.20E-02	2.22E-02	1.11E-01	N	6.88E+00	2.57E-01	1.73E-01	N
RCA-TURB-CONC-035-1.0-B	4.18E-01	5.27E-02	1.88E-01	N	1.40E+01	5.12E-01	2.48E-01	N
RCA-TURB-CONC-036-1.0-B	2.02E+01	4.16E-01	2.17E-01	N	6.06E+01	1.87E+00	3.15E-01	N
RCA-TURB-CONC-037-1.0-B-QC	2.39E-01	0.00E+00	2.39E-01	N	5.25E+00	2.07E-01	1.77E-01	N
RCA-TURB-CONC-038-1.0-B-QC	1.88E-01	0.00E+00	1.88E-01	N	2.47E+00	1.16E-01	1.39E-01	N
RCA-TURB-CONC-039-1.0-B	2.40E-01	0.00E+00	2.40E-01	N	1.28E+00	1.02E-01	1.85E-01	N
RCA-TURB-CONC-040-1.0-B	1.69E-01	0.00E+00	1.69E-01	N	2.00E-01	0.00E+00	2.00E-01	N
RCA-TURB-CONC-041-1.0-B	2.30E-01	0.00E+00	2.30E-01	N	2.10E-01	0.00E+00	2.10E-01	N
RCA-TURB-CONC-042-1.0-B	1.36E-01	1.85E-02	9.22E-02	N	1.93E+02	5.87E+00	5.01E-01	N
RCA-TURB-CONC-043-1.0-B	7.08E-01	6.58E-02	1.25E-01	N	3.79E+00	1.95E-01	1.82E-01	N
RCA-TURB-CONC-044-1.0-B	1.94E+00	1.00E-01	1.72E-01	N	4.28E+01	1.38E+00	3.10E-01	N
RCA-TURB-CONC-045-1.0-B	9.37E-01	4.80E-02	1.21E-01	N	2.07E+01	6.68E-01	3.52E-01	N
Average Activity	7.17E-01				8.90E+00			
Activity Standard Deviation	2.98E+00				3.03E+01			
Activity Range	7.20E-02	to	2.02E+01		1.17E-01	to	1.93E+02	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	RCA	Survey Building:	TURB	Number of Samples:	45			
Initial Classification:	Class 1	Sample Depth:	1.5					
Result Comparison								
	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-TURB-CONC-001-1.5-B-D	2.32E-01	0.00E+00	2.32E-01	N	2.10E-01	0.00E+00	2.10E-01	N
RCA-TURB-CONC-002-1.5-B	1.82E-01	0.00E+00	1.82E-01	N	1.72E-01	0.00E+00	1.72E-01	N
RCA-TURB-CONC-003-1.5-B	1.97E-01	0.00E+00	1.97E-01	N	1.63E-01	0.00E+00	1.63E-01	N
RCA-TURB-CONC-004-1.5-B	1.99E-01	0.00E+00	1.99E-01	N	2.13E-01	0.00E+00	2.13E-01	N
RCA-TURB-CONC-005-1.5-B	2.14E-01	0.00E+00	2.14E-01	N	1.69E-01	0.00E+00	1.69E-01	N
RCA-TURB-CONC-006-1.5-B	2.26E-01	0.00E+00	2.26E-01	N	1.59E-01	0.00E+00	1.59E-01	N
RCA-TURB-CONC-007-1.5-B	1.89E-01	0.00E+00	1.89E-01	N	1.73E-01	0.00E+00	1.73E-01	N
RCA-TURB-CONC-008-1.5-B	1.96E-01	0.00E+00	1.96E-01	N	1.58E-01	0.00E+00	1.58E-01	N
RCA-TURB-CONC-009-1.5-B	1.85E-01	0.00E+00	1.85E-01	N	1.75E-01	0.00E+00	1.75E-01	N
RCA-TURB-CONC-010-1.5-B	1.94E-01	0.00E+00	1.94E-01	N	1.47E-01	0.00E+00	1.47E-01	N
RCA-TURB-CONC-011-1.5-B	2.15E-01	0.00E+00	2.15E-01	N	1.61E-01	0.00E+00	1.61E-01	N
RCA-TURB-CONC-012-1.5-B	2.15E-01	0.00E+00	2.15E-01	N	1.77E-01	0.00E+00	1.77E-01	N
RCA-TURB-CONC-013-1.5-B	2.04E-01	0.00E+00	2.04E-01	N	1.41E-01	0.00E+00	1.41E-01	N
RCA-TURB-CONC-014-1.5-B	1.60E-01	0.00E+00	1.60E-01	N	1.85E-01	0.00E+00	1.85E-01	N
RCA-TURB-CONC-015-1.5-B	2.33E-01	0.00E+00	2.33E-01	N	2.28E-01	0.00E+00	2.28E-01	N
RCA-TURB-CONC-016-1.5-B	1.79E-01	0.00E+00	1.79E-01	N	1.96E-01	0.00E+00	1.96E-01	N
RCA-TURB-CONC-017-1.5-B	1.71E-01	0.00E+00	1.71E-01	N	1.62E-01	0.00E+00	1.62E-01	N
RCA-TURB-CONC-018-1.5-B	1.73E-01	2.88E-02	1.44E-01	N	9.32E+00	3.35E-01	2.25E-01	N
RCA-TURB-CONC-019-1.5-B	2.03E-01	0.00E+00	2.03E-01	N	2.30E-01	0.00E+00	2.30E-01	N
RCA-TURB-CONC-020-1.5-B-D	1.71E-01	0.00E+00	1.71E-01	N	2.13E-01	0.00E+00	2.13E-01	N
RCA-TURB-CONC-021-1.5-B	1.68E-01	0.00E+00	1.68E-01	N	1.59E-01	0.00E+00	1.59E-01	N
RCA-TURB-CONC-022-1.5-B	1.96E-01	0.00E+00	1.96E-01	N	1.71E-01	0.00E+00	1.71E-01	N
RCA-TURB-CONC-023-1.5-B	6.13E-02	3.44E-02	1.53E-01	N	1.00E+00	6.85E-02	1.38E-01	N

RCA-TURB-CONC-024-1.5-B-D	2.30E-01	0.00E+00	2.30E-01	N	1.63E-01	0.00E+00	1.63E-01	N
RCA-TURB-CONC-025-1.5-B-D-QC	1.91E-01	0.00E+00	1.91E-01	N	1.95E+00	1.27E-01	1.52E-01	N
RCA-TURB-CONC-026-1.5-B	2.21E-01	0.00E+00	2.21E-01	N	2.80E-01	4.38E-02	1.21E-01	N
RCA-TURB-CONC-027-1.5-B	2.02E-01	0.00E+00	2.02E-01	N	1.29E-01	4.33E-02	1.73E-01	N
RCA-TURB-CONC-028-1.5-B	2.41E-01	0.00E+00	2.41E-01	N	1.65E-01	0.00E+00	1.65E-01	N
RCA-TURB-CONC-029-1.5-B	2.00E-01	0.00E+00	2.00E-01	N	1.67E-01	0.00E+00	1.67E-01	N
RCA-TURB-CONC-030-1.5-B	1.90E-01	0.00E+00	1.90E-01	N	9.69E+00	3.67E-01	2.50E-01	N
RCA-TURB-CONC-031-1.5-B	2.04E-01	0.00E+00	2.04E-01	N	2.61E-01	0.00E+00	2.61E-01	N
RCA-TURB-CONC-032-1.5-B-D-QC	2.09E-01	0.00E+00	2.09E-01	N	3.24E+00	1.75E-01	1.31E-01	N
RCA-TURB-CONC-033-1.5-B-I-QC	1.84E-01	0.00E+00	1.84E-01	N	9.94E-02	4.27E-02	1.83E-01	N
RCA-TURB-CONC-034-1.5-B	2.28E-01	0.00E+00	2.28E-01	N	4.09E+00	2.02E-01	2.17E-01	N
RCA-TURB-CONC-035-1.5-B	2.12E-01	0.00E+00	2.12E-01	N	1.86E+00	1.25E-01	2.09E-01	N
RCA-TURB-CONC-036-1.5-B	8.69E+00	1.93E-01	1.95E-01	N	2.60E+01	8.14E-01	2.36E-01	N
RCA-TURB-CONC-037-1.5-B-QC	2.30E-01	0.00E+00	2.30E-01	N	1.50E+00	1.16E-01	2.21E-01	N
RCA-TURB-CONC-038-1.5-B-QC	2.27E-01	0.00E+00	2.27E-01	N	2.01E+00	1.16E-01	1.75E-01	N
RCA-TURB-CONC-039-1.5-B	1.55E-01	0.00E+00	1.55E-01	N	1.72E-01	4.33E-02	1.63E-01	N
RCA-TURB-CONC-040-1.5-B	1.91E-01	0.00E+00	1.91E-01	N	2.06E-01	0.00E+00	2.06E-01	N
RCA-TURB-CONC-041-1.5-B	2.20E-01	0.00E+00	2.20E-01	N	2.12E-01	0.00E+00	2.12E-01	N
RCA-TURB-CONC-042-1.5-B	9.12E-02	3.35E-02	1.30E-01	N	5.90E+01	1.84E+00	2.68E-01	N
RCA-TURB-CONC-043-1.5-B	1.83E-01	3.74E-02	1.71E-01	N	4.35E+00	2.08E-01	1.66E-01	N
RCA-TURB-CONC-044-1.5-B	2.63E-01	4.30E-02	1.22E-01	N	1.39E+01	5.08E-01	1.98E-01	N
RCA-TURB-CONC-045-1.5-B	1.95E-01	2.75E-02	1.23E-01	N	4.42E+00	1.79E-01	1.55E-01	N
Average Activity	3.85E-01				3.29E+00			
Activity Standard Deviation	1.27E+00				9.68E+00			
Activity Range	6.13E-02	to	8.69E+00		9.94E-02	to	5.90E+01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**TURB**	**Number of Samples:**	**45**
Initial Classification:	**Class 1**	**Sample Depth:**	**2.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-TURB-CONC-001-2.0-B-D	1.61E-01	0.00E+00	1.61E-01	N	1.76E-01	0.00E+00	1.76E-01	N
RCA-TURB-CONC-002-2.0-B	1.83E-01	0.00E+00	1.83E-01	N	1.91E-01	0.00E+00	1.91E-01	N
RCA-TURB-CONC-003-2.0-B	1.29E-01	3.36E-02	1.17E-01	N	1.68E-01	0.00E+00	1.68E-01	N
RCA-TURB-CONC-004-2.0-B	2.09E-01	0.00E+00	2.09E-01	N	1.40E-01	0.00E+00	1.40E-01	N
RCA-TURB-CONC-005-2.0-B	2.26E-01	0.00E+00	2.26E-01	N	1.52E-01	0.00E+00	1.52E-01	N
RCA-TURB-CONC-006-2.0-B	2.39E-01	0.00E+00	2.39E-01	N	1.99E-01	0.00E+00	1.99E-01	N
RCA-TURB-CONC-007-2.0-B	1.85E-01	0.00E+00	1.85E-01	N	1.72E-01	0.00E+00	1.72E-01	N
RCA-TURB-CONC-008-2.0-B	2.09E-01	0.00E+00	2.09E-01	N	1.56E-01	0.00E+00	1.56E-01	N
RCA-TURB-CONC-009-2.0-B	1.75E-01	0.00E+00	1.75E-01	N	1.86E-01	0.00E+00	1.86E-01	N
RCA-TURB-CONC-010-2.0-B	2.15E-01	0.00E+00	2.15E-01	N	1.50E-01	0.00E+00	1.50E-01	N
RCA-TURB-CONC-011-2.0-B	1.92E-01	0.00E+00	1.92E-01	N	1.80E-01	0.00E+00	1.80E-01	N
RCA-TURB-CONC-012-2.0-B	2.01E-01	0.00E+00	2.01E-01	N	2.17E-01	0.00E+00	2.17E-01	N
RCA-TURB-CONC-013-2.0-B	1.71E-01	0.00E+00	1.71E-01	N	1.66E-01	0.00E+00	1.66E-01	N
RCA-TURB-CONC-014-2.0-B	1.77E-01	0.00E+00	1.77E-01	N	1.65E-01	0.00E+00	1.65E-01	N
RCA-TURB-CONC-015-2.0-B	1.83E-01	4.10E-02	1.33E-01	N	1.83E-01	0.00E+00	1.83E-01	N
RCA-TURB-CONC-016-2.0-B	1.57E-01	0.00E+00	1.57E-01	N	2.10E-01	0.00E+00	2.10E-01	N
RCA-TURB-CONC-017-2.0-B	2.29E-01	0.00E+00	2.29E-01	N	2.16E-01	0.00E+00	2.16E-01	N
RCA-TURB-CONC-018-2.0-B	1.56E-01	2.94E-02	1.32E-01	N	7.48E+00	2.82E-01	2.11E-01	N
RCA-TURB-CONC-019-2.0-B	1.75E-01	0.00E+00	1.75E-01	N	1.81E-01	0.00E+00	1.81E-01	N
RCA-TURB-CONC-020-2.0-B-D	2.36E-01	0.00E+00	2.36E-01	N	1.94E-01	0.00E+00	1.94E-01	N
RCA-TURB-CONC-021-2.0-B	1.97E-01	0.00E+00	1.97E-01	N	1.64E-01	0.00E+00	1.64E-01	N
RCA-TURB-CONC-022-2.0-B	1.91E-01	0.00E+00	1.91E-01	N	1.90E-01	0.00E+00	1.90E-01	N

RCA-TURB-CONC-023-2.0-B	8.99E-02	4.14E-02	1.64E-01	N	2.52E-01	0.00E+00	2.52E-01	N
RCA-TURB-CONC-024-2.0-B-D	1.97E-01	0.00E+00	1.97E-01	N	1.52E-01	0.00E+00	1.52E-01	N
RCA-TURB-CONC-025-2.0-B-D	2.29E-01	0.00E+00	2.29E-01	N	4.27E-01	5.58E-02	1.40E-01	N
RCA-TURB-CONC-026-2.0-B	2.12E-01	0.00E+00	2.12E-01	N	2.35E-01	0.00E+00	2.35E-01	N
RCA-TURB-CONC-027-2.0-B	2.41E-01	0.00E+00	2.41E-01	N	2.29E-01	0.00E+00	2.29E-01	N
RCA-TURB-CONC-028-2.0-B	1.95E-01	0.00E+00	1.95E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-TURB-CONC-029-2.0-B	1.79E-01	0.00E+00	1.79E-01	N	1.95E-01	0.00E+00	1.95E-01	N
RCA-TURB-CONC-030-2.0-B	2.17E-01	0.00E+00	2.17E-01	N	5.82E+00	2.61E-01	1.85E-01	N
RCA-TURB-CONC-031-2.0-B	8.58E-02	3.77E-02	1.59E-01	N	1.91E-01	0.00E+00	1.91E-01	N
RCA-TURB-CONC-032-2.0-B-D-QC	1.90E-01	0.00E+00	1.90E-01	N	2.71E+00	1.27E-01	1.53E-01	N
RCA-TURB-CONC-033-2.0-B-I	2.16E-01	0.00E+00	2.16E-01	N	1.83E-01	0.00E+00	1.83E-01	N
RCA-TURB-CONC-034-2.0-B	1.97E-01	0.00E+00	1.97E-01	N	2.56E+00	1.38E-01	1.73E-01	N
RCA-TURB-CONC-035-2.0-B	2.06E-01	0.00E+00	2.06E-01	N	8.41E-01	8.33E-02	1.91E-01	N
RCA-TURB-CONC-036-2.0-B	3.21E+00	1.46E-01	1.81E-01	N	1.02E+01	4.01E-01	2.61E-01	N
RCA-TURB-CONC-037-2.0-B	8.40E-02	3.66E-02	1.56E-01	N	7.43E-01	6.00E-02	1.37E-01	N
RCA-TURB-CONC-038-2.0-B-QC	1.35E-01	5.67E-02	2.42E-01	N	4.09E+00	1.87E-01	2.53E-01	N
RCA-TURB-CONC-039-2.0-B	2.07E-01	0.00E+00	2.07E-01	N	2.12E-01	0.00E+00	2.12E-01	N
RCA-TURB-CONC-040-2.0-B	1.97E-01	0.00E+00	1.97E-01	N	1.60E-01	0.00E+00	1.60E-01	N
RCA-TURB-CONC-041-2.0-B	2.12E-01	0.00E+00	2.12E-01	N	1.96E-01	0.00E+00	1.96E-01	N
RCA-TURB-CONC-042-2.0-B	2.25E-01	0.00E+00	2.25E-01	N	1.24E+01	4.25E-01	1.67E-01	N
RCA-TURB-CONC-043-2.0-B	2.37E-01	0.00E+00	2.37E-01	N	3.16E+00	1.66E-01	1.47E-01	N
RCA-TURB-CONC-044-2.0-B	2.06E-01	0.00E+00	2.06E-01	N	7.01E+00	2.80E-01	1.73E-01	N
RCA-TURB-CONC-045-2.0-B	2.41E-01	0.00E+00	2.41E-01	N	1.40E+00	9.00E-02	1.35E-01	N
Average Activity	2.58E-01				1.44E+00			
Activity Standard Deviation	4.52E-01				2.81E+00			
Activity Range	8.40E-02	to	3.21E+00		1.40E-01	to	1.24E+01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**	**Survey Building:**	**TURB**	**Number of Samples:**	**45**			
Initial Classification:	**Class 1**	**Sample Depth:**	**2.5**					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-TURB-CONC-001-2.5-B-D	2.16E-01	0.00E+00	2.16E-01	N	1.39E-01	0.00E+00	1.39E-01	N
RCA-TURB-CONC-002-2.5-B	1.90E-01	0.00E+00	1.90E-01	N	1.80E-01	0.00E+00	1.80E-01	N
RCA-TURB-CONC-003-2.5-B	2.26E-01	0.00E+00	2.26E-01	N	1.46E-01	0.00E+00	1.46E-01	N
RCA-TURB-CONC-004-2.5-B	2.30E-01	0.00E+00	2.30E-01	N	1.81E-01	0.00E+00	1.81E-01	N
RCA-TURB-CONC-005-2.5-B	2.14E-01	0.00E+00	2.14E-01	N	1.84E-01	0.00E+00	1.84E-01	N
RCA-TURB-CONC-006-2.5-B	2.30E-01	0.00E+00	2.30E-01	N	1.72E-01	0.00E+00	1.72E-01	N
RCA-TURB-CONC-007-2.5-B	2.40E-01	0.00E+00	2.40E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-TURB-CONC-008-2.5-B	1.97E-01	0.00E+00	1.97E-01	N	1.46E-01	0.00E+00	1.46E-01	N
RCA-TURB-CONC-009-2.5-B	1.89E-01	0.00E+00	1.89E-01	N	1.44E-01	0.00E+00	1.44E-01	N
RCA-TURB-CONC-010-2.5-B	2.20E-01	0.00E+00	2.20E-01	N	1.93E-01	0.00E+00	1.93E-01	N
RCA-TURB-CONC-011-2.5-B	2.37E-01	0.00E+00	2.37E-01	N	1.66E-01	0.00E+00	1.66E-01	N
RCA-TURB-CONC-012-2.5-B	1.91E-01	0.00E+00	1.91E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-TURB-CONC-013-2.5-B	2.12E-01	0.00E+00	2.12E-01	N	1.73E-01	0.00E+00	1.73E-01	N
RCA-TURB-CONC-014-2.5-B	2.10E-01	0.00E+00	2.10E-01	N	1.50E-01	0.00E+00	1.50E-01	N
RCA-TURB-CONC-015-2.5-B	2.30E-01	0.00E+00	2.30E-01	N	2.42E-01	0.00E+00	2.42E-01	N
RCA-TURB-CONC-016-2.5-B	2.01E-01	0.00E+00	2.01E-01	N	2.02E-01	0.00E+00	2.02E-01	N
RCA-TURB-CONC-017-2.5-B	1.03E-01	2.32E-02	1.15E-01	N	1.51E-01	0.00E+00	1.51E-01	N
RCA-TURB-CONC-018-2.5-B	1.70E-01	2.81E-02	1.26E-01	N	1.74E+01	5.78E-01	1.57E-01	N
RCA-TURB-CONC-019-2.5-B	2.28E-01	0.00E+00	2.28E-01	N	1.72E-01	0.00E+00	1.72E-01	N
RCA-TURB-CONC-020-2.5-B-D	2.44E-01	0.00E+00	2.44E-01	N	1.52E-01	0.00E+00	1.52E-01	N
RCA-TURB-CONC-021-2.5-B	1.96E-01	0.00E+00	1.96E-01	N	1.80E-01	0.00E+00	1.80E-01	N
RCA-TURB-CONC-022-2.5-B	2.40E-01	0.00E+00	2.40E-01	N	1.63E-01	0.00E+00	1.63E-01	N

RCA-TURB-CONC-023-2.5-B	2.01E-01	0.00E+00	2.01E-01	N	1.77E-01	0.00E+00	1.77E-01	N
RCA-TURB-CONC-024-2.5-B-D	1.51E-01	0.00E+00	1.51E-01	N	1.70E-01	0.00E+00	1.70E-01	N
RCA-TURB-CONC-025-2.5-B-D	2.37E-01	0.00E+00	2.37E-01	N	2.45E-01	4.06E-02	1.61E-01	N
RCA-TURB-CONC-026-2.5-B	1.91E-01	0.00E+00	1.91E-01	N	1.71E-01	0.00E+00	1.71E-01	N
RCA-TURB-CONC-027-2.5-B	7.45E-02	3.80E-02	1.66E-01	N	1.65E-01	0.00E+00	1.65E-01	N
RCA-TURB-CONC-028-2.5-B	2.35E-01	0.00E+00	2.35E-01	N	1.60E-01	0.00E+00	1.60E-01	N
RCA-TURB-CONC-029-2.5-B	1.76E-01	0.00E+00	1.76E-01	N	1.48E-01	0.00E+00	1.48E-01	N
RCA-TURB-CONC-030-2.5-B	1.67E-01	0.00E+00	1.67E-01	N	3.37E+00	1.74E-01	1.40E-01	N
RCA-TURB-CONC-031-2.5-B	2.33E-01	0.00E+00	2.33E-01	N	7.41E-02	3.18E-02	1.37E-01	N
RCA-TURB-CONC-032-2.5-B-D-QC	2.14E-01	0.00E+00	2.14E-01	N	8.90E-01	8.14E-02	1.91E-01	N
RCA-TURB-CONC-033-2.5-B-I	1.93E-01	0.00E+00	1.93E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-TURB-CONC-034-2.5-B	1.72E-01	0.00E+00	1.72E-01	N	1.16E+00	9.17E-02	1.39E-01	N
RCA-TURB-CONC-035-2.5-B	1.05E-01	3.10E-02	1.09E-01	N	2.96E-01	4.13E-02	1.21E-01	N
RCA-TURB-CONC-036-2.5-B	8.88E-01	6.61E-02	2.13E-01	N	2.48E+00	1.30E-01	1.57E-01	N
RCA-TURB-CONC-037-2.5-B	2.07E-01	0.00E+00	2.07E-01	N	4.07E-01	5.85E-02	1.52E-01	N
RCA-TURB-CONC-038-2.5-B	2.22E-01	0.00E+00	2.22E-01	N	4.48E-01	5.76E-02	1.31E-01	N
RCA-TURB-CONC-039-2.5-B	2.38E-01	0.00E+00	2.38E-01	N	1.66E-01	0.00E+00	1.66E-01	N
RCA-TURB-CONC-040-2.5-B	1.94E-01	0.00E+00	1.94E-01	N	1.77E-01	0.00E+00	1.77E-01	N
RCA-TURB-CONC-041-2.5-B	2.10E-01	0.00E+00	2.10E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-TURB-CONC-042-2.5-B	2.32E-01	0.00E+00	2.32E-01	N	4.84E+00	1.96E-01	1.69E-01	N
RCA-TURB-CONC-043-2.5-B	1.38E-01	3.74E-02	1.40E-01	N	3.11E+00	1.37E-01	1.65E-01	N
RCA-TURB-CONC-044-2.5-B	2.30E-01	0.00E+00	2.30E-01	N	2.01E+00	1.15E-01	1.92E-01	N
RCA-TURB-CONC-045-2.5-B	2.34E-01	0.00E+00	2.34E-01	N	5.14E-01	5.40E-02	1.24E-01	N
Average Activity	2.17E-01				9.46E-01			
Activity Standard Deviation	1.09E-01				2.70E+00			
Activity Range	7.45E-02	to	8.88E-01		7.41E-02	to	1.74E+01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**TURB**	**Number of Samples:**	**45**
Initial Classification:	**Class 1**	**Sample Depth:**	**3.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-TURB-CONC-001-3.0-B-D	2.14E-01	0.00E+00	2.14E-01	N	1.55E-01	0.00E+00	1.55E-01	N
RCA-TURB-CONC-002-3.0-B	1.80E-01	0.00E+00	1.80E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-TURB-CONC-003-3.0-B	2.06E-01	0.00E+00	2.06E-01	N	1.97E-01	0.00E+00	1.97E-01	N
RCA-TURB-CONC-004-3.0-B	1.86E-01	0.00E+00	1.86E-01	N	1.74E-01	0.00E+00	1.74E-01	N
RCA-TURB-CONC-005-3.0-B	2.38E-01	0.00E+00	2.38E-01	N	1.41E-01	0.00E+00	1.41E-01	N
RCA-TURB-CONC-006-3.0-B	1.53E-01	0.00E+00	1.53E-01	N	1.94E-01	0.00E+00	1.94E-01	N
RCA-TURB-CONC-007-3.0-B	2.20E-01	0.00E+00	2.20E-01	N	1.37E-01	0.00E+00	1.37E-01	N
RCA-TURB-CONC-008-3.0-B	2.00E-01	0.00E+00	2.00E-01	N	1.67E-01	0.00E+00	1.67E-01	N
RCA-TURB-CONC-009-3.0-B	2.21E-01	0.00E+00	2.21E-01	N	2.08E-01	0.00E+00	2.08E-01	N
RCA-TURB-CONC-010-3.0-B	1.67E-01	0.00E+00	1.67E-01	N	1.85E-01	0.00E+00	1.85E-01	N
RCA-TURB-CONC-011-3.0-B	2.02E-01	0.00E+00	2.02E-01	N	1.95E-01	0.00E+00	1.95E-01	N
RCA-TURB-CONC-012-3.0-B	1.91E-01	0.00E+00	1.91E-01	N	2.01E-01	0.00E+00	2.01E-01	N
RCA-TURB-CONC-013-3.0-B	2.30E-01	0.00E+00	2.30E-01	N	1.83E-01	0.00E+00	1.83E-01	N
RCA-TURB-CONC-014-3.0-B	1.99E-01	0.00E+00	1.99E-01	N	1.72E-01	0.00E+00	1.72E-01	N
RCA-TURB-CONC-015-3.0-B	2.39E-01	0.00E+00	2.39E-01	N	2.29E-01	0.00E+00	2.29E-01	N
RCA-TURB-CONC-016-3.0-B	2.07E-01	0.00E+00	2.07E-01	N	1.76E-01	0.00E+00	1.76E-01	N
RCA-TURB-CONC-017-3.0-B	1.96E-01	0.00E+00	1.96E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-TURB-CONC-018-3.0-B	1.82E-01	3.13E-02	1.40E-01	N	7.64E+00	2.97E-01	1.97E-01	N
RCA-TURB-CONC-019-3.0-B	1.19E-01	0.00E+00	1.19E-01	N	2.10E-01	0.00E+00	2.10E-01	N
RCA-TURB-CONC-020-3.0-B-D	1.95E-01	0.00E+00	1.95E-01	N	1.57E-01	0.00E+00	1.57E-01	N
RCA-TURB-CONC-021-3.0-B	2.44E-01	0.00E+00	2.44E-01	N	1.94E-01	0.00E+00	1.94E-01	N
RCA-TURB-CONC-022-3.0-B	2.25E-01	0.00E+00	2.25E-01	N	1.95E-01	0.00E+00	1.95E-01	N

RCA-TURB-CONC-023-3.0-B	2.11E-01	0.00E+00	2.11E-01	N	1.66E-01	0.00E+00	1.66E-01	N
RCA-TURB-CONC-024-3.0-B-D	2.05E-01	0.00E+00	2.05E-01	N	1.67E-01	0.00E+00	1.67E-01	N
RCA-TURB-CONC-025-3.0-B-D	1.78E-01	0.00E+00	1.78E-01	N	2.06E-01	3.71E-02	1.32E-01	N
RCA-TURB-CONC-026-3.0-B	1.90E-01	0.00E+00	1.90E-01	N	1.97E-01	0.00E+00	1.97E-01	N
RCA-TURB-CONC-027-3.0-B	1.70E-01	0.00E+00	1.70E-01	N	1.61E-01	0.00E+00	1.61E-01	N
RCA-TURB-CONC-028-3.0-B	2.09E-01	0.00E+00	2.09E-01	N	1.71E-01	0.00E+00	1.71E-01	N
RCA-TURB-CONC-029-3.0-B	1.88E-01	0.00E+00	1.88E-01	N	1.61E-01	0.00E+00	1.61E-01	N
RCA-TURB-CONC-030-3.0-B	2.04E-01	0.00E+00	2.04E-01	N	2.17E+00	1.31E-01	1.42E-01	N
RCA-TURB-CONC-031-3.0-B	2.36E-01	0.00E+00	2.36E-01	N	2.37E-01	0.00E+00	2.37E-01	N
RCA-TURB-CONC-032-3.0-B-D	2.14E-01	0.00E+00	2.14E-01	N	5.76E-01	7.11E-02	1.92E-01	N
RCA-TURB-CONC-033-3.0-B-I	2.00E-01	0.00E+00	2.00E-01	N	1.71E-01	0.00E+00	1.71E-01	N
RCA-TURB-CONC-034-3.0-B	2.22E-01	0.00E+00	2.22E-01	N	8.27E-01	7.79E-02	1.34E-01	N
RCA-TURB-CONC-035-3.0-B	2.36E-01	0.00E+00	2.36E-01	N	1.79E-01	4.20E-02	1.33E-01	N
RCA-TURB-CONC-036-3.0-B	7.58E-01	5.07E-02	1.66E-01	N	7.96E-01	6.30E-02	1.46E-01	N
RCA-TURB-CONC-037-3.0-B	5.08E-02	3.34E-02	1.50E-01	N	1.65E-01	3.21E-02	1.13E-01	N
RCA-TURB-CONC-038-3.0-B	1.75E-01	0.00E+00	1.75E-01	N	1.64E-01	3.88E-02	1.38E-01	N
RCA-TURB-CONC-039-3.0-B	1.50E-01	0.00E+00	1.50E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-TURB-CONC-040-3.0-B	1.66E-01	0.00E+00	1.66E-01	N	1.91E-01	0.00E+00	1.91E-01	N
RCA-TURB-CONC-041-3.0-B	2.14E-01	0.00E+00	2.14E-01	N	1.81E-01	0.00E+00	1.81E-01	N
RCA-TURB-CONC-042-3.0-B	2.29E-01	0.00E+00	2.29E-01	N	1.23E+00	9.76E-02	1.68E-01	N
RCA-TURB-CONC-043-3.0-B	2.40E-01	0.00E+00	2.40E-01	N	3.39E+00	1.62E-01	1.85E-01	N
RCA-TURB-CONC-044-3.0-B	2.37E-01	0.00E+00	2.37E-01	N	1.14E+00	8.13E-02	1.32E-01	N
RCA-TURB-CONC-045-3.0-B	2.26E-01	0.00E+00	2.26E-01	N	3.43E-01	5.52E-02	1.73E-01	N
Average Activity	2.12E-01				5.47E-01			
Activity Standard Deviation	9.05E-02				1.23E+00			
Activity Range	5.08E-02	to	7.58E-01		1.37E-01	to	7.64E+00	

Note: Measurement Uncertainty values of 0.00E+00 indicate no detected activity.

Table 2-50 Gamma Results for TURB Sand Samples

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment									
Survey Area:	RCA	**Survey Building:**	TURB	**Number of Samples:**	45				
Initial Classification:	Class 1	**Sample Media:**	Sand						
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	
RCA-TURB-SAND-019-B	4.14E-02	0.00E+00	4.14E-02	N	1.06E-01	0.00E+00	1.06E-01	N	
RCA-TURB-SAND-020-B-D	1.01E-01	0.00E+00	1.01E-01	N	8.19E-02	0.00E+00	8.19E-02	N	
RCA-TURB-SAND-021-B	6.73E-01	8.15E-02	4.87E-02	N	4.33E-01	0.00E+00	4.33E-01	N	
RCA-TURB-SAND-022-B	4.00E-02	0.00E+00	4.00E-02	N	1.91E-01	0.00E+00	1.91E-01	N	
Average Activity	2.14E-01				2.03E-01				
Activity Standard Deviation	3.07E-01				1.60E-01				
Activity Range	4.00E-02	to	6.73E-01		8.19E-02	to	4.33E-01		

Note: Measurement Uncertainty values of 0.00E+00 indicate no detected activity.

Duplicate gamma spectroscopy analysis was performed onsite for each of the samples with a "D" designator in the sample number; samples with a "QC" designator were analyzed onsite by gamma spectroscopy and sent offsite for gamma analysis, radiochemical separation, evaluation of HTD beta emitters and alpha spectroscopy. Onsite gamma spectroscopy analysis for "D" and "QC" samples greater than MDC was evaluated as part of the ongoing quality assessment of the onsite laboratory. The results were within an acceptable margin of error for the analysis. A few analyses were repeated after an initial failure and attributed to changes in counting geometry. The offsite laboratory reports indicate no beta HTDs or alpha HTDs exceeded the AC. The following conclusions were reached for the TURB:

- MARSSIM Class 1 designation is appropriate for the TURB survey area.
- Excavation or remediation of concrete in the below-ground structure of the TURB may be required to a depth of 0.5 inches for exterior walls and floor surfaces to meet the site release criteria.

Table 2-51 Gamma Results for RXBT Concrete Core Samples

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**	**Survey Building:**	**RXBT**	**Number of Samples:**	**3**			
Initial Classification:	**Class 1**	**Sample Depth:**	**0.0**					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXBT-CONC-001-0.0-B-D-QC	8.88E+00	2.19E-01	2.42E-01	N	5.11E+01	1.59E+00	3.00E-01	N
RCA-RXBT-CONC-002-0.0-B-QC	1.39E-01	1.78E-02	9.20E-02	N	5.43E-01	3.82E-02	1.14E-01	N
RCA-RXBT-CONC-003-0.0-B-QC	5.69E+00	1.26E-01	1.41E-01	N	6.19E+01	1.89E+00	2.03E-01	N
Average Activity	4.90E+00				3.78E+01			
Activity Standard Deviation	4.42E+00				3.28E+01			
Activity Range	1.39E-01	to	8.88E+00		5.43E-01	to	6.19E+01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**	**Survey Building:**	**RXBT**	**Number of Samples:**	**3**			
Initial Classification:	**Class 1**	**Sample Depth:**	**0.5**					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXBT-CONC-001-0.5-B-D	2.35E-01	0.00E+00	2.35E-01	N	1.09E+01	4.27E-01	1.89E-01	N
RCA-RXBT-CONC-002-0.5-B	1.98E-01	0.00E+00	1.98E-01	N	1.73E-01	0.00E+00	1.73E-01	N
RCA-RXBT-CONC-003-0.5-B	1.36E-01	3.22E-02	8.80E-02	N	1.49E+01	5.12E-01	3.27E-01	N
Average Activity	1.90E-01				8.66E+00			
Activity Standard Deviation	5.00E-02				7.62E+00			
Activity Range	1.36E-01	to	2.35E-01		1.73E-01	to	1.49E+01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**RXBT**	**Number of Samples:**	**3**
Initial Classification:	**Class 1**	**Sample Depth:**	**1.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXBT-CONC-001-1.0-B-D	1.60E-01	0.00E+00	1.60E-01	N	1.53E+00	8.46E-02	1.59E-01	N
RCA-RXBT-CONC-002-1.0-B	2.26E-01	0.00E+00	2.26E-01	N	1.64E-01	0.00E+00	1.64E-01	N
RCA-RXBT-CONC-003-1.0-B	2.16E-01	0.00E+00	2.16E-01	N	3.85E+00	1.92E-01	1.92E-01	N
Average Activity	2.01E-01				1.85E+00			
Activity Standard Deviation	3.56E-02				1.86E+00			
Activity Range	1.60E-01	to	2.26E-01		1.64E-01	to	3.85E+00	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**RXBT**	**Number of Samples:**	**3**
Initial Classification:	**Class 1**	**Sample Depth:**	**1.5**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXBT-CONC-001-1.5-B-D	2.03E-01	0.00E+00	2.03E-01	N	7.47E-01	7.40E-02	1.63E-01	N
RCA-RXBT-CONC-002-1.5-B	1.61E-01	0.00E+00	1.61E-01	N	1.77E-01	0.00E+00	1.77E-01	N
RCA-RXBT-CONC-003-1.5-B	2.29E-01	0.00E+00	2.29E-01	N	1.84E+00	1.15E-01	1.82E-01	N
Average Activity	1.98E-01				9.21E-01			
Activity Standard Deviation	3.43E-02				8.45E-01			
Activity Range	1.61E-01	to	2.29E-01		1.77E-01	to	1.84E+00	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**RXBT**	**Number of Samples:**	**3**
Initial Classification:	**Class 1**	**Sample Depth:**	**2.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXBT-CONC-001-2.0-B-D	2.34E-01	0.00E+00	2.34E-01	N	6.00E-01	5.92E-02	1.33E-01	N
RCA-RXBT-CONC-002-2.0-B	2.19E-01	0.00E+00	2.19E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-RXBT-CONC-003-2.0-B	2.14E-01	0.00E+00	2.14E-01	N	4.89E-01	5.34E-02	1.24E-01	N
Average Activity	2.22E-01				4.26E-01			
Activity Standard Deviation	1.04E-02				2.13E-01			
Activity Range	2.14E-01	to	2.34E-01		1.89E-01	to	6.00E-01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**RXBT**	**Number of Samples:**	**3**
Initial Classification:	**Class 1**	**Sample Depth:**	**2.5**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXBT-CONC-001-2.5-B-D	2.06E-01	0.00E+00	2.06E-01	N	2.82E-01	5.70E-02	1.93E-01	N
RCA-RXBT-CONC-002-2.5-B	9.29E-02	2.76E-02	1.03E-01	N	1.21E-01	0.00E+00	1.21E-01	N
RCA-RXBT-CONC-003-2.5-B	1.95E-01	0.00E+00	1.95E-01	N	1.90E-01	3.82E-02	1.41E-01	N
Average Activity	1.65E-01				1.98E-01			
Activity Standard Deviation	6.24E-02				8.08E-02			
Activity Range	9.29E-02	to	2.06E-01		1.21E-01	to	2.82E-01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**	**Survey Building:**	**RXBT**	**Number of Samples:**	**3**			
Initial Classification:	**Class 1**	**Sample Depth:**	**3.0**					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-RXBT-CONC-001-3.0-B-D	1.94E-01	0.00E+00	1.94E-01	N	2.67E-01	0.00E+00	2.67E-01	N
RCA-RXBT-CONC-002-3.0-B	2.09E-01	0.00E+00	2.09E-01	N	2.07E-01	0.00E+00	2.07E-01	N
RCA-RXBT-CONC-003-3.0-B	2.15E-01	0.00E+00	2.15E-01	N	2.48E-01	0.00E+00	2.48E-01	N
Average Activity	2.06E-01				2.41E-01			
Activity Standard Deviation	1.08E-02				3.07E-02			
Activity Range	1.94E-01	to	2.15E-01		2.07E-01	to	2.67E-01	

Note: Measurement Uncertainty values of 0.00E+00 indicate no detected activity.

Duplicate gamma spectroscopy analysis was performed onsite for each of the samples with a "D" designator in the sample number; samples with a "QC" designator were analyzed onsite by gamma spectroscopy and sent offsite for gamma spectroscopy analysis, radiochemical separation, evaluation of HTD beta emitters and alpha spectroscopy. Onsite gamma spectroscopy analysis for "D" and "QC" samples greater than MDC was evaluated as part of the ongoing quality assessment of the onsite laboratory. The results were within an acceptable margin of error for the analysis. The offsite laboratory reports indicate no beta HTDs or alpha HTDs exceeded the AC.

The following conclusions were reached for the RXBT area:

- MARSSIM Class 1 designation is appropriate for the RXBT survey area.
- Remediation of concrete surfaces in the below-ground structure of the RXBT may be required. Remediation may not be required on wall surfaces to meet the site release criteria.

Table 2-52 Gamma Results for TURT Concrete Core Samples

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**	**Survey Building:**	**TURT**	**Number of Samples:**	**10**			
Initial Classification:	**Class 1**	**Sample Depth:**	**0.0**					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-TURT-CONC-001-0.0-B-QC	3.74E+00	9.45E-02	1.58E-01	N	7.36E+01	2.25E+00	1.79E-01	N
RCA-TURT-CONC-002-0.0-B	3.16E-01	3.45E-02	1.34E-01	N	1.15E+00	7.22E-02	1.13E-01	N
RCA-TURT-CONC-003-0.0-B-QC	1.98E+00	7.53E-02	1.57E-01	N	3.63E+01	1.14E+00	1.76E-01	N
RCA-TURT-CONC-004-0.0-B	1.93E-01	2.79E-02	1.30E-01	N	1.53E+00	8.28E-02	1.25E-01	N
RCA-TURT-CONC-005-0.0-B-QC	1.21E+00	4.51E-02	1.07E-01	N	7.22E+01	2.21E+00	1.74E-01	N
RCA-TURT-CONC-006-0.0-B	3.34E-01	3.34E-02	1.29E-01	N	3.34E+00	1.40E-01	1.27E-01	N
RCA-TURT-CONC-007-0.0-B-D-QC	1.94E+00	9.93E-02	2.03E-01	N	2.12E+01	7.19E-01	2.19E-01	N
RCA-TURT-CONC-008-0.0-B	1.36E-01	1.97E-02	1.06E-01	N	6.08E-01	4.30E-02	1.23E-01	N
RCA-TURT-CONC-009-0.0-B-QC	3.87E+00	1.45E-01	2.11E-01	N	4.36E+01	1.40E+00	3.24E-01	N
RCA-TURT-CONC-010-0.0-B	4.38E-01	5.21E-02	1.49E-01	N	2.90E+00	1.61E-01	1.96E-01	N
Average Activity	1.42E+00				2.56E+01			
Activity Standard Deviation	1.43E+00				2.93E+01			
Activity Range	1.36E-01	to	3.87E+00		6.08E-01	to	7.36E+01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**TURT**	**Number of Samples:**	**10**
Initial Classification:	**Class 1**	**Sample Depth:**	**0.5**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-TURT-CONC-001-0.5-B	2.37E-01	0.00E+00	2.37E-01	N	4.77E-01	5.16E-02	1.41E-01	N
RCA-TURT-CONC-002-0.5-B	2.27E-01	0.00E+00	2.27E-01	N	1.64E-01	0.00E+00	1.64E-01	N
RCA-TURT-CONC-003-0.5-B	3.18E-01	4.25E-02	1.63E-01	N	1.25E+00	8.82E-02	1.33E-01	N
RCA-TURT-CONC-004-0.5-B	1.87E-01	0.00E+00	1.87E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-TURT-CONC-005-0.5-B-QC	1.08E-01	3.53E-02	1.36E-01	N	8.14E+00	3.00E-01	2.22E-01	N
RCA-TURT-CONC-006-0.5-B	2.11E-01	0.00E+00	2.11E-01	N	1.93E-01	0.00E+00	1.93E-01	N
RCA-TURT-CONC-007-0.5-B-D-QC	9.38E-02	3.30E-02	1.17E-01	N	7.20E+00	2.82E-01	2.11E-01	N
RCA-TURT-CONC-008-0.5-B	2.08E-01	0.00E+00	2.08E-01	N	1.46E-01	0.00E+00	1.46E-01	N
RCA-TURT-CONC-009-0.5-B	1.30E-01	3.68E-02	1.39E-01	N	2.63E-01	3.85E-02	1.20E-01	N
RCA-TURT-CONC-010-0.5-B	2.36E-01	0.00E+00	2.36E-01	N	2.31E-01	0.00E+00	2.31E-01	N
Average Activity	1.96E-01				1.82E+00			
Activity Standard Deviation	6.84E-02				3.11E+00			
Activity Range	9.38E-02	to	3.18E-01		1.46E-01	to	8.14E+00	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**TURT**	**Number of Samples:**	**10**
Initial Classification:	**Class 1**	**Sample Depth:**	**1.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-TURT-CONC-001-1.0-B	1.83E-01	0.00E+00	1.83E-01	N	1.56E-01	0.00E+00	1.56E-01	N
RCA-TURT-CONC-002-1.0-B	2.24E-01	0.00E+00	2.24E-01	N	1.77E-01	0.00E+00	1.77E-01	N
RCA-TURT-CONC-003-1.0-B	2.41E-01	0.00E+00	2.41E-01	N	1.93E-01	0.00E+00	1.93E-01	N
RCA-TURT-CONC-004-1.0-B	2.12E-01	0.00E+00	2.12E-01	N	1.52E-01	0.00E+00	1.52E-01	N
RCA-TURT-CONC-005-1.0-B	7.52E-02	2.14E-02	8.51E-02	N	1.64E-01	0.00E+00	1.64E-01	N
RCA-TURT-CONC-006-1.0-B	2.06E-01	0.00E+00	2.06E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-TURT-CONC-007-1.0-B-D	2.16E-01	0.00E+00	2.16E-01	N	1.71E-01	4.35E-02	1.61E-01	N
RCA-TURT-CONC-008-1.0-B	2.23E-01	0.00E+00	2.23E-01	N	1.80E-01	0.00E+00	1.80E-01	N
RCA-TURT-CONC-009-1.0-B	1.66E-01	0.00E+00	1.66E-01	N	4.91E-02	2.09E-02	8.91E-02	N
RCA-TURT-CONC-010-1.0-B	1.80E-01	0.00E+00	1.80E-01	N	1.70E-01	0.00E+00	1.70E-01	N
Average Activity	1.93E-01				1.60E-01			
Activity Standard Deviation	4.73E-02				4.11E-02			
Activity Range	7.52E-02	to	2.41E-01		4.91E-02	to	1.93E-01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**	**Survey Building:**	**TURT**	**Number of Samples:**	**10**			
Initial Classification:	**Class 1**	**Sample Depth:**	**1.5**					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-TURT-CONC-001-1.5-B	1.92E-01	0.00E+00	1.92E-01	N	1.95E-01	0.00E+00	1.95E-01	N
RCA-TURT-CONC-002-1.5-B	2.07E-01	0.00E+00	2.07E-01	N	1.72E-01	0.00E+00	1.72E-01	N
RCA-TURT-CONC-003-1.5-B	2.09E-01	0.00E+00	2.09E-01	N	2.00E-01	0.00E+00	2.00E-01	N
RCA-TURT-CONC-004-1.5-B	2.08E-01	0.00E+00	2.08E-01	N	2.14E-01	0.00E+00	2.14E-01	N
RCA-TURT-CONC-005-1.5-B	2.07E-01	0.00E+00	2.07E-01	N	1.94E-01	0.00E+00	1.94E-01	N
RCA-TURT-CONC-006-1.5-B	1.27E-01	0.00E+00	1.27E-01	N	1.65E-01	0.00E+00	1.65E-01	N
RCA-TURT-CONC-007-1.5-B-D	2.18E-01	0.00E+00	2.18E-01	N	2.62E-01	0.00E+00	2.62E-01	N
RCA-TURT-CONC-008-1.5-B	1.90E-01	0.00E+00	1.90E-01	N	1.49E-01	0.00E+00	1.49E-01	N
RCA-TURT-CONC-009-1.5-B	2.24E-01	0.00E+00	2.24E-01	N	2.49E-01	0.00E+00	2.49E-01	N
RCA-TURT-CONC-010-1.5-B	1.70E-01	0.00E+00	1.70E-01	N	2.10E-01	0.00E+00	2.10E-01	N
Average Activity	1.95E-01				2.01E-01			
Activity Standard Deviation	2.85E-02				3.53E-02			
Activity Range	1.27E-01	to	2.24E-01		1.49E-01	to	2.62E-01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**TURT**	**Number of Samples:**	**10**
Initial Classification:	**Class 1**	**Sample Depth:**	**2.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-TURT-CONC-001-2.0-B	2.08E-01	0.00E+00	2.08E-01	N	1.39E-01	0.00E+00	1.39E-01	N
RCA-TURT-CONC-002-2.0-B	1.79E-01	0.00E+00	1.79E-01	N	1.58E-01	0.00E+00	1.58E-01	N
RCA-TURT-CONC-003-2.0-B	5.90E-02	3.18E-02	1.36E-01	N	1.82E-01	0.00E+00	1.82E-01	N
RCA-TURT-CONC-004-2.0-B	2.30E-01	0.00E+00	2.30E-01	N	1.78E-01	0.00E+00	1.78E-01	N
RCA-TURT-CONC-005-2.0-B	2.04E-01	0.00E+00	2.04E-01	N	1.82E-01	0.00E+00	1.82E-01	N
RCA-TURT-CONC-006-2.0-B	2.11E-01	0.00E+00	2.11E-01	N	2.44E-01	0.00E+00	2.44E-01	N
RCA-TURT-CONC-007-2.0-B-D	1.14E-01	3.94E-02	1.46E-01	N	2.04E-01	0.00E+00	2.04E-01	N
RCA-TURT-CONC-008-2.0-B	1.87E-01	0.00E+00	1.87E-01	N	1.91E-01	0.00E+00	1.91E-01	N
RCA-TURT-CONC-009-2.0-B	2.28E-01	0.00E+00	2.28E-01	N	1.79E-01	0.00E+00	1.79E-01	N
RCA-TURT-CONC-010-2.0-B	1.98E-01	0.00E+00	1.98E-01	N	1.88E-01	0.00E+00	1.88E-01	N
Average Activity	1.82E-01				1.85E-01			
Activity Standard Deviation	5.42E-02				2.76E-02			
Activity Range	5.90E-02	to	2.30E-01		1.39E-01	to	2.44E-01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**RCA**	**Survey Building:**	**TURT**	**Number of Samples:**	**10**				
Initial Classification:	**Class 1**	**Sample Depth:**	**2.5**						
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	
RCA-TURT-CONC-001-2.5-B	2.09E-01	0.00E+00	2.09E-01	N	1.67E-01	0.00E+00	1.67E-01	N	
RCA-TURT-CONC-002-2.5-B	2.07E-01	0.00E+00	2.07E-01	N	1.81E-01	0.00E+00	1.81E-01	N	
RCA-TURT-CONC-003-2.5-B	2.37E-01	0.00E+00	2.37E-01	N	1.79E-01	0.00E+00	1.79E-01	N	
RCA-TURT-CONC-004-2.5-B	2.41E-01	0.00E+00	2.41E-01	N	1.92E-01	0.00E+00	1.92E-01	N	
RCA-TURT-CONC-005-2.5-B	2.12E-01	0.00E+00	2.12E-01	N	1.74E-01	0.00E+00	1.74E-01	N	
RCA-TURT-CONC-006-2.5-B	2.01E-01	0.00E+00	2.01E-01	N	1.53E-01	0.00E+00	1.53E-01	N	
RCA-TURT-CONC-007-2.5-B-D	1.99E-01	0.00E+00	1.99E-01	N	1.90E-01	0.00E+00	1.90E-01	N	
RCA-TURT-CONC-008-2.5-B	2.07E-01	0.00E+00	2.07E-01	N	1.83E-01	0.00E+00	1.83E-01	N	
RCA-TURT-CONC-009-2.5-B	2.05E-01	0.00E+00	2.05E-01	N	1.96E-01	0.00E+00	1.96E-01	N	
RCA-TURT-CONC-010-2.5-B	2.10E-01	0.00E+00	2.10E-01	N	1.54E-01	0.00E+00	1.54E-01	N	
Average Activity	2.13E-01				1.77E-01				
Activity Standard Deviation	1.44E-02				1.50E-02				
Activity Range	1.99E-01	to	2.41E-01		1.53E-01	to	1.96E-01		

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**RCA**	**Survey Building:**	**TURT**	**Number of Samples:**	**10**				
Initial Classification:	**Class 1**	**Sample Depth:**	**3.0**						
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	
RCA-TURT-CONC-001-3.0-B	2.13E-01	0.00E+00	2.13E-01	N	1.74E-01	0.00E+00	1.74E-01	N	
RCA-TURT-CONC-002-3.0-B	2.05E-01	0.00E+00	2.05E-01	N	1.50E-01	0.00E+00	1.50E-01	N	
RCA-TURT-CONC-003-3.0-B	2.13E-01	0.00E+00	2.13E-01	N	1.95E-01	0.00E+00	1.95E-01	N	
RCA-TURT-CONC-004-3.0-B	2.22E-01	0.00E+00	2.22E-01	N	2.54E-01	0.00E+00	2.54E-01	N	
RCA-TURT-CONC-005-3.0-B	2.15E-01	0.00E+00	2.15E-01	N	1.79E-01	0.00E+00	1.79E-01	N	
RCA-TURT-CONC-006-3.0-B	2.42E-01	0.00E+00	2.42E-01	N	1.95E-01	0.00E+00	1.95E-01	N	
RCA-TURT-CONC-007-3.0-B-D	1.91E-01	0.00E+00	1.91E-01	N	1.44E-01	0.00E+00	1.44E-01	N	
RCA-TURT-CONC-008-3.0-B	2.40E-01	0.00E+00	2.40E-01	N	1.88E-01	0.00E+00	1.88E-01	N	
RCA-TURT-CONC-009-3.0-B	2.17E-01	0.00E+00	2.17E-01	N	1.82E-01	0.00E+00	1.82E-01	N	
RCA-TURT-CONC-010-3.0-B	1.93E-01	0.00E+00	1.93E-01	N	2.09E-01	0.00E+00	2.09E-01	N	
Average Activity	2.15E-01				1.87E-01				
Activity Standard Deviation	1.69E-02				3.09E-02				
Activity Range	1.91E-01	to	2.42E-01		1.44E-01	to	2.54E-01		

Note: Measurement Uncertainty values of 0.00E+00 indicate no detected activity.

Duplicate gamma spectroscopy analysis was performed onsite for each of the samples with a "D" designator in the sample number; samples with a "QC" designator were analyzed onsite by gamma spectroscopy and sent offsite for gamma spectroscopy analysis, radiochemical separation, evaluation of HTD beta emitters and alpha spectroscopy. Onsite gamma spectroscopy analysis for "D" and "QC" samples greater than MDC was evaluated as part of the ongoing quality assessment of the onsite laboratory. The results were within an acceptable margin of error for the analysis. The offsite laboratory reports indicate no beta HTDs or alpha HTDs exceeded the AC.

The following conclusions were reached for the TURT area:

- MARSSIM Class 1 designation is appropriate for the TURT survey area.
- Remediation of concrete surfaces in the below-ground structure of the TURT may be required for floor surfaces. Remediation may not be required on wall surfaces to meet the site release criteria.

Table 2-53 Gamma Results for BSTK Concrete Core Samples

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**	**Survey Building:**	**BSTK**	**Number of Samples:**	**4**			
Initial Classification:	**Class 1**	**Sample Depth:**	**0.0**					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-BSTK-CONC-001-0.0-B-QC	2.29E+02	4.32E+00	9.44E-01	Y	2.30E+02	7.03E+00	1.11E+00	Y
RCA-BSTK-CONC-002-0.0-B	1.77E-01	1.84E-02	9.26E-02	N	8.33E-01	4.35E-02	9.89E-02	N
RCA-BSTK-CONC-003-0.0-B-D-QC	8.17E+03	1.51E+02	1.93E+00	Y	2.68E+03	8.11E+01	2.21E+00	Y
RCA-BSTK-CONC-004-0.0-B-QC	3.09E+01	6.57E-01	3.78E-01	Y	3.52E+01	1.13E+00	4.58E-01	Y
Average Activity	2.11E+03				7.37E+02			
Activity Standard Deviation	4.04E+03				1.30E+03			
Activity Range	1.77E-01	to	8.17E+03		8.33E-01	to	2.68E+03	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**BSTK**	**Number of Samples:**	**4**
Initial Classification:	**Class 1**	**Sample Depth:**	**0.5**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-BSTK-CONC-001-0.5-B	3.98E-01	3.48E-02	1.13E-01	N	1.89E+01	6.17E-01	2.13E-01	N
RCA-BSTK-CONC-002-0.5-B	2.28E-01	0.00E+00	2.28E-01	N	2.52E-01	0.00E+00	2.52E-01	N
RCA-BSTK-CONC-003-0.5-B-D	1.22E+00	5.92E-02	1.42E-01	N	1.70E+01	5.62E-01	2.94E-01	N
RCA-BSTK-CONC-004-0.5-B	1.95E-01	0.00E+00	1.95E-01	N	5.46E+00	2.17E-01	1.72E-01	N
Average Activity	5.10E-01				1.04E+01			
Activity Standard Deviation	4.81E-01				9.00E+00			
Activity Range	1.95E-01	to	1.22E+00		2.52E-01	to	1.89E+01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**BSTK**	**Number of Samples:**	**4**
Initial Classification:	**Class 1**	**Sample Depth:**	**1.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-BSTK-CONC-001-1.0-B	2.42E-01	2.85E-02	1.02E-01	N	6.08E+00	2.34E-01	2.25E-01	N
RCA-BSTK-CONC-002-1.0-B	2.38E-01	0.00E+00	2.38E-01	N	2.08E-01	0.00E+00	2.08E-01	N
RCA-BSTK-CONC-003-1.0-B-D	2.26E-01	0.00E+00	2.26E-01	N	9.69E-01	7.28E-02	1.26E-01	N
RCA-BSTK-CONC-004-1.0-B	1.62E-01	0.00E+00	1.62E-01	N	1.31E+00	8.28E-02	1.52E-01	N
Average Activity	2.17E-01				2.14E+00			
Activity Standard Deviation	3.73E-02				2.67E+00			
Activity Range	1.62E-01	to	2.42E-01		2.08E-01	to	6.08E+00	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**RCA**	**Survey Building:**	**BSTK**	**Number of Samples:**	**4**				
Initial Classification:	**Class 1**	**Sample Depth:**	**1.5**						
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	
RCA-BSTK-CONC-001-1.5-B	8.23E-02	2.73E-02	1.09E-01	N	5.80E+00	2.15E-01	1.58E-01	N	
RCA-BSTK-CONC-002-1.5-B	1.57E-01	0.00E+00	1.57E-01	N	1.39E-01	0.00E+00	1.39E-01	N	
RCA-BSTK-CONC-003-1.5-B-D	7.36E-02	3.58E-02	1.53E-01	N	3.18E-01	4.47E-02	1.32E-01	N	
RCA-BSTK-CONC-004-1.5-B	2.28E-01	0.00E+00	2.28E-01	N	5.52E-01	6.49E-02	1.73E-01	N	
Average Activity	1.35E-01				1.70E+00				
Activity Standard Deviation	7.23E-02				2.74E+00				
Activity Range	7.36E-02	to	2.28E-01		1.39E-01	to	5.80E+00		

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment									
Survey Area:	**RCA**		**Survey Building:**	**BSTK**		**Number of Samples:**	**4**		
Initial Classification:	**Class 1**		**Sample Depth:**	**2.0**					
Result Comparison									
	Co-60				**Cs-137**				
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-BSTK-CONC-001-2.0-B	2.26E-01	0.00E+00	2.26E-01	N	3.82E+00	1.59E-01	1.80E-01	N
RCA-BSTK-CONC-002-2.0-B	1.87E-01	0.00E+00	1.87E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-BSTK-CONC-003-2.0-B-D	1.57E-01	0.00E+00	1.57E-01	N	9.07E-02	2.67E-02	1.09E-01	N
RCA-BSTK-CONC-004-2.0-B	2.00E-01	0.00E+00	2.00E-01	N	2.93E-01	5.22E-02	1.76E-01	N
Average Activity	1.93E-01				1.10E+00			
Activity Standard Deviation	2.87E-02				1.82E+00			
Activity Range	1.57E-01	to	2.26E-01		9.07E-02	to	3.82E+00	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**	**Survey Building:**	**BSTK**	**Number of Samples:**	**4**			
Initial Classification:	**Class 1**	**Sample Depth:**	**2.5**					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-BSTK-CONC-001-2.5-B	2.34E-01	0.00E+00	2.34E-01	N	1.26E+00	9.53E-02	1.57E-01	N
RCA-BSTK-CONC-002-2.5-B	1.93E-01	0.00E+00	1.93E-01	N	1.92E-01	0.00E+00	1.92E-01	N
RCA-BSTK-CONC-003-2.5-B-D	1.99E-01	0.00E+00	1.99E-01	N	1.77E-01	0.00E+00	1.77E-01	N
RCA-BSTK-CONC-004-2.5-B	1.82E-01	0.00E+00	1.82E-01	N	2.05E-01	0.00E+00	2.05E-01	N
Average Activity	2.02E-01				4.59E-01			
Activity Standard Deviation	2.25E-02				5.34E-01			
Activity Range	1.82E-01	to	2.34E-01		1.77E-01	to	1.26E+00	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**	**Survey Building:**	**BSTK**	**Number of Samples:**	**4**			
Initial Classification:	**Class 1**	**Sample Depth:**	**3.0**					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-BSTK-CONC-001-3.0-B	2.38E-01	0.00E+00	2.38E-01	N	3.05E-01	4.35E-02	1.26E-01	N
RCA-BSTK-CONC-002-3.0-B	1.96E-01	0.00E+00	1.96E-01	N	1.66E-01	0.00E+00	1.66E-01	N
RCA-BSTK-CONC-003-3.0-B-D	1.73E-01	0.00E+00	1.73E-01	N	2.08E-01	0.00E+00	2.08E-01	N
RCA-BSTK-CONC-004-3.0-B	2.20E-01	0.00E+00	2.20E-01	N	1.90E-01	0.00E+00	1.90E-01	N
Average Activity	2.07E-01				2.17E-01			
Activity Standard Deviation	2.83E-02				6.10E-02			
Activity Range	1.73E-01	to	2.38E-01		1.66E-01	to	3.05E-01	

Note: Measurement Uncertainty values of 0.00E+00 indicate no detected activity.

Duplicate gamma spectroscopy analysis was performed onsite for each of the samples with a "D" designator in the sample number. Samples with a "QC" designator were analyzed onsite by gamma spectroscopy and sent offsite for gamma spectroscopy analysis, radiochemical separation, evaluation of HTD beta emitters, and alpha spectroscopy. Onsite gamma spectroscopy analysis for "D" and "QC" samples greater than MDC was evaluated as part of the ongoing quality assessment of the onsite laboratory. The results were within an acceptable margin of error for the analysis. One analysis was repeated after an initial failure and attributed to changes in counting geometry. The offsite laboratory reports indicate no beta HTDs or alpha HTDs exceeded the AC.

The following conclusions were reached for the BSTK area:

- MARSSIM Class 1 designation is appropriate for the BSTK survey area.
- Excavation or remediation of concrete in the below-ground structure of the Base of the Stack may be required to a depth of 0.5 inches for floor surfaces. Remediation may not be required on wall surfaces to meet the site release criteria.

Table 2-54 Gamma Results for NRWT Concrete Core Samples

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	RCA	**Survey Building:**	NRWT	**Number of Samples:**	9			
Initial Classification:	Class 1	**Sample Depth:**	0.0					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-NRWT-CONC-001-0.0-B	1.35E+01	2.79E-01	2.56E-01	N	1.81E+01	5.71E-01	2.49E-01	N
RCA-NRWT-CONC-002-0.0-B-QC	1.79E+01	3.91E-01	2.85E-01	N	6.58E+02	2.00E+01	8.02E-01	N
RCA-NRWT-CONC-003-0.0-B-QC	1.83E+00	5.75E-02	1.33E-01	N	3.27E+01	1.01E+00	2.22E-01	N
RCA-NRWT-CONC-004-0.0-B-D	3.43E+00	1.21E-01	2.36E-01	N	1.54E+01	5.19E-01	2.14E-01	N
RCA-NRWT-CONC-005-0.0-B-QC	1.04E+01	2.65E-01	2.53E+01	N	4.82E+01	1.52E+00	3.72E-01	N
RCA-NRWT-CONC-006-0.0-B-QC	1.26E+01	2.55E-01	1.70E-01	N	8.74E+01	2.67E+00	2.30E-01	N
RCA-NRWT-CONC-007-0.0-B-QC	3.73E+03	6.93E+01	1.75E+00	Y	5.42E+03	1.65E+02	1.70E+00	Y
RCA-NRWT-CONC-008-0.0-B	5.52E-01	3.17E-02	1.15E-01	N	3.07E-01	3.50E-02	1.26E-01	N
RCA-NRWT-CONC-009-0.0-B	9.14E+00	2.12E-01	2.50E-01	N	4.43E+00	1.74E-01	2.53E-01	N
Average Activity	4.22E+02				6.98E+02			
Activity Standard Deviation	1.24E+03				1.78E+03			
Activity Range	5.52E-01	to	3.73E+03		3.07E-01	to	5.42E+03	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment								
Survey Area:	**RCA**	**Survey Building:**	**NRWT**	**Number of Samples:**	**9**			
Initial Classification:	**Class 1**	**Sample Depth:**	**0.5**					
Result Comparison								
	Co-60				**Cs-137**			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-NRWT-CONC-001-0.5-B	6.70E+00	1.71E-01	2.96E-01	N	1.30E+00	8.51E-02	2.45E-01	N
RCA-NRWT-CONC-002-0.5-B-QC	4.72E-01	5.35E-02	2.06E-01	N	2.59E+01	8.59E-01	2.63E-01	N
RCA-NRWT-CONC-003-0.5-B	2.43E-01	0.00E+00	2.43E-01	N	2.31E+00	1.25E-01	1.41E-01	N
RCA-NRWT-CONC-004-0.5-B-D	2.21E-01	0.00E+00	2.21E-01	N	2.34E-01	0.00E+00	2.34E-01	N
RCA-NRWT-CONC-005-0.5-B	2.04E-01	0.00E+00	2.04E-01	N	7.16E-01	5.54E-02	1.30E-01	N
RCA-NRWT-CONC-006-0.5-B	9.29E-01	7.62E-02	2.26E-01	N	7.20E+00	2.93E-01	1.62E-01	N
RCA-NRWT-CONC-007-0.5-B-QC	2.30E-01	2.33E-02	1.07E-01	N	6.28E+01	1.93E+00	2.21E-01	N
RCA-NRWT-CONC-008-0.5-B	8.39E-02	3.55E-02	1.46E-01	N	1.83E-01	0.00E+00	1.83E-01	N
RCA-NRWT-CONC-009-0.5-B	8.91E-02	4.09E-02	1.74E-01	N	2.12E-01	0.00E+00	2.12E-01	N
Average Activity	1.02E+00				1.12E+01			
Activity Standard Deviation	2.15E+00				2.10E+01			
Activity Range	8.39E-02	to	6.70E+00		1.83E-01	to	6.28E+01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**NRWT**	**Number of Samples:**	**9**
Initial Classification:	**Class 1**	**Sample Depth:**	**1.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-NRWT-CONC-001-1.0-B	3.76E-01	4.34E-02	1.61E-01	N	1.98E-01	0.00E+00	1.98E-01	N
RCA-NRWT-CONC-002-1.0-B	2.24E-01	0.00E+00	2.24E-01	N	2.22E-01	0.00E+00	2.22E-01	N
RCA-NRWT-CONC-003-1.0-B	2.26E-01	0.00E+00	2.26E-01	N	1.08E+00	7.43E-02	1.59E-01	N
RCA-NRWT-CONC-004-1.0-B-D	2.37E-01	0.00E+00	2.37E-01	N	1.77E-01	0.00E+00	1.77E-01	N
RCA-NRWT-CONC-005-1.0-B	2.35E-01	0.00E+00	2.35E-01	N	1.71E-01	0.00E+00	1.71E-01	N
RCA-NRWT-CONC-006-1.0-B	3.58E-01	4.82E-02	2.88E-02	N	5.73E-01	7.78E-02	2.43E-01	N
RCA-NRWT-CONC-007-1.0-B	1.55E-01	2.86E-02	1.42E-01	N	1.49E+01	5.04E-01	2.84E-01	N
RCA-NRWT-CONC-008-1.0-B	1.69E-01	0.00E+00	1.69E-01	N	1.64E-01	0.00E+00	1.64E-01	N
RCA-NRWT-CONC-009-1.0-B	2.22E-01	0.00E+00	2.22E-01	N	1.86E-01	0.00E+00	1.86E-01	N
Average Activity	2.45E-01				1.96E+00			
Activity Standard Deviation	7.52E-02				4.86E+00			
Activity Range	1.55E-01	to	3.76E-01		1.64E-01	to	1.49E+01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**NRWT**	**Number of Samples:**	**9**
Initial Classification:	**Class 1**	**Sample Depth:**	**1.5**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-NRWT-CONC-001-1.5-B	2.17E-01	0.00E+00	2.17E-01	N	1.51E-01	0.00E+00	1.51E-01	N
RCA-NRWT-CONC-002-1.5-B	1.41E-01	0.00E+00	1.41E-01	N	1.56E-01	0.00E+00	1.56E-01	N
RCA-NRWT-CONC-003-1.5-B	2.17E-01	0.00E+00	2.17E-01	N	2.99E-01	3.80E-02	1.10E-01	N
RCA-NRWT-CONC-004-1.5-B-D	2.32E-01	0.00E+00	2.32E-01	N	1.89E-01	0.00E+00	1.89E-01	N
RCA-NRWT-CONC-005-1.5-B	2.15E-01	0.00E+00	2.15E-01	N	1.78E-01	0.00E+00	1.78E-01	N
RCA-NRWT-CONC-006-1.5-B	3.08E-01	3.70E-02	1.51E-01	N	1.98E-01	0.00E+00	1.98E-01	N
RCA-NRWT-CONC-007-1.5-B	2.17E-01	0.00E+00	2.17E-01	N	6.42E+00	2.51E-01	2.05E-01	N
RCA-NRWT-CONC-008-1.5-B	1.93E-01	0.00E+00	1.93E-01	N	1.68E-01	0.00E+00	1.68E-01	N
RCA-NRWT-CONC-009-1.5-B	2.35E-01	0.00E+00	2.35E-01	N	1.84E-01	0.00E+00	1.84E-01	N
Average Activity	2.19E-01				8.83E-01			
Activity Standard Deviation	4.35E-02				2.08E+00			
Activity Range	1.41E-01	to	3.08E-01		1.51E-01	to	6.42E+00	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**NRWT**	**Number of Samples:**	**9**
Initial Classification:	**Class 1**	**Sample Depth:**	**2.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-NRWT-CONC-001-2.0-B	1.84E-01	0.00E+00	1.84E-01	N	1.65E-01	0.00E+00	1.65E-01	N
RCA-NRWT-CONC-002-2.0-B	2.31E-01	0.00E+00	2.31E-01	N	1.90E-01	0.00E+00	1.90E-01	N
RCA-NRWT-CONC-003-2.0-B	2.24E-01	0.00E+00	2.24E-01	N	3.02E-01	0.00E+00	3.02E-01	N
RCA-NRWT-CONC-004-2.0-B-D	1.78E-01	0.00E+00	1.78E-01	N	1.96E-01	0.00E+00	1.96E-01	N
RCA-NRWT-CONC-005-2.0-B	1.78E-01	0.00E+00	1.78E-01	N	1.50E-01	0.00E+00	1.50E-01	N
RCA-NRWT-CONC-006-2.0-B	2.44E-01	0.00E+00	2.44E-01	N	1.94E-01	0.00E+00	1.94E-01	N
RCA-NRWT-CONC-007-2.0-B	2.40E-01	0.00E+00	2.40E-01	N	1.02E+00	8.00E-02	1.82E-01	N
RCA-NRWT-CONC-008-2.0-B	2.43E-01	0.00E+00	2.43E-01	N	1.55E-01	0.00E+00	1.55E-01	N
RCA-NRWT-CONC-009-2.0-B	1.71E-01	0.00E+00	1.71E-01	N	1.61E-01	0.00E+00	1.61E-01	N
Average Activity	2.10E-01				2.81E-01			
Activity Standard Deviation	3.17E-02				2.81E-01			
Activity Range	1.71E-01	to	2.44E-01		1.50E-01	to	1.02E+00	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**NRWT**	**Number of Samples:**	**9**
Initial Classification:	**Class 1**	**Sample Depth:**	**2.5**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-NRWT-CONC-001-2.5-B	1.96E-01	0.00E+00	1.96E-01	N	1.90E-01	0.00E+00	1.90E-01	N
RCA-NRWT-CONC-002-2.5-B	1.93E-01	0.00E+00	1.93E-01	N	1.54E-01	0.00E+00	1.54E-01	N
RCA-NRWT-CONC-003-2.5-B	1.93E-01	0.00E+00	1.93E-01	N	1.77E-01	0.00E+00	1.77E-01	N
RCA-NRWT-CONC-004-2.5-B-D	2.31E-01	0.00E+00	2.31E-01	N	1.87E-01	0.00E+00	1.87E-01	N
RCA-NRWT-CONC-005-2.5-B	1.62E-01	0.00E+00	1.62E-01	N	1.51E-01	0.00E+00	1.51E-01	N
RCA-NRWT-CONC-006-2.5-B	2.10E-01	0.00E+00	2.10E-01	N	1.65E-01	0.00E+00	1.65E-01	N
RCA-NRWT-CONC-007-2.5-B	2.25E-01	0.00E+00	2.25E-01	N	2.01E-01	0.00E+00	2.01E-01	N
RCA-NRWT-CONC-008-2.5-B	2.22E-01	0.00E+00	2.22E-01	N	1.99E-01	0.00E+00	1.99E-01	N
RCA-NRWT-CONC-009-2.5-B	2.19E-01	0.00E+00	2.19E-01	N	2.31E-01	0.00E+00	2.31E-01	N
Average Activity	2.06E-01				1.84E-01			
Activity Standard Deviation	2.18E-02				2.54E-02			
Activity Range	1.62E-01	to	2.31E-01		1.51E-01	to	2.31E-01	

Concrete (CONC) Sample Gamma Spec - Data Quality Assessment

Survey Area:	**RCA**	**Survey Building:**	**NRWT**	**Number of Samples:**	**9**
Initial Classification:	**Class 1**	**Sample Depth:**	**3.0**		

Result Comparison

	Co-60				Cs-137			
Sample #	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)	Measured Activity (pCi/g)	Measurement Uncertainty (pCi/g)	Achieved MDC Value (pCi/g)	Assessment Criteria Exceeded (Y/N)
RCA-NRWT-CONC-001-3.0-B	1.93E-01	0.00E+00	1.93E-01	N	1.81E-01	0.00E+00	1.81E-01	N
RCA-NRWT-CONC-002-3.0-B	2.10E-01	0.00E+00	2.10E-01	N	1.39E-01	0.00E+00	1.39E-01	N
RCA-NRWT-CONC-003-3.0-B	2.30E-01	0.00E+00	2.30E-01	N	2.71E-01	0.00E+00	2.71E-01	N
RCA-NRWT-CONC-004-3.0-B-D	2.35E-01	0.00E+00	2.35E-01	N	2.27E-01	0.00E+00	2.27E-01	N
RCA-NRWT-CONC-005-3.0-B	2.04E-01	0.00E+00	2.04E-01	N	1.69E-01	0.00E+00	1.69E-01	N
RCA-NRWT-CONC-006-3.0-B	2.24E-01	0.00E+00	2.24E-01	N	1.57E-01	0.00E+00	1.57E-01	N
RCA-NRWT-CONC-007-3.0-B	2.39E-01	0.00E+00	2.39E-01	N	2.06E-01	0.00E+00	2.06E-01	N
RCA-NRWT-CONC-008-3.0-B	2.07E-01	0.00E+00	2.07E-01	N	1.50E-01	0.00E+00	1.50E-01	N
RCA-NRWT-CONC-009-3.0-B	1.71E-01	0.00E+00	1.71E-01	N	1.57E-01	0.00E+00	1.57E-01	N
Average Activity	2.13E-01				1.84E-01			
Activity Standard Deviation	2.20E-02				4.30E-02			
Activity Range	1.71E-01	to	2.39E-01		1.39E-01	to	2.71E-01	

Note: Measurement Uncertainty values of 0.00E+00 indicate no detected activity.

Duplicate gamma spectroscopy analysis was performed onsite for each of the samples with a “D” designator in the sample number; samples with a “QC” designator were analyzed onsite by gamma spectroscopy and sent offsite for gamma spectroscopy analysis, radiochemical separation, evaluation of HTD beta emitters and alpha spectroscopy. Onsite gamma spectroscopy analysis for “D” and “QC” samples greater than MDC was evaluated as part of the ongoing quality assessment of the onsite laboratory. The results were within an acceptable margin of error for the analysis. The offsite laboratory reports indicate no beta HTDs or alpha HTDs exceeded the AC.

The following conclusions were reached for the NRWT area:

- MARSSIM Class 1 designation is appropriate for the NRWT survey area.
- Excavation or remediation of concrete in the below-ground structure of the NRWT may be required to a depth of 0.5 inches for floor and wall surfaces to meet the site release criteria.

2.3.3 Survey Results for Class 2 and Class 3 Structures

2.3.3.1 North Protected Area Buildings

Survey activities were governed by SAP 07, Building/Structures – North Protected Area. Survey planning for the NPA buildings/structures area included using the VSP program to identify random sample locations consistent with MARSSIM methodology. In addition, biased locations were selected by the Radiological Engineer as locations where plant-related cross-contamination may have resulted from personnel. Some random survey locations were located within 6 feet of the roof's edge and were relocated to the closest point greater than 6 feet from the roof's edge for safety reasons. All sample locations included $1m^2$ scans with direct beta and alpha radiation measurements and 100 cm^2 smears obtained at the highest count rate observed during the scan.

2.3.3.2 Warehouse

Planning for the survey of the Warehouse building included 90 VSP-generated random sample points on floor surfaces. In addition, 59 biased survey locations were selected on walls, including areas most likely to have been touched by personnel: light switches, door handles, frames, thermostat controllers, etc. Six locations on the warehouse roof were identified and surveyed as investigative samples due to elevated readings at roof drain locations. Two roof sample locations (NPA-WHS-86 and NPA-WHS-87) had to be relocated for safety concerns.

Warehouse scans were conducted at all sample locations, and general area floor scans were done using calibrated gas flow proportional or equivalent survey meters to identify the presence of elevated radioactivity. 14,793 m^2 were scanned (first floor 6,472 m^2, second floor 1,241 m^2, and roof 7,080 m^2). Direct measurements were logged. Except for 4 locations on the roof, all the scan surveys did not identify areas with "audible distinction" above the location bkg. The 4 roof locations were investigated and discussed below.

The characterization data from the Warehouse consists of gross activity measurements without identifying specific ROCs. It is important to emphasize that gross activity measurements may not reflect only residual plant-related radioactivity and should not be directly compared to any specific ROC's DCGL value without consideration of material bkg radioactivity (i.e., NORM associated with building materials). Experience has shown that NORM content in various building materials, such as concrete, tiles, wallboard, and ceiling materials, can contribute several hundred counts to gross activity measurements.

The direct beta/gamma measurements collected on the first and second floors of the Warehouse are below the AC for Cs-137 and Co-60, and the direct alpha measurements are below the AC for the representative alpha-emitting ROC (Am-241). The direct measurements from the roof show wider ranges for beta/gamma and alpha measurements. The upper end of those ranges exceeds the AC for Co-60 (8.10E+03 dpm/100 cm^2) and Am-241 (9.88E+02 dpm/100 cm^2). Smear data

from the roof, first, and second floors show no removable contamination. Data summaries for statistically and biasedly determined samples are in Table 2-55 and Table 2-56.

The higher measurements from the Warehouse roof do not necessarily reflect a need for remediation. They may reflect a higher quantity of NORM in roofing material or possibly residual deposition from gaseous effluent releases. Further characterization data, particularly material bkg radioactivity data, should be collected to support FSS designs for buildings.

The Warehouse is currently designated as a Class 2 structure. Collecting material bkg data to determine the amount of potential residual plant-related radioactivity may lead to less restrictive MARSSIM classification for FSS.

Table 2-55 Data Summaries for Statistically Determined Warehouse Floor Measurement Locations

Floor	Gross Measurement	Direct Measurement Range		Mean ($dpm/100cm^2$)	SD ($dpm/100cm^2$)	Percent Removable	Instrument Type
		Minimum ($dpm/100cm^2$)	Maximum ($dpm/100cm^2$)				
1st	Beta	967	5993	3511	1616	0.00%	3003/43-68
	Alpha	0	91	37	30	0.00%	3003/43-68
2nd	Beta	4162	6706	5097	661	0.00%	3003/43-68
	Alpha	0	169	42	42	0.00%	3003/43-68
Roof	Beta	5756	8531	6861	809	0.00%	3002/43-93
	Alpha	239	1093	568	193	0.08%	3002/43-93

Table 2-56 Data Summaries for Biasedly Determined Warehouse Measurement Locations

Floor	Gross Measurement	Direct Measurement Range		Mean ($dpm/100cm^2$)	SD ($dpm/100cm^2$)	Percent Removable	Instrument Type
		Minimum ($dpm/100cm^2$)	Maximum ($dpm/100cm^2$)				
1st	Beta	2314	4522	3554	571	0.00%	3003/43-68
	Alpha	0	61	24	24	0.00%	3003/43-68
2nd	Beta	1220	4985	3040	1132	0.00%	3003/43-68
	Alpha	0	61	15	19	0.00%	3003/43-68

While performing the scan and direct measurements of the VSP-generated survey locations, direct measurements of the warehouse roof revealed 4 roof drains with “audible distinction” above the location bkg. To determine the extent of the condition, all 6 roof drains were surveyed. The roof drains showed elevated direct measurements and low levels of removable activity. The investigation survey locations were identified with consecutive sample numbers NPA-WHS-150-I through NPA-WHS-155-I. Upon review of the smear results, it was determined that the loose surface activity was attributable to NORM or gaseous effluent fallout.

Additionally, 3 investigative surveys were performed to evaluate the presence of NORM on the roof surface. These sample locations were identified with consecutive sample numbers NPA-WHS-156-I through NPA-WHS-158-I. Upon review of the survey results, it could not be determined conclusively if the measurements were due to either NORM or gaseous effluent fallout.

The following conclusions were reached for the NPA Buildings/Structures:

- The Warehouse does not present an unexpected radiological issue or concern.
- Material bkg data should be collected to support a successful final survey design.
- The preliminary Class 2 designation should be retained until material bkg data becomes available to determine the potential presence and amount of residual plant-related radioactivity.
- The source of the removable activity on the roof needs to be evaluated further.

2.3.3.3 South Protected Area Buildings

Survey activities were governed by SAP 09, Building/Structures – South Protected Area. Survey planning for the SPA buildings/structures area included using the VSP program to identify random sample locations consistent with MARSSIM methodology. In addition, biased locations were selected by the Radiological Engineer as locations where plant-related cross-contamination may have resulted from personnel. Some random survey locations were located within 6 feet of the roof's edge and were relocated to the closest point greater than 6 feet from the roof's edge for safety reasons. All sample locations included $1m^2$ scans with direct beta and alpha radiation measurements and 100 cm^2 smears obtained at the highest count rate observed during the scan. The planned number of samples and measurement type for each SPA structure are shown in Table 2-57 through Table 2-62.

2.3.3.4 New Gatehouse Facility

Planning for the New Gatehouse Facility (NGF) survey included 45 VSP-generated random sample points on floor surfaces. In addition, 15 biased survey locations were selected on the walls, including areas below 8 feet. Personnel most likely touched these locations: light switches, door handles, frames, thermostat controllers, etc. For safety concerns, three roof sample locations (SPA-NGF-48, -54, and -55) had to be relocated.

NGF scans were conducted at all sample locations, using calibrated gas flow proportional or equivalent survey meters to identify the presence of elevated radioactivity. A total of 1,319 m^2 was scanned (first floor 802 m^2 and roof 517 m^2). Direct measurements were logged. Data summaries for statistically and biasedly determined samples are in Table 2-57 and Table 2-58.

2.3.3.5 Oyster Creek Administration Building

Planning for the survey of the OCAB included 100 VSP-generated random sample points on floor surfaces. In addition, 56 biased survey locations were selected, 55 on wall surfaces and 1 on the floor. The biased locations on the walls, including areas below 8 feet, were most likely to have been touched by personnel such as light switches, door handles, frames, thermostat controllers, etc. One of the biased locations (SPA-OCB-156-B) was selected under a false floor in the computer room.

OCAB scans were conducted at all sample locations, and general area floor scans were performed using calibrated gas flow proportional or equivalent survey meters to identify the presence of

elevated radioactivity. 12,579 m^2 were scanned (first floor 2,884 m^2, second floor 3,049 m^2, third floor 4,366 m^2, and roof 2,280 m^2). Direct measurements were logged. Except for 2 locations on the roof, none of the scan surveys identified areas with "audible distinction" above the location bkg. The 2 roof locations were investigated. Four roof sample locations (SPA-OCB-61, -62, -63, and -64) had to be relocated for safety concerns. Data summaries for statistically and biasedly determined samples are in Table 2-59 and Table 2-60.

2.3.3.6 Site Emergency Building

Planning for the survey of the SEB included 125 VSP-generated random sample points on floor surfaces. In addition, 46 biased survey locations were selected, 43 on wall surfaces and 3 on the floor. The biased locations on the walls, including areas below 8 feet, were most likely to have been touched by personnel: light switches, door handles, frames, thermostat controllers, etc. Three biased locations were selected under a false floor in the computer room. Three roof sample locations (SPA-SEB-111-D, -112, and -114) had to be relocated for safety concerns.

SEB scans were conducted at all sample locations, and general area floor scans were performed using calibrated gas flow proportional or equivalent survey meters to identify the presence of elevated radioactivity. A total of 5,634 m^2 were scanned (first floor 2,395 m^2, second floor 1,821 m^2, and roof 1,418 m^2). Direct measurements were logged. Data summaries for statistically and biasedly determined samples are in Table 2-61 and Table 2-62.

Comparison of the direct measurements to the AC for Cs-137 and Co-60 shows that while the upper ends of the measurement ranges are less than the Cs-137 AC in all the buildings, they exceed the more conservative AC for Co-60 on at least one floor inside each building. Comparing direct measurement ranges for the roofs to the Co-60 AC shows similar results. In addition, the upper ends of the gross alpha measurement ranges for the OCAB and SEB exceed the AC for the representative alpha-emitting ROC (i.e., Am-241). Except for the NGF roof, the mean values for the direct measurements are significantly below the AC.

The finding that some gross measurements exceed AC does not necessarily reflect a need for remediation. Gross measurements collected inside the buildings may reflect varying material backgrounds. Gross measurements from the roofs may reflect a high NORM content in roofing material or possibly residual deposition from gaseous effluent releases. Additional characterization and material bkg data are needed to determine if the gross measurements reflect NORM or plant-related radioactivity.

Table 2-57 Data Summaries for Statistically Determined NGF Floor Measurement Locations

Floor	Gross Measurement	Fixed-Point Measurement Range		Mean ($dpm/100cm^2$)	SD ($dpm/100cm^2$)	Percent Removable	Instrument Type
		Minimum ($dpm/100cm^2$)	Maximum ($dpm/100cm^2$)				
1st	Beta	3085	11225	7797	2241	0.00%	3003/43-68
	Alpha	0	190	33	39	0.00%	3003/43-68
Roof	Beta	7332	11169	9776	1026	0.00%	3002/43-93
	Alpha	60	501	234	137	0.00%	3002/43-93

Table 2-58 Data Summaries for Biasedly Determined NGF Measurement Locations

Floor	Gross Measurement	Fixed-Point Measurement Range		Mean ($dpm/100cm^2$)	SD ($dpm/100cm^2$)	Percent Removable	Instrument Type
		Minimum ($dpm/100cm^2$)	Maximum ($dpm/100cm^2$)				
1st	Beta	3306	7539	4620	1102	0.00%	3003/43-68
	Alpha	0	113	30	34	0.00%	3003/43-68

Table 2-59 Data Summaries for Statistically Determined OCAB Floor Measurement Locations

Floor	Gross Measurement	Fixed-Point Measurement Range		Mean ($dpm/100cm^2$)	SD ($dpm/100cm^2$)	Percent Removable	Instrument Type
		Minimum ($dpm/100cm^2$)	Maximum ($dpm/100cm^2$)				
1st	Beta	1241	6120	2931	1576	0.00%	3003/43-68
	Alpha	0	213	44	64	0.00%	3003/43-68
2nd	Beta	3461	9630	4671	1413	0.00%	3003/43-68
	Alpha	0	84	22	27	0.00%	3003/43-68
3rd	Beta	3362	4726	4180	326	0.00%	3003/43-68
	Alpha	0	148	30	45	0.00%	3003/43-68
Roof	Beta	2019	5700	3395	1080	0.00%	3003/43-68
	Alpha	213	911	464	176	0.00%	3003/43-68

Table 2-60 Data Summaries for Biasedly Determined OCAB Measurement Locations

Floor	Gross Measurement	Fixed-Point Measurement Range		Mean ($dpm/100cm^2$)	SD ($dpm/100cm^2$)	Percent Removable	Instrument Type
		Minimum ($dpm/100cm^2$)	Maximum ($dpm/100cm^2$)				
1st	Beta	1619	7908	2626	1440	0.00%	3003/43-68
	Alpha	0	91	24	26	0.00%	3003/43-68
2nd	Beta	2610	4667	3248	455	0.00%	3003/43-68
	Alpha	0	106	37	25	0.00%	3003/43-68
3rd	Beta	1704	2776	2144	313	0.00%	3003/43-68
	Alpha	0	61	22	24	0.00%	3003/43-68

Table 2-61 Data Summaries for Statistically Determined SEB Floor Measurement Locations

Floor	Gross Measurement	Fixed-Point Measurement Range		Mean ($dpm/100cm^2$)	SD ($dpm/100cm^2$)	Percent Removable	Instrument Type
		Minimum ($dpm/100cm^2$)	Maximum ($dpm/100cm^2$)				
1st	Beta	3599	8044	5029	981	0.00%	3003/43-68
	Alpha	0	141	47	32	0.00%	3003/43-68
2nd	Beta	2965	7298	4751	1027	0.00%	3003/43-68
	Alpha	0	141	42	40	0.00%	3003/43-68
Roof	Beta	4539	9623	6571	951	0.00%	3002/43-93
	Alpha	209	1171	519	224	0.00%	3002/43-93

Table 2-62 Data Summaries for Biasedly Determined SEB Measurement Locations

Floor	Gross Measurement	Fixed-Point Measurement Range		Mean (dpm/100cm^2)	SD (dpm/100cm^2)	Percent Removable[1]	Instrument Type
		Minimum (dpm/100cm^2)	Maximum (dpm/100cm^2)				
1st	Beta	2714	8044	5029	981	0.00%	3003/43-68
	Alpha	0	141	47	32	0.00%	3003/43-68
2nd	Beta	3496	11034	4799	1778	0.00%	3003/43-68
	Alpha	0	141	42	40	0.00%	3003/43-68

Elevated readings were identified during the building surface scan surveys on the OCAB's third floor. The location was investigated and recorded as SPA-OCB-159-I. The measurement was not reproducible during the investigation and was determined to be a false positive.

Additionally, surface scans of the OCAB roof revealed two locations, SPA-OCB-157-I and SPA-OCB-158-I, where counts with "audible distinction" above bkg. The investigation measurements at the location were within the statistical range of the data set. Smears were counted, and alpha contamination above MDC was identified. The activity was still present when the smears were recounted approximately 6 hours later. Three additional investigation surveys were performed to evaluate the presence of NORM on the roof surface. These sample locations were identified with consecutive sample numbers SPA-OCB-160-I through SPA-OCB-162-I; the results were inconclusive. The investigation continued by collecting a volumetric sample of sediment from the roof. On-site gamma analysis of the sample (SPA-OCB-SEDI-01-I) showed the presence of NORM, Cs-137 (9.74E-01 pCi/g), and Co-60 (1.60E+00 pCi/g).

Three similar investigative surveys were performed on the SEB and NGF roofs. The SEB sample locations were identified with consecutive sample numbers SPA-SEB-169-I through SPA-SEB-171-I. The NGF sample locations were SPA-NGF-61-I through SPA-NGF-63-I. Volumetric samples of sediment were collected from the two roofs. On-site gamma analysis of the SEB volumetric sample (SPA-SEB-SEDI-02-I) showed the presence of NORM and Cs-137 (1.43E-01 pCi/g). On-site gamma analysis of the NGF volumetric sample (SPA-NGF-SEDI-01-I) showed the presence of NORM. The results of the investigations could not conclusively determine if the activity was due to NORM or gaseous effluent fallout.

The following conclusions were reached for the SPA Buildings/Structures:

- The OCAB, SEB, and NGF do not present an unexpected radiological issue or concern and areas likely to meet release criteria.
- The roof of the OCAB should be reclassified as MARSSIM Class 2. The preliminary Class 3 should be retained for the remaining portions of the SPA Area structures (OCAB, SEB, and NGF).
- Consider collecting material bkg data for various structure media types to support the final survey design.

2.3.4 Buildings and Structures Not Remaining at License Termination

Occupational surveys are conducted as an ongoing part of the radiation protection program and waste characterization programs. As SSC are removed and evaluated for waste acceptance by disposal facilities, there is an ongoing radiological characterization of the generated waste. There is little or no production mechanism for "new" radioactivity with the elimination of nuclear fuel, so in some cases (e.g., Dry Active Waste), the radioactivity is simply a decay correction of existing waste streams and is reconfirmed under 10 CFR §61 on a biennial basis for Class A waste streams and annually for Class B and C waste streams. However, potential new waste streams may be identified because some building demolition debris and system components were not previously identified as waste streams.

Ongoing waste characterization analyses evaluate the different waste streams against existing waste characterization profiles or modify the waste characterization profile to represent the changing waste stream.

In some cases, demolition debris may contain trace quantities of radioactivity acceptable for disposal in alternate regulated disposal facilities. Occasionally, debris from lesser-impacted structures may be released from radiological controls for disposal in an industrial landfill. In either case, the waste acceptance criteria for the specific disposal facility are satisfied.

The existing decommissioning radiation protection and radioactive waste programs have the necessary controls to maintain radiological and non-radiological characterization of wastes as they are generated. Any remaining slabs, substructures, or building remnants are subject to FSS requirements for license termination.

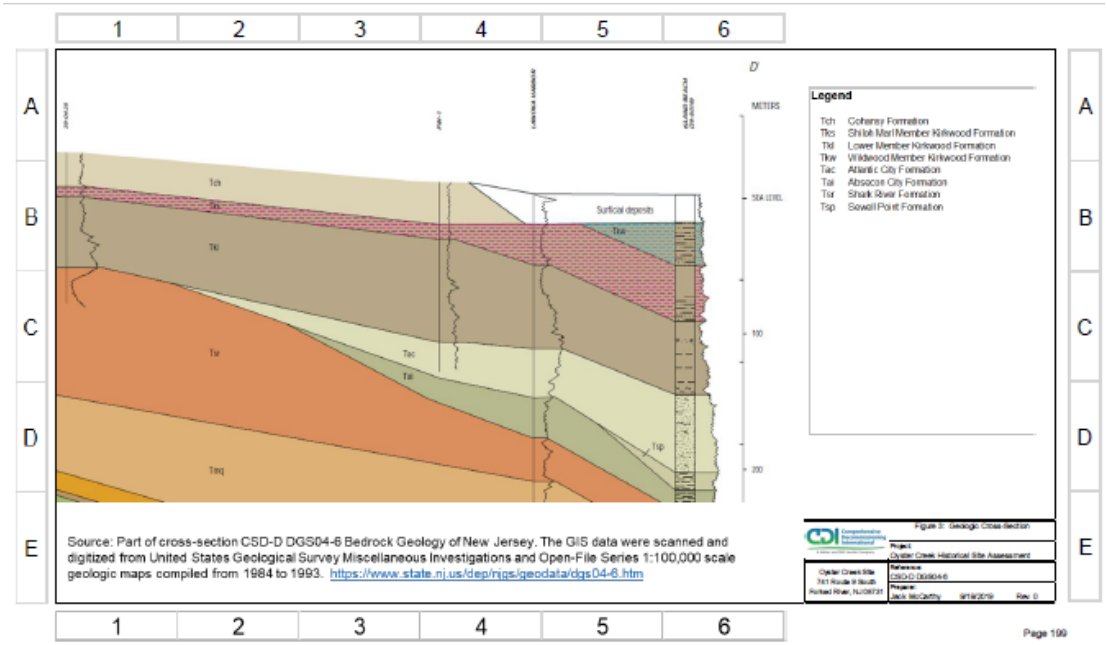


Figure 2-13 Geologic Cross-Section

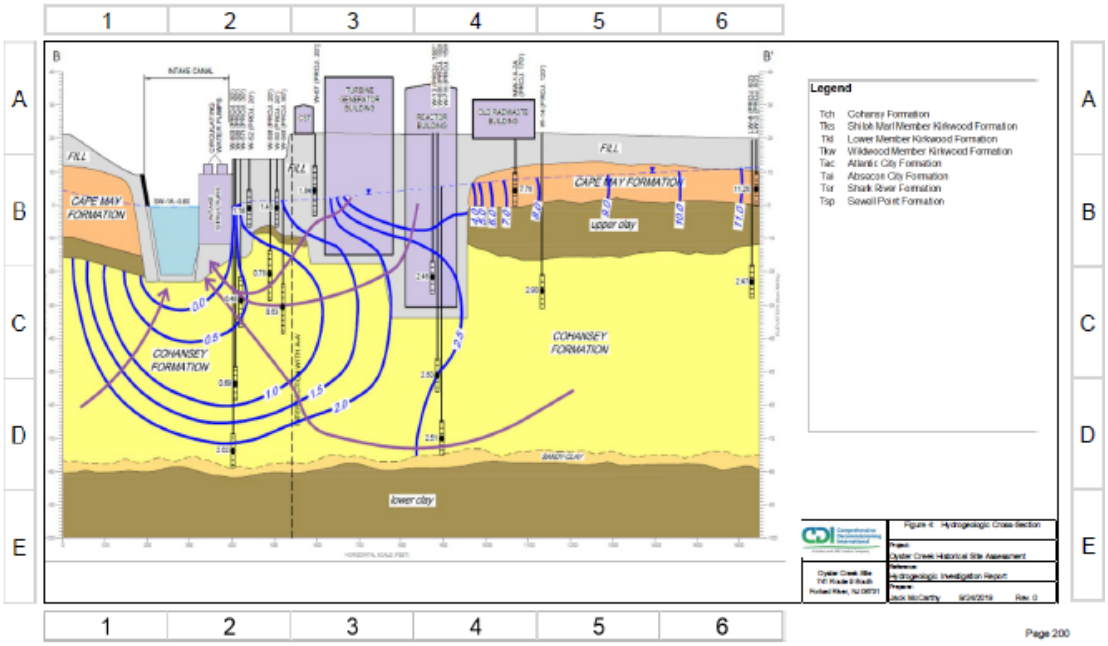


Figure 2-14 Hydrogeologic Cross-Section

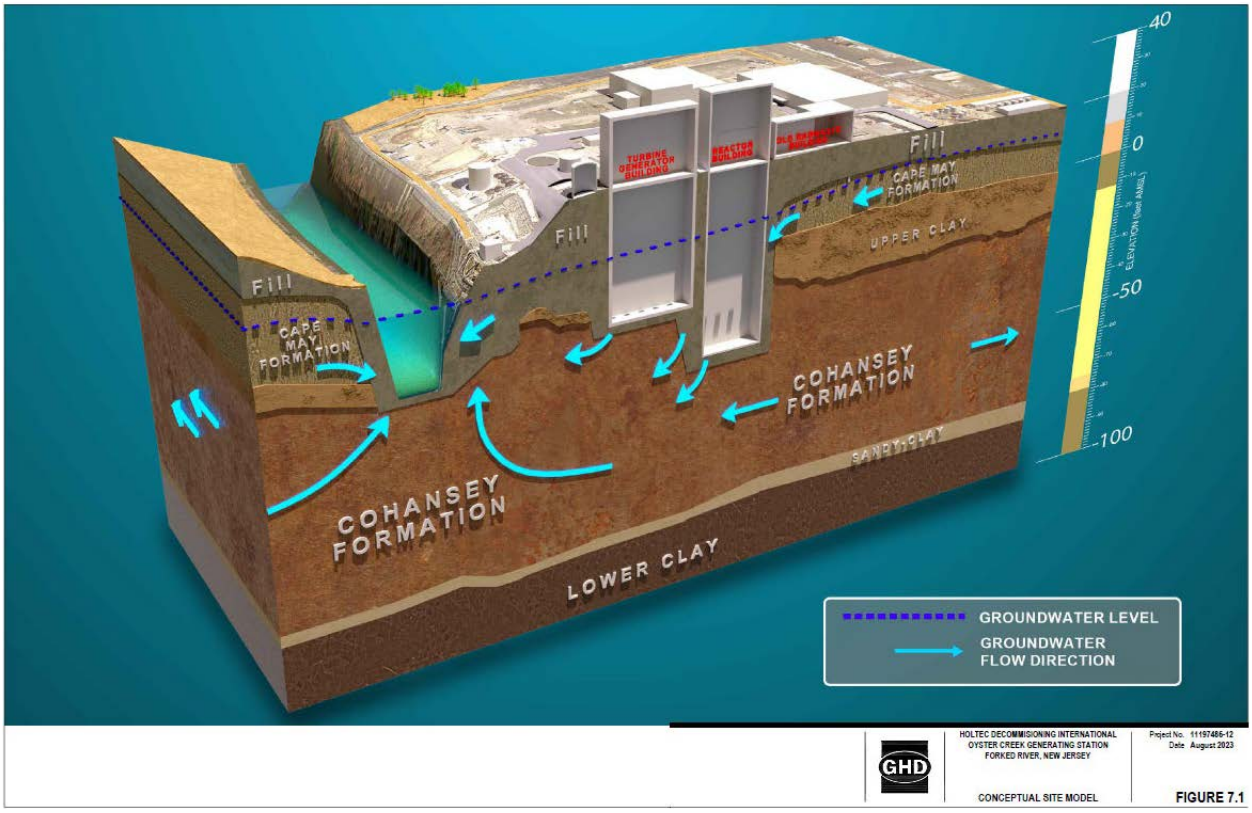


Figure 2-15 Conceptual Site Model Cross-Section

2.4 Surface and Groundwater

OCNGS continues to monitor groundwater in accordance with Nuclear Energy Institute (NEI) 07-07 Industry Groundwater Protection Initiative – Final Guidance Document (Reference 2-13) utilizing the Radiological Groundwater Protection Program (RGPP). As part of the radiological characterization of the OCNGS, the current radiological status of the groundwater at the OCNGS site was determined by reviewing the 2023 groundwater monitoring data summarized in a February 2024 letter from AMO Environmental Decisions to the OCNGS RGPP Coordinator (Reference 2-14).

The Conceptual Site Model (CSM) was developed in the Hydrogeologic Investigation Report (Reference 2-15) which synthesizes known site information regarding the hydrogeology and groundwater flow domain, potential contaminants and their sources, mechanisms for their release to the environment, pathways for contaminant transport and exposure, and the potential human or environmental receptors of contamination. The CSM considers locations of known or suspected contamination, types, and concentrations of contaminants, potentially contaminated media, mechanisms for their transport, locations of potential receptors, and locations of potential reference (background) areas.

2.4.1 On-Going Investigations

2.4.1.1 Radiological Environmental Monitoring Program

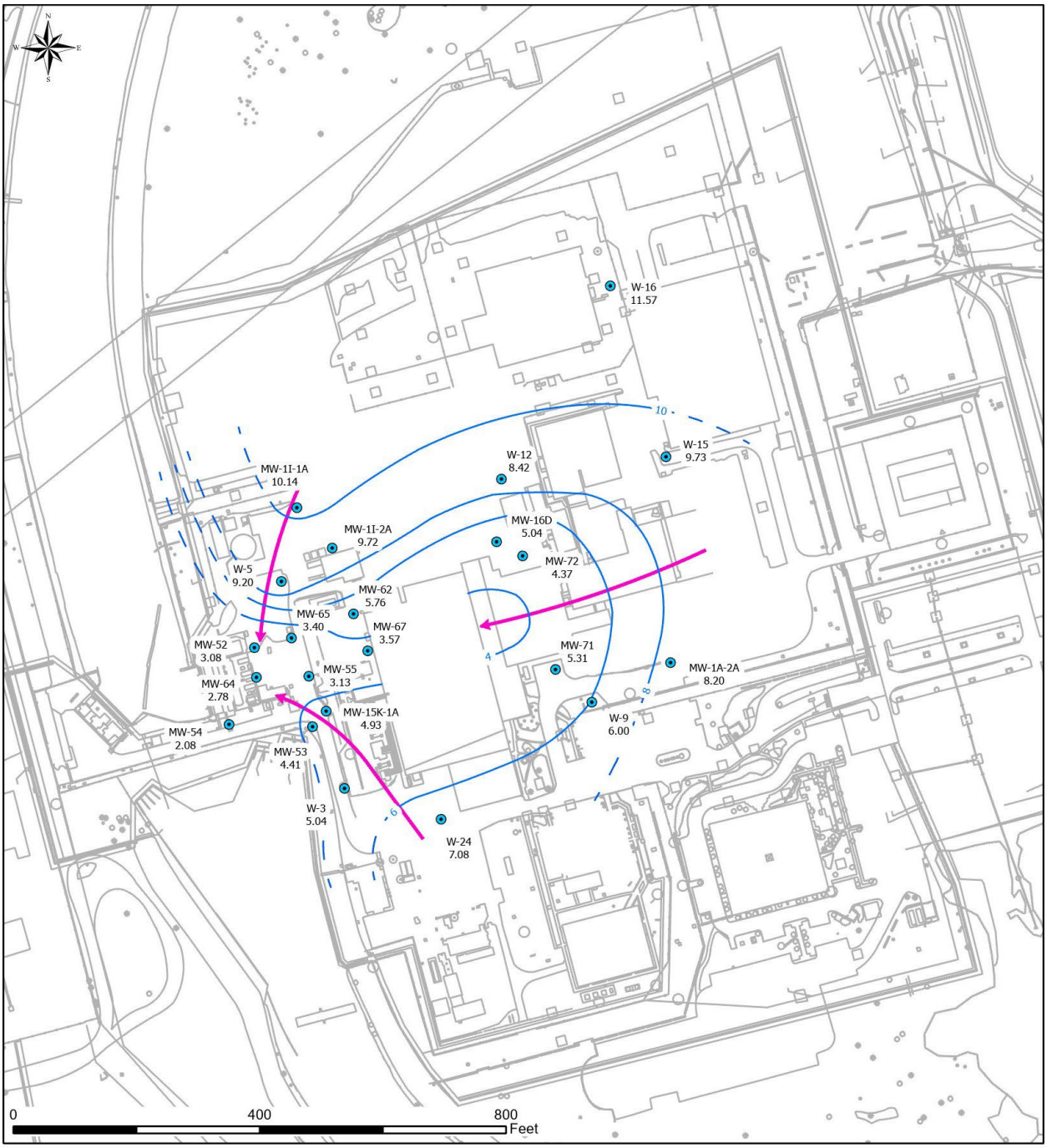
As decommissioning progresses, radiological monitoring data and changes in monitoring locations are made available through the ODCM, ARERR, or the AREOR, as appropriate.

2.4.1.2 Radiological Groundwater Protection Program

In 2023, the OCNGS RGPP includes 14 background wells, 14 detection wells, 6 long-term shutdown wells, and 3 surface water monitoring locations. These wells allow monitoring of the Cape May and Cohansey Aquifers. In early 2023, tritium was detected at just above the laboratory MDC in 1 groundwater sample collected from the Cape May Formation wells and 2 samples collected from Cohansey Formation wells. However, the last groundwater sampling event in 2023, tritium was not detected in any of the site's RGPP wells. Alert levels for gross-alpha and beta are established based on values that are deemed as statistical outlier results. A statistical outlier is a value that is significantly higher or lower than most of the results, that can skew the results and not reflect the true dataset.

Data collected under the OCNGS RGPP indicate tritium contamination is not present (no wells have detectable tritium as of October 2023) and represents a low risk compared to the U.S. EPA (EPA) drinking water standard. The highest and most recent detected tritium concentration of 370 pCi/l in April 2023, represents <2% of the EPA drinking water standard (20,000 pCi/l).

As decommissioning progresses, some existing monitoring wells may require formal closure or abandonment to avoid damage and/or mitigate a potential contamination pathway to groundwater. When a groundwater monitoring well is abandoned, the formal closure is in accordance with the state and local requirements and is updated as closed in the RGPP. The status of the groundwater monitoring program is available through the OCNGS RGPP until license termination or until formally discontinued or transferred to another entity.



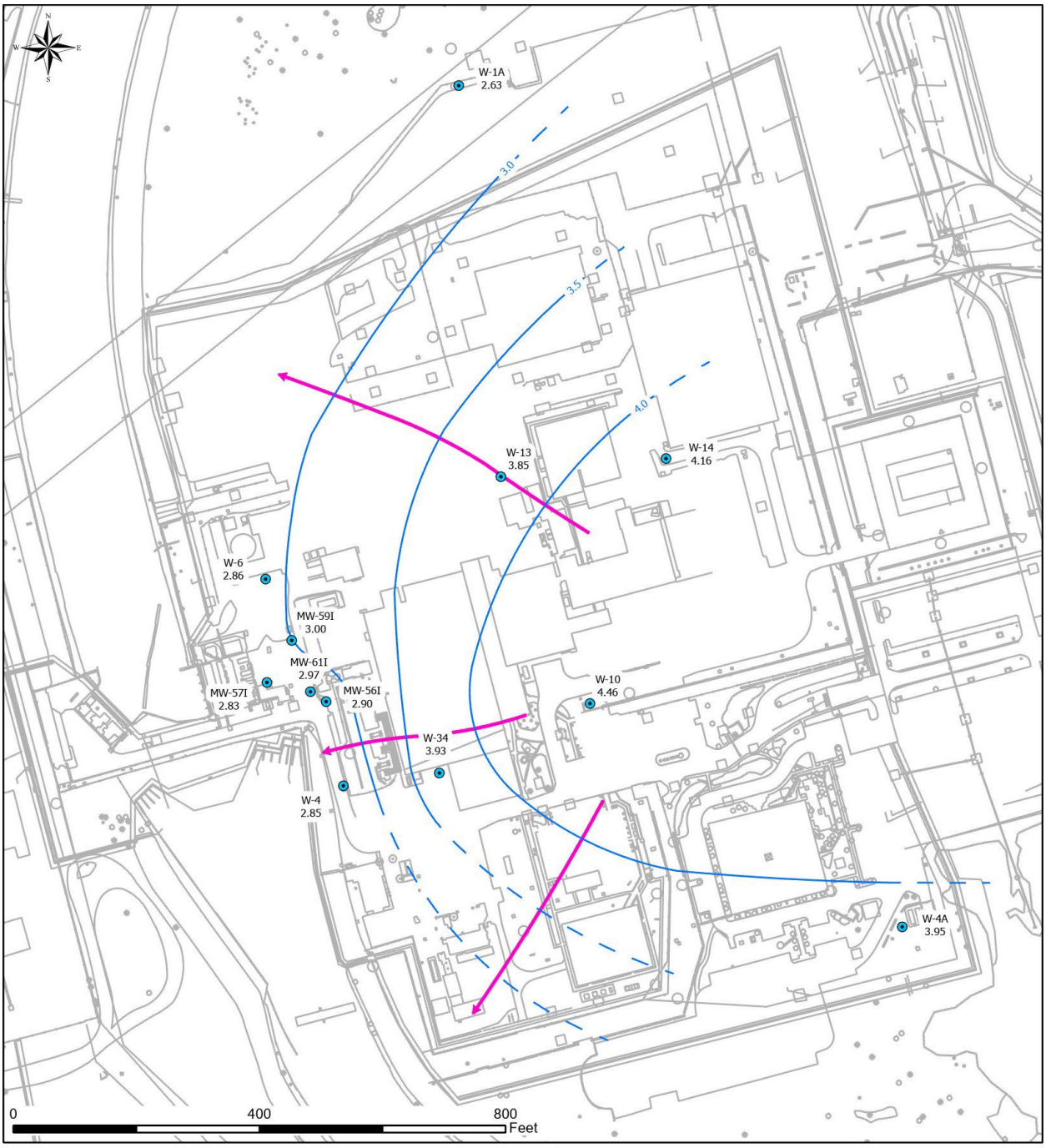
Explanation:

- October 2023 Cape May Groundwater Elevations

October 2023 Cape May Groundwater Elevation Contours

- Groundwater Elevation Contour
- Inferred Groundwater Elevation Contour
- Groundwater Flow Direction

Figure 2-16 OCNGS Cape May Aquifer Sample Points and Groundwater Elevations



Explanation:

- October 2023 Cohansey Groundwater Elevations

October 2023 Cohansey Groundwater Elevation Contour

- Groundwater Elevation Contour
- Inferred Groundwater Elevation Contour
- Groundwater Flow Direction

Figure 2-17 OCNGS Cohansey Aquifer Sample Points and Groundwater Elevations

2.4.2 On-Going Investigations

2.4.2.1 Radiological Environmental Monitoring Program

As decommissioning progresses, radiological monitoring data and changes in monitoring locations are made available through the ODCM, ARERR, or the AREOR, as appropriate.

2.4.2.2 Radiological Groundwater Protection Program

In 2023, the OCNGS RGPP includes 14 background wells, 14 detection wells, 6 long-term shutdown wells, and 3 surface water monitoring locations. These wells allow monitoring of the Cape May and Cohansey Aquifers. In early 2023, tritium was detected at just above the laboratory MDC in 1 groundwater sample collected from the Cape May Formation wells and 2 samples collected from Cohansey Formation wells. However, the last groundwater sampling event in 2023, tritium was not detected in any of the site's RGPP wells. Alert levels for gross-alpha and beta are established based on values that are deemed as statistical outlier results. A statistical outlier is a value that is significantly higher or lower than most of the results, that can skew the results and not reflect the true dataset.

Data collected under the OCNGS RGPP indicate tritium contamination is not present (no wells have detectable tritium as of October 2023) and represents a low risk compared to the U.S. EPA (EPA) drinking water standard. The highest and most recent detected tritium concentration of 370 pCi/l in April 2023, represents <2% of the EPA drinking water standard (20,000 pCi/l).

As decommissioning progresses, some existing monitoring wells may require formal closure or abandonment to avoid damage and/or mitigate a potential contamination pathway to groundwater. When a groundwater monitoring well is abandoned, the formal closure is in accordance with the state and local requirements and is updated as closed in the RGPP. The status of the groundwater monitoring program is available through the OCNGS RGPP until license termination or until formally discontinued or transferred to another entity.

2.4.3 Summary of Analytical Results in Groundwater

Tritium (H-3) has been detected in 15 monitoring wells over the 2013 through 2023 groundwater monitoring period. Tritium concentrations in groundwater have been decreasing since 2010 and as of the October 2023, tritium was not detected in surface water or groundwater from the Cape May Formation wells or Cohansey Formation wells. The H-3 detections indicate that groundwater at the OCNGS is no longer impacted by radiological contaminants and that H-3 has not migrated off-site.

The H-3 detected in 10 monitoring wells was associated with the Cape May formation, and the remaining 5 were associated with the Cohansey formation (4 shallow depth and 1 intermediate depth). A summary of Tritium sample data for wells with activity greater than MDC during the evaluated period is shown in Table 2-63. The target MDC during the monitoring period was 200 pCi/l. No on-site activities performed during these times would have triggered increased H-3 levels.

Gross Alpha and gross Beta activity has been detected in 30 monitoring wells over the 2013 through 2023 groundwater monitoring period. Gross activity has been detected above the alert level in 8 wells since OCNGS stopped operation in 2018. Gamma spectroscopy, alpha spectroscopy, and HTD analysis identified no plant-related radionuclides during the evaluation

period. Gross activity measurements indicate that groundwater at the OCNGS site is not significantly impacted by radiological contaminants. A summary of gross activity sample data for wells that had results greater than the Alert Level during the evaluated period is shown in Table 2-63.

Table 2-63 Summary of Ground Water Tritium Results

Well / Aquifer		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
MW-50	Total	9	7	4	4	4	3	0	0	0	0	0
Cape May	Positive	9	7	3	4	-	1	-	-	-	-	-
	Average (pCi/l)	11852	4181	2511	1755	-	329	-	-	-	-	-
MW-54	Total	6	6	4	4	7	3	1	1	0	1	1
Cape May	Positive	1	3	3	-	5	1	-	1	-	1	1
	Average (pCi/l)	378	370	230	-	631	393	-	283	-	237	195
MW-55	Total	7	5	4	4	4	4	4	4	1	2	2
Cape May	Positive	7	2	2	-	-	-	-	-	-	-	-
	Average (pCi/l)	1672	720	176	-	-	-	-	-	-	-	-
MW-64	Total	6	4	4	4	4	4	5	5	2	3	3
Cape May	Positive	2	-	-	-	-	-	-	-	-	-	-
	Average (pCi/l)	273	-	-	-	-	-	-	-	-	-	-
MW-67	Total	7	6	4	4	6	4	4	4	1	2	2
Cape May	Positive	7	6	4	4	4	4	2	1	-	1	-
	Average (pCi/l)	23447	8042	4495	5300	312	460	259	197	-	236	-
MW-72	Total	4	4	4	4	4	4	4	4	1	3	3
Cape May	Positive	-	-	-	-	-	-	-	-	-	1	-
	Average (pCi/l)	-	-	-	-	-	-	-	-	-	204	-
W-16	Total	4	6	8	5	5	4	1	1	0	2	1
Cape May	Positive	-	-	-	-	-	-	-	-	-	1	-
	Average (pCi/l)	-	-	-	-	-	-	-	-	-	222	-
W-24	Total	8	6	8	4	4	3	1	1	0	1	1
Cape May	Positive	-	-	3	-	-	-	-	-	-	-	-
	Average (pCi/l)	-	-	483	-	-	-	-	-	-	-	-
W-3	Total	10	8	8	5	4	4	4	4	1	2	2
Cape May	Positive	-	-	-	-	-	-	-	-	-	1	-
	Average (pCi/l)	-	-	-	-	-	-	-	-	-	187	-
	Cape May Samples	67	56	52	42	47	38	28	28	7	18	17
	Cape May Positives	26	18	15	8	9	6	2	2	-	5	1
	Cape May Average (pCi/l)	4230	1430	539	672	94	67	19	17	-	60	12
MW-56I	Total	8	8	9	4	6	4	4	4	1	2	2
Shallow Cohansey	Positive	8	8	9	4	6	4	4	2	1	2	-
	Average (pCi/l)	5841	13046	8411	2530	4698	1318	1085	699	231	240	-
MW-57I	Total	8	5	6	4	5	4	4	4	1	2	2
Shallow Cohansey	Positive	8	5	6	4	3	4	4	4	1	1	-
	Average (pCi/l)	9819	10014	2118	3900	1004	1575	664	1050	191	368	-
MW-59I	Total	6	6	4	4	4	4	4	4	1	2	2
Shallow Cohansey	Positive	-	-	-	-	1	-	-	2	-	1	1
	Average (pCi/l)	-	-	-	-	788	-	-	504	-	379	208
MW-61I	Total	4	4	4	4	4	4	4	4	1	2	2
Intermediate Cohansey	Positive	-	-	-	-	-	-	-	-	-	2	-
	Average (pCi/l)	-	-	-	-	-	-	-	-	-	186	-
W-13	Total	4	5	4	4	4	3	1	1	0	2	1
Shallow Cohansey	Positive	-	-	-	-	-	-	-	-	-	2	1
	Average (pCi/l)	-	-	-	-	-	-	-	-	-	459	370
	Cohansey Samples	30	28	27	20	23	19	17	17	4	10	9
	Cohansey Positives	16	13	15	8	10	8	8	8	2	8	2
	Cohansey Average (pCi/l)	4176	5516	3274	1286	1391	609	411	389	106	252	64
	Site Positives	42	31	30	16	19	14	10	10	2	13	3
	Site Average (pCi/l)	9731	7565	3880	3371	1916	1010	772	709	211	277	258

Note: Values of "-" indicate a zero value.

Table 2-64 Summary of Ground Water Gross Alpha / Beta Results

Cape May Wells		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
MW-15K-1A	Samples	1	1	1	1	1	1	1	4	4	2	3
	Alpha Above Alert Level	-	-	-	-	2	1	1	-	1	-	-
	Beta Above Alert Level	-	-	-	-	1	1	-	-	1	-	-
MW-1I-1A	Samples	1	1	1	1	1	1	1	1	1	1	1
	Alpha Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
	Beta Above Alert Level	1	-	-	-	-	-	-	-	-	-	-
MW-1I-2A	Samples	1	1	1	1	1	1	1	1	1	1	1
	Alpha Above Alert Level	-	-	-	-	-	1	-	-	-	-	-
	Beta Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
MW-52	Samples	1	1	1	1	1	1	0	0	0	0	0
	Alpha Above Alert Level	-	-	1	-	-	-	-	-	-	-	-
	Beta Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
MW-53	Samples	1	1	1	1	1	1	0	0	0	0	0
	Alpha Above Alert Level	-	-	-	-	1	-	-	-	-	-	-
	Beta Above Alert Level	-	-	-	-	1	-	-	-	-	-	-
MW-54	Samples	1	1	1	1	1	1	0	0	0	0	0
	Alpha Above Alert Level	-	-	-	1	-	-	-	-	-	-	-
	Beta Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
MW-55	Samples	1	1	1	1	1	1	1	3	4	2	2
	Alpha Above Alert Level	-	-	-	-	1	-	-	-	-	-	-
	Beta Above Alert Level	-	-	-	-	1	1	-	-	-	-	-
MW-62	Samples	1	1	1	1	1	1	1	1	1	1	1
	Alpha Above Alert Level	-	-	-	-	-	1	1	-	-	-	-
	Beta Above Alert Level	-	-	-	-	-	1	1	-	-	-	-
MW-64	Samples	1	1	1	1	1	1	1	1	1	1	1
	Alpha Above Alert Level	1	-	-	-	-	-	1	1	-	-	-
	Beta Above Alert Level	1	-	-	1	-	-	1	-	-	-	-
MW-65	Samples	1	1	1	1	1	1	2	4	4	2	3
	Alpha Above Alert Level	-	-	-	-	-	1	1	3	1	-	-
	Beta Above Alert Level	-	-	-	-	-	-	1	4	-	-	-
MW-67	Samples	1	1	1	1	1	1	2	4	4	2	2
	Alpha Above Alert Level	-	1	1	-	1	-	-	-	-	-	-
	Beta Above Alert Level	1	-	1	-	1	-	-	-	-	-	-
MW-71	Samples	1	1	1	1	1	1	1	1	1	1	1
	Alpha Above Alert Level	-	-	-	-	-	-	1	-	-	-	-
	Beta Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
W-12	Samples	1	1	1	1	1	1	1	1	1	1	1
	Alpha Above Alert Level	-	1	-	1	-	-	-	-	-	-	-
	Beta Above Alert Level	-	1	-	1	-	-	-	-	-	-	-
W-15	Samples	1	1	1	1	1	1	-	-	-	-	-
	Alpha Above Alert Level	-	-	-	-	1	-	-	-	-	-	-
	Beta Above Alert Level	-	-	-	-	1	-	-	-	-	-	-
W-16	Samples	1	1	1	1	1	1	0	0	0	0	0
	Alpha Above Alert Level	1	-	-	-	-	-	-	-	-	-	-
	Beta Above Alert Level	1	-	-	-	-	-	-	-	-	-	-
W-24	Samples	1	1	1	1	1	1	0	0	0	0	0
	Alpha Above Alert Level	1	-	-	-	-	-	-	-	-	-	-
	Beta Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
W-3	Samples	1	1	1	1	1	1	1	1	1	1	1
	Alpha Above Alert Level	-	1	1	-	-	1	1	-	-	-	-
	Beta Above Alert Level	-	1	1	-	-	-	-	-	-	-	-
W-5	Samples	1	1	1	1	1	1	1	1	1	1	1
	Alpha Above Alert Level	-	-	-	-	-	-	1	-	-	-	-
	Beta Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
W-7	Samples	1	1	1	1	1	1	0	0	0	0	0
	Alpha Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
	Beta Above Alert Level	-	1	-	-	-	1	-	-	-	-	-
	Cape May Samples	19	19	19	19	19	19	14	23	24	16	18
	Cape May Alpha Above Alert Level	3	3	3	2	6	5	7	4	2	-	-
	Cape May Beta Above Alert Level	4	3	2	2	5	4	3	4	1	-	-

Cohansey Wells		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
MW-56I	Samples	1	1	1	1	1	1	2	4	4	2	2
	Alpha Above Alert Level	-	-	1	-	1	-	-	-	-	-	-
	Beta Above Alert Level	-	-	1	-	1	-	-	-	-	-	-
MW-57I	Samples	1	1	1	1	1	1	2	4	4	2	2
	Alpha Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
	Beta Above Alert Level	-	-	-	-	-	-	-	1	-	-	-
MW-59I	Samples	1	1	1	1	1	1	1	1	1	1	1
	Alpha Above Alert Level	1	-	1	-	-	1	-	-	-	-	-
	Beta Above Alert Level	-	-	-	-	-	1	-	-	-	-	-
MW-60I	Samples	1	1	1	1	1	1	0	0	0	0	0
	Alpha Above Alert Level	-	1	1	-	-	-	-	-	-	-	-
	Beta Above Alert Level	-	1	1	-	-	-	-	-	-	-	-
MW-61I	Samples	1	1	1	1	1	1	1	1	1	1	1
	Alpha Above Alert Level	-	1	-	-	-	-	-	-	-	-	-
	Beta Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
MW-63I	Samples	1	1	1	1	1	1	0	0	0	0	0
	Alpha Above Alert Level	-	1	-	-	-	-	-	-	-	-	-
	Beta Above Alert Level	-	1	-	-	-	-	-	-	-	-	-
MW-69I	Samples	1	1	1	1	1	1	0	0	0	0	0
	Alpha Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
	Beta Above Alert Level	-	1	-	-	-	-	-	-	-	-	-
W-14	Samples	1	1	1	1	1	1	0	0	0	0	0
	Alpha Above Alert Level	-	1	-	-	-	-	-	-	-	-	-
	Beta Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
W-34	Samples	1	1	1	1	1	1	1	1	1	1	1
	Alpha Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
	Beta Above Alert Level	1	1	-	-	-	-	-	-	-	-	-
W-4	Samples	1	1	1	1	1	1	0	0	0	0	0
	Alpha Above Alert Level	-	1	-	-	-	-	-	-	-	-	-
	Beta Above Alert Level	-	1	-	-	-	-	-	-	-	-	-
W-6	Samples	1	1	1	1	1	1	0	0	0	0	0
	Alpha Above Alert Level	-	-	-	-	1	-	-	-	-	-	-
	Beta Above Alert Level	-	-	-	-	-	-	-	-	-	-	-
	Cohansey Samples	11	11	11	11	11	11	7	11	11	7	7
	Cohansey Alpha Above Alert Level	1	5	3	-	2	1	-	-	-	-	-
	Cohansey Beta Above Alert Level	1	5	2	-	1	1	-	1	-	-	-
	Site Alpha Above Alert Level	4	8	6	2	8	6	7	4	2	-	-
	Site Beta Above Alert Level	5	8	4	2	6	5	3	5	1	-	-

Note: Values of "-" indicate a zero value.

2.4.4 Summary of Analytical Results in Surface Water

Under the Radiological Environmental Monitoring Program (REMP), four surface water locations were sampled at least quarterly until 2021. Based on the plant shut-down, sample location Main Condenser Discharge (MCD) was no longer available to be sampled after January 2019. The sample frequency on the remaining 3 locations was changed to semi-annual, effective in 2021. The samples were evaluated using gamma isotopic analysis and H-3 analysis.

The sampling results from 2013 through 2023 reveal that there has been only one sample above the detection limit for H-3 identified in 2019 at sample location SW-2. The results were a H-3 concentration of 211 pCi/l analysis. This suggests that the value was potentially a false positive.

2.5 Continuing Characterization

The characterization of inaccessible or not readily accessible subsurface soils, buried pipes, or concrete surfaces was deferred during the initial characterization in the second Quarter of 2022. These areas will be characterized (termed "continuing characterization") as access is gained and source terms are diminished. The DQO process will define the number and location of measurements characterization during survey design. The following are areas at OCNGS where continuing characterization will occur:

- Potable Water Supply: In 2023, a project was begun to provide a potable water supply for future site use. The potable water supply line crosses existing Class 2 and Class 3 areas in the NPA and EOCA where radiological contamination of subsurface soils is not expected at levels above the AC. However, during the excavation and pipeline installation process, characterization samples were collected using the characterization survey, sampling, and analysis protocols to provide data as existing evidence of subsurface soil assessment for inclusion in future survey unit packages. In this case, the sample locations are dictated by the routing of the pipeline rather than random sampling based on a survey area with random survey and sample points.
- Perform additional characterization in sump areas, including volumetric concrete sampling when sump liners have been removed.
- Perform additional characterization in drywell and tunnel areas, including volumetric concrete sampling when SSC has been removed.
- Perform additional characterization surveys, including volumetric concrete samples in the Base of Stack and Old Radioactive Waste Pipe Tunnel when SSC has been removed and radiological conditions support keeping personnel exposures as low as reasonably achievable (ALARA) to collect the samples.
- Collect and evaluate building material bkg data to support the final survey design.
- Retain the preliminary MARSSIM classification of buildings until building material bkg data becomes available.

Surface soil at OCNGS has been adequately characterized; additional characterization of surface soil is not anticipated during continuing characterization. Radiological Assessments (RAs) will be performed in currently inaccessible soil areas that are exposed after removal of asphalt or concrete roadways and parking lots, rail lines, buried piping, or building foundation pads (slab on grade). Survey results for RAs will be presented in the relevant survey unit release records.

The decision to defer characterization was based on one or more of the following conditions:

- ALARA considerations (e.g., the area is either a high radiation or high contamination area, and additional data would likely not change the survey area or area classification of the location or surrounding areas).
- Safety considerations.

- Historical data shows that the area could be classified without further characterization.
- Access for characterization would require significant deconstruction of adjacent SSC or other obstacles where the removal could result in an unsafe condition or interfere with the continued operation of operating systems.
- The ability to use engineering judgment in assigning the area classification based on physical relationship to surrounding areas and the likelihood of the area having radiological conditions represented by the conditions in these adjacent areas.

Continuing characterization data will be used along with existing data to update the types of radionuclides present and update the variability in the radionuclide mix for both gamma-emitting and HTD radionuclides. In addition, as the decommissioning progresses, data from operational events caused by equipment failures or personnel errors, which may affect the radiological status of a survey unit, are captured in a corrective action database or §50.75(g) files, as appropriate. These events will be evaluated and, when appropriate, stored in the characterization database. Characterization data will be used in validating initial classifications and in planning for FSS.

Additional characterization data will not result in an update to the LTP, as submitted. Future characterization data or events that represent a significant change in the scope of decommissioning activities or a challenge to the decommissioning funds to achieve license termination will be communicated to the NRC.

2.6 References

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3

IDENTIFICATION OF REMAINING SITE DISMANTLEMENT ACTIVITIES

LIST OF ACRONYMS

Acronym	Full Form
ACM	Asbestos Containing Material
ALARA	As Low As Reasonably Achievable
AOG	Augmented Offgas Building
AREOR	Annual Radiological Environmental Operating Report
ARERR	Annual Radiological Effluents Release Report
CS	Carbon Steel
CST	Condensate Storage Tank
FSS	Final Status Surveys
GTCC	Greater Than Class C
HDI	Holtec Decommissioning International, LLC
ISFSI	Independent Spent Fuel Storage Installation
LLRW	Low-Level Radioactive Waste
LTP	License Termination Plan
NRC	United States Nuclear Regulatory Commission
NRW	New Radwaste Building
OCNGS	Oyster Creek Nuclear Generating Station
ORW	Old Radwaste Building
RB	Reactor Building
REMP	Radiological Environmental Monitoring Program
RWCU	Reactor Water Cleanup
SS	Stainless Steel
TB	Turbine Building
TBOF	Turbine Building Operating Floor

3 IDENTIFICATION OF REMAINING SITE DISMANTLEMENT ACTIVITIES

3.1 Introduction

In accordance with 10 CFR §50.82 (a)(9)(ii)(B), the License Termination Plan (LTP) that accompanies or precedes an application for license termination must include "identification of remaining dismantlement activities". The information includes those areas and equipment that need further remediation and an assessment of the potential radiological conditions that may be encountered. Estimates of the occupational radiation dose for completion of the scheduled task and the projected volumes of radioactive waste that will be generated are also included. These activities will be undertaken pursuant to the current 10 CFR §50 license and are consistent with the Revised Post-Shutdown Decommissioning Activities Report and Revised Site-Specific Decommissioning Cost Estimate for Oyster Creek Nuclear Generating Station (OCNGS) (Reference 3-1). The dismantlement activities described in this chapter do not depend upon LTP approval to proceed.

The information presented in this chapter follows the guidance in NUREG-1700, Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans (Reference 3-2) and Regulatory Guide 1.179, Standard Format and Content of License Termination Plans for Nuclear Power Reactors (Reference 3-3) and will describe the remaining dismantlement as of the date of the LTP submittal. The information includes a description of remaining dismantlement activities along with an estimate of the types and volume of radioactive waste produced.

Holtec Decommissioning International, LLC (HDI) has conducted dismantlement and demolition activities described in Section 3.2 in accordance with approved programs, procedures, and work plans. To the extent required by regulation and to keep stakeholders informed of strategy and progress, decommissioning activities are coordinated with the appropriate federal, state, and local stakeholders.

If an activity requires prior United States Nuclear Regulatory Commission (NRC) approval under 10 CFR §50.59(c)(2) or a change to the OCNGS license, a submittal will be made to the NRC for review and approval prior to implementation of the activity in question.

The activities listed in Section 3.3, Remaining Dismantlement Activities include dismantlement and demolition activities that will be conducted to support the unrestricted release of all portions of the site except the Independent Spent Fuel Storage Installation (ISFSI). The dismantlement activities described in Section 3.3 provide the information to support site release and future license termination pursuant to 10 CFR §50.82(a)(11)(i). Therefore, this section was written to describe each major dismantlement activity that remains to be completed prior to submission of a request for license termination.

Section 3.4 provides a milestone schedule for the completion of remaining dismantlement activities.

Section 3.5 includes a description of the physical and procedural controls to be put in place at the OCNGS site to prevent the recontamination of areas where demolition activities have been completed and Final Status Survey (FSS) performed to demonstrate compliance with radiological release criteria.

Sections 3.6 and 3.7 address radiation exposure and radioactive waste produced by decommissioning activities. A description of the end state of the site following decommissioning and site restoration activities is included in Section 3.8.

The information presented in this chapter supports the assessment of impacts considered in other sections of the LTP and provides sufficient detail, along with routine communication with the NRC, to identify timing for inspections or technical resources during the remaining dismantlement activities. In addition to routine communications with the NRC, the State of New Jersey Department of Environmental Protection will be routinely updated on decommissioning progress.

3.2 Completed Decommissioning Activities

3.2.1 Spent Nuclear Fuel Storage

The spent nuclear fuel has been placed in dry storage at the ISFSI using the Holtec HI-STORM 100 Cask System. The system is comprised of the multi-purpose canister, the HI-TRAC transfer cask, and the HI-STORM 100 storage overpack.

During the spent fuel transfer campaign, thirty-four canisters of fuel were loaded in the spent fuel pool, inverted and seal welded in the Reactor Building (RB), moved to the ISFSI, and placed into storage on concrete pads. These canisters, along with thirty-four NUHOMS® canisters previously loaded with spent nuclear fuel will be protected and monitored while they await acceptance by the Department of Energy.

3.2.2 Reactor Building

In preparation for reactor internals dismantlement and segmentation, interferences were removed in the work areas on the RB 119’ elevation, including the Equipment Storage Pool Shield Plugs, Head Strongback, and Stud Tensioner Assembly.

The drywell and reactor heads were size reduced, coated for contamination control and placed in interim storage onsite. Pieces were subsequently further size-reduced and either shipped to a processing facility for recycle of clean material or disposed of as Low-Level Radioactive Waste (LLRW).

Reactor internals were segmented or crushed and segregated by waste classification. Class B and C waste was placed into shielded containers and stored onsite pending shipment to a low-level waste disposal facility. Greater Than Class C (GTCC) waste was placed in four HI-STORM canisters and moved to storage locations at the ISFSI. The reactor cavity and equipment pits have been cleaned to remove equipment and debris from reactor internals segmentation and are currently in the process of being drained and coated for contamination control. The reactor vessel and a portion of the reactor cavity and equipment pit remains filled with water for shielding pending future demolition activities.

Equipment and tools were removed from the Spent Fuel Pool. Fuel storage racks were hydrolased and removed from the pool for packaging, transport, and disposal at a LLRW facility. The pool has been drained and the walls of the stainless-steel liner have been coated for contamination control pending demolition activities.

3.2.3 Turbine Building

Completed decommissioning activities in the Turbine Building (TB) have consisted of removal of Asbestos Containing Material (ACM), dismantlement of large components, and clearing of the Turbine Building Operating Floor (TBOF) to support dismantlement, survey, segregation, and removal of plant components and equipment.

3.2.4 New Radwaste Building

Preparations for dismantlement and demolition of the New Radwaste Building (NRW) consisted of isolation of the building to eliminate hazards from electrical and other sources of energy, removal of hazardous wastes, draining and removal of fluids in systems and components, decontamination to reduce worker dose and meet waste acceptance criteria, and reconfiguration of ventilation and lighting to support decommissioning activities.

Dismantlement activities included removal of systems, components and supporting equipment. Interior structures were demolished as required to provide access to components. Waste material was segregated and packaged for disposal or recovery. Dismantlement activities were performed within the envelope of the building structure to prevent potential onsite or offsite contamination.

3.2.5 Augmented Offgas Building

Preparations for dismantlement and demolition of the Augmented Offgas Building (AOG) consisted of isolation of the building to eliminate hazards and removal of hazardous wastes. Components and equipment were dismantled and removed from the building followed by radiological survey and open-air demolition to grade. Potentially contaminated floor drains and sumps were grouted pending future removal and disposal of the concrete slab.

3.2.6 Old Radwaste Building

Preparations for dismantlement of the Old Radwaste Building (ORW) consisted of isolation of the building, removal of hazardous wastes, draining and removal of fluids in systems and components, and decontamination of components and areas as required. Dismantlement activities are in the planning phase.

3.2.7 Other Buildings and Components

Numerous other buildings that housed plant systems, equipment, supplies, or operational support staff have been demolished and resulting waste disposed of as low-level radioactive waste or conventional waste. Tanks that are no longer needed to support decommissioning activities have been removed. Facilities and components that have been dismantled and demolished along with the date these activities were completed, are compiled in Table 3-1.

3.3 Remaining Decommissioning Activities

Preparations for remaining dismantlement activities consist of removal of hazardous wastes, draining and removal of fluids in systems and components, decontamination to reduce worker dose and meet waste acceptance criteria, and reconfiguration of electrical supply, ventilation, and lighting to support decommissioning activities.

Table 3-1 Building or Component Decommissioning Complete

Building or Component	Date Demo Completed
Radiation Protection Building	2/19/2020
Auxiliary Office Building Annex	2/21/2020
Maintenance Storage Building	2/28/2020
Contractor Building	3/13/2020
Turbine Dirty Oil Tank	8/20/2020
Abandoned Demin Tank	9/11/2020
Torus Water Storage Tank	10/7/2020
Maintenance Supervisor Building	10/9/2020
Maintenance Building	11/20/2020
Drywell Support and Outage Control Centers	12/3/2020
North Annex Old Radwaste Building	12/4/2020
Radioactive Material Storage (scaffold)	12/4/2020
Drywell Surge Tank	3/30/2021
Fuel Oil Storage Tank	5/26/2021
Auxiliary Boiler No. 2	6/10/2021
Auxiliary Boiler No. 1	6/15/2021
Breathing Air Compressor Building	9/23/2021
Liquid Nitrogen Tank	9/29/2021
New Sampling Building	11/8/2021
Condensate Storage Tank	11/9/2021
Old Radwaste Sample Tank Shed	11/18/2021
Security Building	12/6/2021
Boiler House	12/7/2021
Pre-Treatment Building	2/16/2023

Additional preparatory activities include recovery or disposal of tools and equipment, abatement of ACM, and removal of components such as motors, heat exchangers, generator, and cables for processing and recovery of recyclable materials.

3.3.1 Reactor Building

The remaining RB dismantlement activities will include the demolition of interior structures as required to provide access to components. Components such as large motors and cables containing recoverable materials will be removed, dismantled, and shipped to a processing facility for decontamination and sorting of recyclable metals. Systems, components, and supporting

infrastructure will be removed, and resulting waste material will be segregated and packaged for disposal or recovery. Demolition of the reactor vessel will consist of segmentation or removal of the intact vessel. Components and equipment within the drywell will be removed along with bio-shield and reactor pedestal concrete, and the steel drywell pressure boundary and torus will be sectioned and removed for processing or disposal. Openings in the RB structure will be created to facilitate large component removal. To the extent practicable, dismantlement activities will be performed within the envelope of the building structure to prevent the spread of contamination.

When the RB structure has been shown to meet open-air demolition criteria, the structural steel and siding above the 119' elevation will be removed and either recovered as clean, recyclable material or size-reduced, packaged. and shipped to a low-level radioactive waste disposal facility. The concrete and masonry structures consisting of exterior walls, internal load-bearing walls, and floors will be demolished to three feet below grade, and the resulting waste will be processed to remove reinforcing steel, size reduced, surveyed, and either recovered for beneficial reuse or disposed of. The remaining structure will consist of the 10' thick reinforced concrete slab with the top at elevation (-)19'-6", the 67' to 86' diameter reinforced concrete drywell pedestal, and the 3' to 4'-6" thick reinforced concrete exterior walls. Figure 3-1 and Figure 3-2 depict plan and section views, respectively, of below-grade structures.

The remaining structure and any piping or penetrations will be remediated as required to meet radiological release criteria. Concrete waste will either be recovered as clean material for beneficial use or shipped to a low-level radwaste storage facility for disposal.

Following FSS, the structure will be backfilled with soil from original site canal and building foundation excavations or with concrete rubble with remaining activity that is low enough to meet 10 CFR §20 Subpart E criteria to the existing grade of approximately 23'-6" and stabilized using best management practices.

3.3.2 Turbine Building

Remaining dismantlement activities include demolition of internal concrete and masonry structures to facilitate access to equipment and removal of components and materials. Floors, including the 6" slab and compacted sand subfloor at the 3'-6" elevation and non-load bearing internal concrete and masonry block walls, will be removed.

Remaining components, supports, piping, conduits, cable trays, ductwork, and miscellaneous equipment will be removed and recycled, shipped offsite for processing, or disposed of as conventional or radioactive waste.

Once the building meets open-air demolition criteria, the structural steel and siding above the TBOF will be removed and recycled or disposed of as conventional or radioactive waste, and the remaining exterior walls, floors, and turbine pedestal will be demolished to three feet below grade. Concrete and masonry waste will be processed to remove reinforcing steel, surveyed for radiological contamination, and either recovered for beneficial reuse or disposed of. The remaining subgrade structure will consist of the 6' to 8' thick reinforced concrete slab with the top at elevation 0'-0" and the sub-slab Circulating Water discharge tunnels.

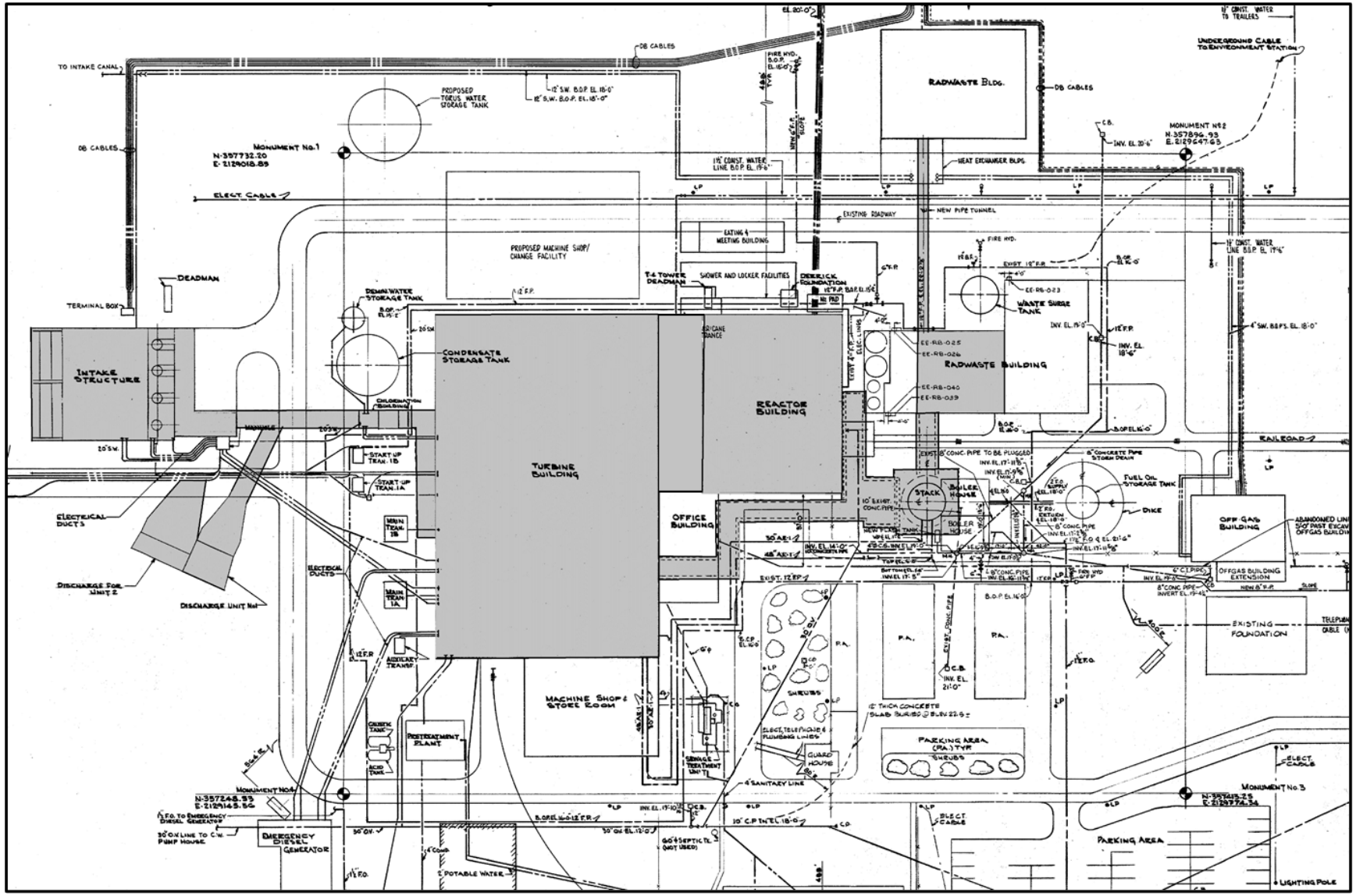


Figure 3-1 Subgrade Structures Plan View

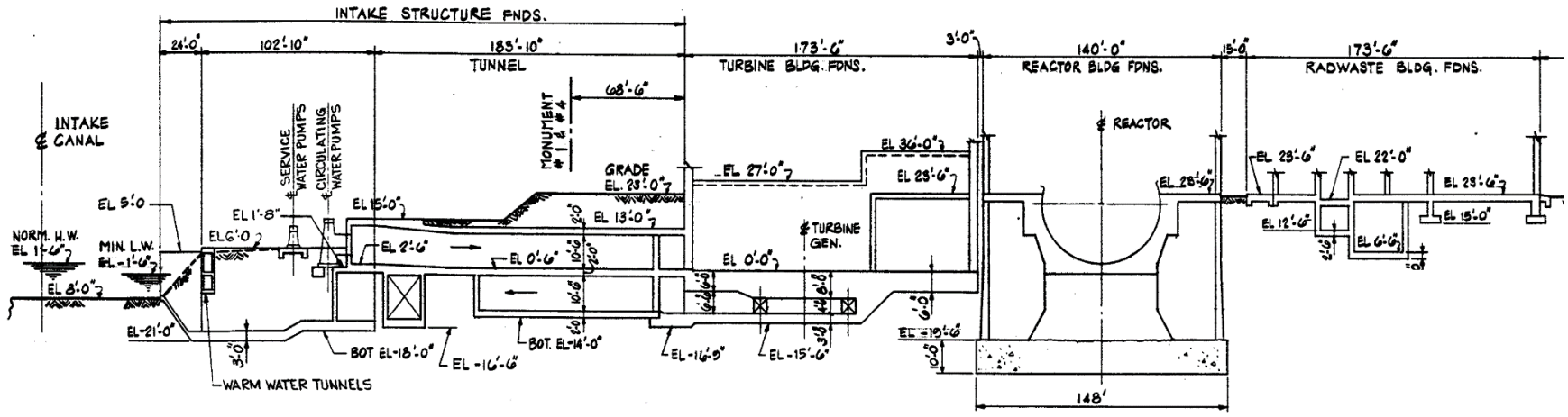


Figure 3-2 Subgrade Structures Section View

The subgrade portion of the TB, including building surfaces, embedded piping, penetrations, and intake and discharge tunnels, will be remediated as required to meet radiological release criteria and subjected to FSS. Subgrade structures will be backfilled with soil from the original site canal and building foundation excavations or with concrete rubble with remaining activity that is low enough to meet 10 CFR §20 Subpart E criteria to the existing grade of approximately 23'-6" and stabilized using best management practices.

3.3.3 New Radwaste Building

Upon completion of commodity removal, the building structure will be demolished by cutting the concrete walls into blocks using diamond wire or by use of heavy equipment such as excavators and hoe-rams. Roofing material, metal siding, and structural steel will be removed via conventional demolition techniques. Floor drains, sumps, and tunnel access points will be secured pending the future removal of the concrete slab.

3.3.4 Old Radwaste Building

Dismantlement activities in the ORW will be preceded by additional decontamination and hot spot removal to maintain worker dose as low as reasonably achievable (ALARA) and prevent the spread of contamination.

Completion of dismantlement of systems and components will be performed with the exterior walls and roof intact and facilitated by removal of internal walls and floors as required to provide access for personnel and equipment.

Once the building meets open air demolition criteria, the building will be demolished to three feet below grade and concrete waste will be recovered for beneficial reuse or disposed. The remaining subgrade structure will consist of the reinforced concrete walls and 3' thick slab with the top at the 6'-6" elevation.

The subgrade portion of the ORW, including building surfaces, embedded piping, and penetrations, will be remediated as required to meet radiological release criteria and subjected to FSS. Subgrade structures will be backfilled with soil from the original site canal and building foundation excavations or with concrete rubble with remaining activity that is low enough to meet 10 CFR §20 Subpart E to the existing grade of approximately 23'-6" and stabilized using best management practices.

3.3.5 Intake, Discharge, and Dilution Water Structures and Tunnels

The Intake and Discharge Structures include above-grade and below-grade structures that supported the delivery of Circulating Water from the intake canal to the inlet of the 72" pipes in the TB and the discharge of warm water from the outlet of TB discharge tunnels to the discharge canal. The Dilution Water Structure contained pumps and equipment used to maintain thermal discharge limits.

Pumps, piping, trash racks, screens, stop logs, and supporting equipment will be removed from the Intake Structure and Dilution Water Structure. Valuable metals will be removed for recycle if recovery is deemed to be cost-beneficial. The concrete and steel Intake Structure, including the 3' thick slab and apron from (-)15'-0" to (-)18'-0" elevation and subgrade walls and bays will be subject to FSS and will remain in place for potential future use.

The Dilution Water Structure, Unit 1 and Unit 2 Discharge Structure, intake and discharge tunnels, and dilution water tunnel will be subject to FSS and will remain in place for potential future use.

The Circulating Water discharge tunnels beneath the TB will be subjected to FSS and backfilled with a flowable material suitable for filling voids.

3.3.6 Tunnels and Stack

The 394-foot reinforced concrete stack (368 feet above grade) is linked by tunnels to the RB, TB, NRW, and ORW. These tunnels contain piping and air ducts between the buildings and the stack.

Access to the tunnel system to support dismantlement activities will be provided by removal of hatch covers or demolition of all or a portion of the tunnel roof. Piping, ductwork, conduit, cables, and equipment will be removed from tunnels and the concrete surfaces will be remediated to meet site release criteria. The reinforced concrete tunnel walls and nominal 2'-6" thick floors will remain in place.

The stack internals will be removed, and the reinforced concrete exterior will be demolished to three feet below grade and the sub-grade portion of the stack foundation and sump will be remediated as required. The sub-grade walls and 7' thick concrete slab with top of mat at elevation (-)3' will remain in place.

Following FSS, the tunnels and stack foundation will be backfilled with soil from original site canal and building foundation excavations or with concrete rubble with remaining activity that is low enough to meet 10 CFR §20 Subpart E criteria and the stack foundation and areas above the tunnels will be restored to existing grade.

3.3.7 Miscellaneous Structures and Components

Other buildings, structures, and support facilities will be demolished to grade on a schedule that allows for the most efficient use of dismantlement and demolition resources.

- Chlorination Facility
- Old Machine Shop
- Condensate Transfer Building
- Respirator and Mac Facility
- Main Office Building
- Hazard Collection Facility
- Fire Water Storage Tank
- Fire Water Pump House
- Domestic Water Facility
- Gas Station
- Fish Sampling Pool

3.3.8 Slabs, Mats, Roads, and Parking Areas

Concrete foundations of slab-on-grade buildings and equipment pads will either be surveyed to establish conformance with radiological release criteria or demolished and the resulting waste concrete either disposed as low-level radioactive waste or processed for beneficial reuse. Concrete, stone, and bituminous road and parking lot surfaces will be removed as required to complete FSS activities or to meet site release criteria. Road and parking lot surfaces may be replaced to preserve potential site reuse options.

3.3.9 Buried Piping

Although a large amount of process piping is enclosed in tunnels and trenches, some piping was installed via direct burial at various elevations below ground surface. Types and quantities of potentially contaminated buried piping at the site are listed in Table 3-2. As part of the response to historical degradation of buried piping, a significant quantity of process piping was enclosed in concrete vaults to provide protection from corrosion and allow access for inspection, maintenance, and repair.

The OCNGS decommissioning strategy includes excavation and removal of buried piping to the extent that is practicable and safe considering obstructions and groundwater elevations.

Table 3-2 Potentially Contaminated Buried Piping

System	Description	Piping	Location
Offgas	Offgas Holdup Lines	510’ of 48” Carbon Steel (CS) pipe 400’ of 36” CS pipe	Between TB and Stack
	AOG Supply	100’ of 4” CS pipe	Between Stack and AOG
	AOG Return	100’ of 2” CS pipe	Between Stack and AOG
	AOG Sump Drain	175’ of 1.5” CS pipe	Between AOG and Boiler House
Condensate	Condensate Transfer to TB	25’ of 6” Aluminum pipe	Condensate Transfer Pumps to TB
	Condensate Transfer to Control Rod Drive	4’ of 12” Aluminum pipe	Under slab between northwest corner of RB and TB
	Condensate Transfer	30’ of 10” CS pipe	Between Condensate Transfer Bldg. and west wall of TB
	Condensate Transfer Line to RB	10’ of 6” Aluminum pipe	Between Pipe Tunnel and southwest corner of RB
	Condensate Storage Tank (CST) Return	30’ of 3” CS pipe	Between CST and northeast corner of TB
	Condensate Pump Startup Seal Water	30’ of 1” CS pipe	Between Condensate Transfer Bldg. and west wall of TB

System	Description	Piping	Location
	Condensate for Reactor Water Cleanup (RWCU) Demin Resin Transfer	3” Stainless Steel (SS) pipe	South of RB between RB and Pipe Tunnel
Solid Waste	RWCU Demin Resin Transfer	3” SS pipe	South of RB between RB and Pipe Tunnel
Torus Water	Torus Water Transfer	1000’ of 4” CS pipe	Between Torus Water Storage Tank and north face of RB
Overboard Discharge	Overboard Discharge	>1000’ of 30” Cured-in-Place Piping	From Radwaste discharge tie-in to Discharge Canal

3.4 Demolition Schedule

Remaining dismantlement activities described in Section 3.3 above will be performed in accordance with the milestone schedule shown in Table 3-3.

Table 3-3 Building or Component Demolition Milestone Schedule

Building or Component	Scheduled Completion
NRW	9/30/2024
Fish Sampling Pool	6/28/2027
Intake Structure	6/28/2027
Diesel Generator Building	7/23/2027
Dilution Water Pump House	9/22/2027
Main Office Building	2/23/2028
TB	2/23/2028
Old Machine Shop	4/5/2028
Chlorination Facility	6/29/2028
Domestic Water Facility	7/11/2028
Gas Station	7/25/2028
Condensate Transfer Building	7/28/2028
Fire Water Storage Tank	8/3/2028
Fire Water Pump House	8/17/2028
Hazard Collection Facility	8/24/2028
ORW	10/2/2028
RB	2/20/2029
Respirator and Mac Facility	2/20/2029
Tunnels and Stack	5/21/2029

Figure 3-3 displays in graphical format the remaining major decommissioning activities, their interrelationships, and the order in which they will occur.

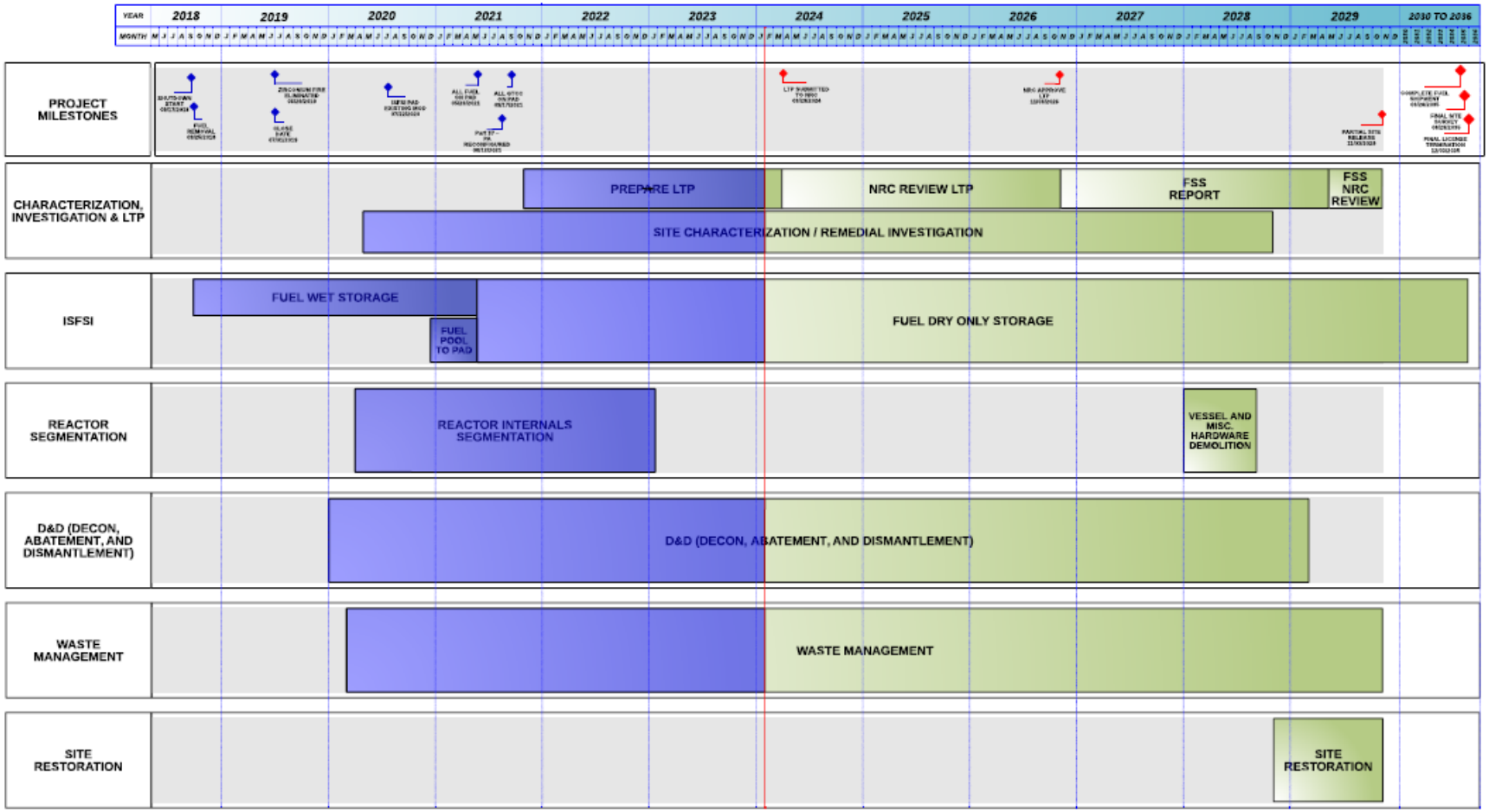


Figure 3-3 Integrated Decommissioning Schedule

3.5 Control Mechanisms to Prevent Recontamination

Due to the large 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, the following actions and controls are used to prevent recontamination:

- Personnel briefings and training (e.g., classroom lecture, handouts, departmental e-mail notifications, and other routed information provided during tailboard briefings).
- Physical barriers to control access or prevent the migration of contamination from adjacent or overhead areas. Physical barriers may include fences., locked entrances to surveyed areas, or installation of tamper-evident devices at entrance points.
- Postings
- Personnel contamination surveys at all access/egress locations to the area.
- Evaluation of FSS equipment to prevent introduction of plant-related radioactive material into the survey unit.

Upon completion of FSS, the area will be placed under periodic routine surveillance to ensure no recontamination occurs. If recontamination is found, an investigation will be initiated that could result in corrective actions up to and including reperformance of the FSS for that area.

Measures to prevent recontamination are controlled and documented in accordance with plant procedures.

3.6 Dose Estimates

3.6.1 Occupational Exposure

Cumulative site exposure for completed decommissioning activities as of year-end 2023 are shown in Table 3-4.

Table 3-4 Occupational Dose Actuals

Year	Dose (person-rem)
2019	19
2020	23
2021	68
2022	55
2023	30
Total	**195**

Table 3-5 summarizes the total decommissioning project occupational dose by major activity. Major activities include the following:

- Refuel Floor work includes reactor disassembly and defueling, removal of equipment and components from the reactor cavity and equipment pit, cleanout of the 119’ elevation, movement of spent fuel to the ISFSI, reactor internals segmentation and packaging of waste, cleanout of the Spent Fuel Pool and removal of fuel racks, demolition of pool liners, and removal of the reactor pressure vessel.
- RB, TB, NRW and tunnel, and ORW and tunnel demolition includes removal of components, piping, instrument lines, supports, Heating Ventilation and Air Conditioning, insulation, cable, conduit, switchgear, and equipment skids. Demolition also includes removal of above-grade structures, removal of grating and stairways, remediation of contaminated concrete and embedded piping that will remain in place, and survey activities to support demolition and FSS.
- Drywell demolition includes removal of all structures, systems, and components within the drywell and complete removal of the drywell shell.
- Spent fuel removal includes all activities supporting the loading and shipping of spent nuclear fuel and GTCC waste.

- Support Work includes Project Management, Operations, Security, Health Physics, Engineering, and other technical staff support for decommissioning activities.

The predominant gamma-emitting radionuclide, and therefore the most conservative source term for occupational dose estimation, is Co-60. The exposure estimates presented in Table 3-5 have been decay corrected to 12/31/2023 using the Co-60 half-life of 5.25 years.

The total nuclear worker exposure estimate for remaining dismantlement activities is 938 person-rem. This estimate, along with the actual occupational dose for completed project activities constitutes 1133 person-rem for the decommissioning project, which is within the range of the cumulative occupational dose estimates for decommissioning Boiling Water Reactor plants of 700-1874 person-rem provided in Table 4-1 of NUREG-0586, Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors (Reference 3-4).

Table 3-5 Occupational Dose Estimates

Activity	Dose Estimate (person-rem)
Refuel Floor Work	71
RB Demolition	238
Drywell Demolition	334
NRW & Tunnel Demolition	62
TB Demolition	74
ORW & Tunnel Demolition	89
Spent Fuel Removal	28
Support Work	42
Total	**938**

3.6.2 Exposure to Members of the Public

The radiological characteristics of the OCNGS decommissioning are monitored in accordance with HDI's Offsite Dose Calculation Manual and Radiological Environmental Monitoring Program (REMP).

Radioactive gaseous and liquid effluents are monitored to ensure that radioactivity released to the environment is ALARA and does not exceed regulatory limits in 10 CFR §20 and §50. Effluent control includes the operation of monitoring systems, in-plant and environmental sampling and analyses programs, quality assurance programs for the effluent and environmental programs, and procedures covering all aspects of effluent and environmental monitoring.

REMP reports containing the results of onsite and offsite monitoring indicate that direct radiation from all sources have been below the 40 CFR §190 limits. The REMP will be continued as required by Part 50 license until removal of spent fuel from the ISFSI and termination of the license.

OCNGS performs sampling of both the potential release paths from the plant and the potential exposure pathways in the environment. There are two reports generated annually, the Annual Radioactive Effluents Release Report (ARERR) and the Annual Radiological Environmental Operating Report (AREOR). The ARERR summarizes all the radioactive effluents released from the plant and quantifies the doses to the public from these effluents. The AREOR summarizes the results of the samples obtained in the environment, looking at all the potential exposure pathways by sampling different media such as air, vegetation, or fish. The AREOR validates that the effluent program is accurate. The ARERR and AREOR together ensure that OCNGS is performing decommissioning activities in a manner that adequately protects the public.

Radiation exposure to the most likely exposed member of the public from both primary effluent pathways and direct radiation for each calendar year as reported in the ARERR (References 3-5 through 3-9) is summarized in Table 3-6 to demonstrate conformance with 40 CFR §190.

Table 3-6 40 CFR §190 Total Dose

Year	Whole Body (mrem)	Thyroid (mrem)	Other Organ (mrem)
2019	6.07	6.95	6.95
2020	6.07	6.09	6.09
2021	5.67	5.68	5.68
2022	5.88	5.88	5.88
2023	4.87	4.87	4.87

3.7 Waste Estimates

Table 3-7 provides a summary of the volume and curie content of Class A, B, and C low-level radioactive wastes shipped for disposal for each calendar year since the start of decommissioning. Low-level radioactive wastes consist of resins, filters, evaporator bottoms, Dry Active Waste (contaminated soil, concrete, misc. protective clothing, etc.), and irradiated components.

Table 3-7 Low-Level Radioactive Waste Actuals

Year	Volume (cubic feet)	Curies
2019	8,970	38.3
2020	43,900	2.3
2021	212,000	32.2
2022	134,000	146
2023	40,000	149
Total	**438,870**	**367.8**

Table 3-8 provides an estimate of the quantity of radioactive waste that will be shipped for disposal at a low-level waste disposal facility. These quantities include waste that has been generated from completed dismantlement activities and is awaiting shipment in addition to the waste that will be generated from remaining activities.

Table 3-8 Low-Level Radioactive Waste Estimates

Waste Type	Waste Class	Volume (cubic feet)
Debris	A	1,400,000
Irradiated Hardware, Resin, Sludge	B/C	3,164
Irradiated Hardware	GTCC	4,800

3.8 Site Description Following Release

Following completion of decommissioning activities and verification that radiological criteria for license termination are met, the site footprint will be reduced to only that portion required for operation of the ISFSI, with the remainder of the site being released for unrestricted use.

In addition to the infrastructure needed to support the operation of the ISFSI, the following facilities, structures, and components will remain for potential future use:

- Oyster Creek Administrative Building
- Site Emergency Building
- Materials Warehouse
- Low-Level Radioactive Waste Storage Facility
- Main Access Facility
- Demineralized Water Storage Tank
- Intake, Discharge and Dilution Water structures and canals
- Roads, pathways, and parking areas

3.9 References

3-1 Cowan, Pamela, HDI. September 2018. Letter to NRC. *"Notification of Revised Post-Shutdown Decommissioning Activities Report and Revised Site-Specific Decommissioning Cost Estimate for Oyster Creek Nuclear Generating Station"*. (ML18275A116)

3-2 Giebel, S., & Watson, B. 2018. *Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans*. NUREG-1700, Revision 2, NRC, Washington, D.C. (ML18116A124)

3-3 NRC. 2019. *Standard Format and Contents for License Termination. Plans for Nuclear Power Reactors*. Regulatory Guide 1.179, Revision 2, NRC, Washington, D.C. (ML19128A067)

3-4 NRC. 2002. *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors.* NUREG-0586, Final Report, Supplement 1, NRC, Office of Nuclear Reactor Regulation, Washington, D.C. (Vol 1: ML023470304) and (Vol 2: ML023470323)

3-5 OCNGS. 2019. *Annual Radioactive Effluent Release Report (ARERR) 2019 Oyster Creek Nuclear Generating Station*. (Docket No. 50-219 and Docket 72-15). Holtec Decommissioning International, LLC. (ML20121A137)

3-6 OCNGS. 2020. *Annual Radioactive Effluent Release Report (ARERR) 2019 Oyster Creek Nuclear Generating Station*. (Docket No. 50-219 and Docket 72-15). Holtec Decommissioning International, LLC. (ML20121A137)

3-7 OCNGS. 2021. *Annual Radioactive Effluent Release Report (ARERR) 2020 Oyster Creek Nuclear Generating Station*. (Docket No. 50-219 and Docket 72-15). Holtec Decommissioning International, LLC. (ML21120A087)

3-8 OCNGS. 2022. *Annual Radioactive Effluent Release Report (ARERR) 2021 Oyster Creek Generating Station*. (Docket No. 50-219 and Docket 72-15). Holtec Decommissioning International, LLC

4

SITE REMEDIATION PLAN

LIST OF ACRONYMS

Acronym	Full Form
ACM	Asbestos Containing Material
AL	Action Level
ALARA	As Low As Reasonably Achievable
$Cost_T$	Total Cost
$Cost_R$	Cost of Performing Remediation Work
$Cost_{WD}$	Cost of Waste Disposal
$Cost_{ACC}$	Cost of Workplace Accident
$Cost_{TF}$	Cost of Traffic Fatality
$Cost_{WDose}$	Cost of Worker Dose
$Cost_{PDose}$	Cost of Dose to the Public
CPI	Consumer Price Index
CPI-U	Consumer Price Index – All Urban Customers
DCGL	Derived Concentration Guideline Level
FSS	Final Status Survey
F_T	Transportation Fatality Rate
F_W	Workplace Accident Fatality Rate
HEPA	High-Efficiency Particular Air
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
mrem	millirem
mSv	Millisievert
MUWE	Median Usual Weekly Earnings
NJAC	New Jersey Administrative Code
NRC	United States Nuclear Regulatory Commission
OCNGS	Oyster Creek Nuclear Generating Station
PCB	Polychlorinated Biphenyl
P_D	Population Density
RP	Radiation Protection
V_{AD}	Value of Averted Dose
V_{SHIP}	Waste Shipment Volume
VSL	Value of Statistical Life
WCS	Waste Control Specialist

4 SITE REMEDIATION PLAN

4.1 Remediation Actions and ALARA Evaluations

This chapter of the License Termination Plan (LTP) describes various remediation and decontamination actions that may be used during the decommissioning of Oyster Creek Nuclear Generating Station (OCNGS). Described are the methods used to reduce residual contamination to levels that comply with the United States Nuclear Regulatory Commission (NRC) requirement that the remaining radioactivity distinguishable from background radiation, not result in a Total Effective Dose Equivalent that would exceed 25 mrem per year to an average member of the critical group, including that from groundwater sources of drinking water and that the residual radioactivity be reduced to levels that are as low as reasonably achievable (ALARA) and the New Jersey Department of Environmental Protection remediation requirement of 15 mrem. Finally, the Radiation Protection (RP) Program requirements for the remediation are described (Reference 4-1).

4.2 Remediation Actions

Remediation actions are performed throughout the decommissioning process. The remediation action taken is dependent on the nature and extent of contamination, the type of contaminated material, and the intended disposition of the material. The principal materials that may be subjected to remediation are structural surfaces and soils that will remain in place following decommissioning.

4.3 Remediation Process

Dismantlement and demolition activities are conducted in accordance with established RP, Safety, Environmental, and Waste Management programs which include approved written procedures. Revisions are made to these programs and procedures to accommodate the changing work environment inherent to decommissioning and documented, processed, and approved in accordance with existing administrative procedures using 10 CFR §50.59 and Regulatory Guide 1.187, Guidance for Implementation of 10 CFR §50.59 Changes, Tests, and Experiments (Reference 4-2) as guidance.

4.3.1 Utility Abandonment

Utility abandonment includes disconnection of utilities, including electrical and fluid connections, followed by verification operations such as Dead/Live/Dead testing. Electrical connections are air-gapped to prevent unintentional reconnection of energy sources.

4.3.2 Equipment Protection

Protective measures are established to prevent damage to nearby equipment, and the remaining utilities are marked to indicate that they are active and not subject to demolition.

4.3.3 Structural Integrity Evaluation

For buildings, a structural integrity evaluation is performed to assess current conditions, develop the demolition approach and sequencing, and establish measures to be taken to prevent an unintended premature collapse of building structures. Engineering and administrative controls are implemented as required to ensure controlled demolition.

4.3.4 Characterization and Survey

Characterization and survey operations are performed to identify and quantify hazardous materials such as Asbestos Containing Material (ACM), hazardous chemicals, universal waste, e-waste, Polychlorinated Biphenyl (PCB) containing materials, mercury-containing lamps and thermostats, and hazardous electrical wiring jacketing or insulation. For buildings and components inside the Radiologically Controlled Area or with a history of radiological contamination, surveys are performed to identify hazards and develop Radiation Work Permits or ALARA work evaluations. Remedial Action Support Surveys are discussed in Chapter 5 of this LTP.

4.3.5 Permitting

Where required, demolition permits are obtained from local authorities.

4.3.6 Asbestos Abatement

Removal of ACM is performed by trained and qualified asbestos abatement workers using appropriate personnel protective equipment. A specific job hazard analysis is developed for each abatement activity. Exclusion zones and containment areas are established as necessary to protect personnel and prevent the spread of ACM to clean areas. Waste generated from asbestos abatement operations is packaged, transported, and disposed of in accordance with applicable regulations and guidance.

4.3.7 Radiological Source Term Management

Decontamination operations or focused demolition activities are performed on components or areas containing significant levels of radiological contamination that could present hazards to workers, result in the spread of contamination, or result in the failure to meet disposal site waste acceptance criteria. Hot spot removal, tank de-sludging, flushing, draining, vacuuming, and wipe-down techniques are employed to manage radiological contamination.

4.3.8 Hazardous Materials Identification and Removal

Oils and Chlorofluorocarbons are removed from equipment, and chemicals are removed from the building or area. Universal waste, e-waste, PCB-containing materials, mercury-containing lamps and thermostats, and hazardous electrical wiring jacketing or insulation are removed and stored at designated locations or packaged for disposal.

4.3.9 Drainage and Runoff Management

Floor drains in building slabs are capped or plugged prior to demolition to prevent the inadvertent release of radioactive material to areas outside the controlled demolition area. Storm drains in the vicinity of the demolition operations are covered to prevent release to ponds, impoundments, or waterways.

4.3.10 Fire Safety

Fire prevention measures are implemented on an as-needed basis to reduce fire risks during demolition. Fire prevention measures include fire safety training, maintaining good housekeeping, removing combustible materials, securing Hot Work Permits, using fire watch personnel where required, and maintaining fire extinguishers in the work area.

4.3.11 Work Area Ingress and Egress

Demolition area ingress and egress routes and controls are established considering traffic patterns, weather conditions, prevailing wind direction, and proximity to other work areas and structures.

4.3.12 Dust Control

Dust controls include ventilation and containment to control particulates, misting or diamond wire saw cutting where appropriate, and preferentially performing interior demolition to the extent practical while exterior walls remain intact and provide structural integrity.

4.3.13 Cleanup & Restoration

Following demolition, demolition debris is segregated and placed into designated onsite storage areas, packaged for transport and disposal at a conventional landfill or low-level radwaste disposal facility, or properly packaged for transport to recycling facilities. Barriers, machinery, tools, and support equipment such as ladders and scaffolding are removed. Disturbed areas are restored to pre-demolition condition at the completion of the cleanup and radiological survey activities. Exposed soil is stabilized as necessary to prevent soil erosion.

4.4 Schedule

The integrated schedule in Chapter 3, Figure 3-3, shows decommissioning activities will be completed well within 60 years of permanent cessation of operations as required by the regulation in 10 CFR §50.82(a)(3).

4.5 Remediation Methods

Remediation methods are utilized to reduce radioactive contamination in various media remaining onsite following decommissioning to levels that meet radiological release criteria.

4.5.1 Structures

Contaminated structural surfaces that remain onsite after license termination are remediated to levels that meet the established radiological criteria provided in Chapter 6. Following the removal of designated equipment and components, structures are surveyed as necessary, and contaminated systems and components are dismantled and disposed of as radioactive waste. 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. Concrete removal, if required, may include using machines with hydraulic-assisted, remote-operated, articulating tools. These machines can exchange scabbling, shear, chisel, and other tool heads. Structural concrete removal may be accomplished via wire cutting of the reinforced concrete into blocks suitable for transportation to a low-level radioactive waste disposal facility or other appropriately designated facility.

4.5.1.1 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 closed-capture attachment 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 closed-capture attachment similar to scabbling equipment. The fractured media and dust from both methods are deposited into a sealed removable container. The exhaust air passes through both roughing and absolute High-Efficiency Particulate Air (HEPA) filtration devices. Dust and debris generated through these remediation processes are collected and controlled during the operation for ultimate disposal.

4.5.1.2 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 removing and chipping 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.

4.5.1.3 Chipping

Chipping includes the use of pneumatic chisels and similar tools coupled to a vacuum-assisted collection. Chipping is employed on structures and areas that do not provide sufficient access for the use of other decontamination equipment, such as pressure washing.

4.5.1.4 Grit Blasting or Hydrolazing

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 cleaned sections under negative pressure and collects the media for reuse or disposal. The final system pass is performed with clean grit to remove residual contamination.

Hydrolazing is like grit blasting, but water under pressure is used to flush surface material from piping internals instead of air and grit. The flush water may be allowed to settle, be filtered, and reused. In both instances, surveys of the internal remediated surfaces are performed to verify the adequacy of the decontamination process.

4.5.1.5 Washing and Wiping

Washing and wiping decontamination techniques are good housekeeping actions performed routinely during remediation activities as contamination control measures. OCNGS will implement good housekeeping throughout decommissioning as an adherence to ALARA principles and to remove and minimize the spread of loose surface contamination generated during remediation activities. Washing and wiping will be performed to remove loose surface contamination prior to evaluating the surface for acceptable concentrations of residual activity.

Washing and wiping techniques that are performed routinely during remediation activities will not always be evaluated as a separate ALARA action. However, when washing and wiping techniques are used as the sole means to reduce residual contamination below Derived Concentration Guideline Level (DCGL) levels, ALARA evaluations may be performed. Washing and wiping techniques used as housekeeping or good practice measures will not be evaluated.

4.5.1.6 Additional Remedial Actions

Mechanical abrasive equipment, such as hones, may be used to remove contamination from embedded or buried piping surfaces. As appropriate, chemical removal means may be used to remove difficult-to-reach contaminants.

4.5.2 Activated Concrete

Activated concrete is evaluated and remediated or removed, as necessary. Evaluation methods will include sampling (i.e. core-boring, etc.). Depending on the volumetric contamination depth profile, concrete remediation may include scabbling, concrete shaving, or chemical removal. Extensive concrete volumetric contamination will be evaluated for remediation based on labor, cost, etc. and may be disposed of at a licensed burial facility.

4.5.3 Soil

Contaminated soil includes native soils and fill material on the site that has been radiologically impacted by plant operation or decommissioning activities. As Chapter 5 of this LTP describes the predominant soil type on the OCNGS site is sand.

Soil contamination above the site-specific DCGL that is removed is disposed of as radioactive waste. Operational constraints and dust control are addressed in site excavation and soil control procedures. In addition, work package instructions for soil remediation may include additional constraints and mitigation or control methods. The site characterization process described in Chapter 2 established the location and extent of soil contamination. As needed, additional investigations are performed to ensure that any changing soil contamination profile during the remediation actions is adequately identified and addressed. LTP Chapter 5 discusses soil sampling and survey methods.

Soil remediation equipment includes, but are not limited to, shovels, backhoe, 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 mixing contaminated soils with acceptable lower soil layers, as would occur with a toothed excavator bucket. Remedial action surveys may be used to determine the depth of final layer removal. Exposed surfaces of

excavations will be surveyed to support the Final Status Survey (FSS) of the site, as appropriate. Remedial Action Surveys are discussed in Chapter 5 of this LTP.

Remediation of soils includes the use of established safety and environmental control procedures. Additionally, work package instructions augment the previous guidance and procedural requirements to ensure adequate erosion, sediment, and air emission controls during soil remediation.

4.5.4 Sediment

Sediment consists of fine-grained material deposited at the bottom of ponds and waterways, in addition to collection points in catchments or washout areas and is typically remediated using the same methods as described in Section 4.5.3 for soil remediation. Remediation of sediment deposited below water, if required, may consist of the use of excavation equipment or vacuum collection.

Characterization data available to date indicates that no remediation of sediments in ponds or waterways at the OCNGS site will be required.

4.5.5 Surface Water and Groundwater

Characterization data available to date indicates that no remediation of surface water or groundwater will be required at OCNGS to meet the site release criteria.

4.6 Onsite Reuse of Material

Following FSS of excavation areas, below-grade structural foundations will be backfilled with suitable clean or reused material with activity that meets 10 CFR §20 Subpart E criteria to the existing grade and stabilized using best management practices.

The radiological characteristics of residual radioactivity in soil or other material used for backfilling an excavation are assessed in accordance with the guidance in NUREG-1757 Volume 2, Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria (Reference 4-3), Appendix G, Section 3.2.1. Surveys of reused soil to receive the same rigor of characterization, scanning and sampling, as the area(s) of the site from which it originated.

4.7 Remediation Activities Impact on the Radiation Protection Program

The RP Program in place during power operation is used for decommissioning. During power operations, contaminated structures, systems, and components were decontaminated to perform maintenance or repair actions. The techniques used during operations are the same or like the techniques used during decommissioning to reduce personnel exposure to radiation and contamination and to prevent the spread of contamination from contaminated areas. Decommissioning planning allows RP personnel to focus on each remediation, dismantlement, or removal activity well in advance of execution. Decommissioning does not present any new challenge to the program, different from those encountered during normal plant operation and refueling.

Low levels of surface contamination are expected to be remediated by washing and wiping. These techniques have been used during the operational history of the facility.

Water-washing with detergent has been the method of choice for large area decontamination. These same techniques are applied to remediate lightly contaminated structure or component surfaces in preparation for remediation actions.

Intermediate levels of exterior contamination on floor, wall, piping, and reactor cavity surfaces have been removed by high-pressure washing, hydrolazing, or grit blasting in the past. Internal surfaces of piping and components have been cleaned and hot spots removed using flushing or hydrolazing. These methods are used to reduce contamination on moderately contaminated exterior surfaces as well as internal surfaces of pipes or components during decommissioning.

Scabbling or other surface removal techniques can reduce high levels of contamination on contaminated concrete. Mechanical or diamond wire cutting may be used to section structural concrete or large components. The current RP Program provides adequate controls to perform these activities.

Proper planning and radiological controls are used to ensure that structures or components with potential alpha contamination are remediated or removed in a manner that protects workers and prevents the spread of contamination.

The decommissioning organization is experienced in and capable of applying remediation techniques on contaminated structures, components, soil, or surfaces during decommissioning. The RP Program is adequate to safely control the radiological aspects of remediation, dismantlement, demolition, packaging, and shipping activities performed in support of decommissioning operations. Because the activities expected to be performed during decommissioning are the same or similar to those encountered during operations, the approval of any changes to the existing approved RP Program is not required or requested in this LTP. Should unique unanticipated circumstances be encountered, the RP Program would be adjusted as necessary to protect the health and safety of the workers and the public.

4.8 ALARA Evaluation

OCNGS must demonstrate compliance with the radiological criteria for unrestricted use established in 10 CFR §20.1402 to terminate the Part 50 license. Those requirements are:

> *"A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a Total Effective Dose Equivalent to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are ALARA. Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal."*

OCNGS used the New Jersey Administrative Code §7:28-12.8 (a)(1) (Reference 4-4) dose criterion (15 mrem/year) to demonstrate whether it is feasible to further reduce the levels of residual activity to below those necessary to meet the ALARA criterion.

NUREG-1757, Appendix N, recognizes that remediation of soils at or below the DCGL values is not likely to be cost-beneficial due to the high costs of waste disposal. The ALARA cleanup levels for OCNGS remediation of soil and buildings are established by generic ALARA evaluations using input from NRC documents and statistics from the U.S. Bureau of Labor and the Bureau of Transportation.

For OCNGS, remediation of soils with contamination levels below the DCGL is not cost-beneficial and soils that meet the DCGL values will be considered ALARA. Similarly, for remaining structures if the loose removable radioactive contamination has been removed and the remaining surface concentration is below the standing structure DCGL, then the levels associated with the structure will be considered ALARA. Activities performed solely to accommodate FSS measurements (e.g., wiping down of surfaces, shaving concrete to allow for proper instrument probe geometries) will not be evaluated for ALARA.

The process in NUREG-1757 for demonstrating compliance with the license termination criteria addresses both the dose criterion and the ALARA requirement established in 10 CFR §20.1402. OCNGS uses a simplified method for demonstrating compliance with the ALARA requirement as outlined in NUREG 1757, Appendix N. The process will be followed using the assumption that the building surface and soil contamination is at the conservative DCGL of Cs-137 (4.70E+04 dpm/100 cm^2 and 9.60E+00 pCi/g, respectively) and conservative values for estimates of costs, distances, and other required inputs that the calculations require.

The calculated Action Level (AL) represents the ratio of incurred cost to remediate to the cost benefit to remediate. If the AL is greater than 1, then remediation is not cost beneficial and therefore not ALARA. If the ratio is less than 1, then remediation is a cost beneficial action.

This calculation is meant to apply to areas of any NUREG-1575 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (Reference 4-5) class and any size. In a Class 1 area, values of residual contamination may exceed the DCGL in limited areas, but the mean concentration should not exceed the DCGL. Since it is assumed that the entire volume of building material and soil removed is at DCGL. The assumed mean will be at the DCGL (i.e., Soils and building surfaces will be remediated so the mean activity remaining will be below the DCGL. Therefore, the assumed case at the 10 CFR §20.1402 25 mrem/year level, or at the NJAC's 15 mrem/year, will be bounding.

Table 4-1 Parameter Values for use in the ALARA Analysis[a]

Parameter	Value	Reference and Comments
Workplace accident fatality rate, F_w	1.8 E-08/hr	Census of Fatal Occupational Injuries Summary, 2020 (Reference 4-6) Change to Hours-Based Fatality Rates in the Census of Fatal Occupational Injuries (Reference 4-7)
Transportation fatality rate, F_T	Trucks: 1.85 E-09/km	2019 Bureau of Transportation Statistics: Truck Occupant Safety Data (Reference 4-8) Table 2-23: Truck Occupant Safety Data (Full Table) (Reference 4-9)
Value of averted dose, V_{AD}, and value of statistical life, VSL (Dollars per person-rem)	$7,950 note: value is updated through 2023	Reassessment of NRC's Dollar Per Person-Rem Conversion Factor NUREG-1530 (Reference 4-10). Regulatory Analysis Guidelines of the Nuclear Regulatory Commission NUREG/BR-0058 (Reference 4-11)
Monetary discount rate, r	Building: 0.07/yr Soil: 0.00/yr	NUREG/BR-0058 Discount rates, with special considerations for intergenerational consequences. - Section N.3.2.1 of NUREG 1757
Number of years of exposure, N	Buildings: 70 years Soil: 1,000 years	Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities NUREG-1496, Volume 2, Appendix B, Table A.1 (Reference 4-12)

Parameter	Value	Reference and Comments
Population density, P_D	Building: 0.09 person/m^2 Land: 0.0004 person/m^2	NUREG-1496
Excavation, monitoring, packaging, and handling soil	1.62 person-hours/m^3 of soil	NUREG-1496
Waste shipments volume, V_{SHIP}	Truck: 13.6 m^3/shipment	NUREG-1496
Statistical monetary value of a life (or fatality).	$13,000,000	Section 4.2.5 of NUREG-1530

(a) The values are taken from Table N.2 NUREG-1757, Appendix N. Some values have been updated to provide current values.

4.8.1 ALARA Analysis Value Updates

Table 4-2 Value of Averted Dose (V_{AD})[a]

Base Year 2014	
Low Dollar/Person-Rem	$2,600
Best Dollar/Person-Rem	$5,200
High Dollar/Person-Rem	$7,800
Base year CPI-U	236.7
Base year MUWE	791
Income Elasticity	0.5

(a) The values are taken from NUREG-1530

Table 4-3 Consumer Price Index – for All Urban Customers (CPI-U) Values

Most recent 1/2-year CPI-U	306.996	2023 Half 2
Previous 1/2-year CPI-U	302.408	2023 Half 1
Current year 2023 CPI-U (average)	304.702	

(a) The values are taken from Weekly and Hourly Earnings Data from the Current Population Survey: Series LEU0252881500 (Reference 4-13)

$$Inflation\ rate\ change\ (percent) = \frac{CPI\text{-}U_{current\ year}}{CPI\text{-}U_{base\ year}} \times 100\%$$

Equation 4-1

$$Inflation\ rate\ change\ (percent) = \frac{304.702}{236.7} \times 100\% = 128.73\%$$

Table 4-4 Median Usual Weekly Earnings (MUWE) Values

Most recent Quarter MUWE (4Q 2023)	1145
First Previous Quarter MUWE (3Q 2023)	1118
First Previous Quarter MUWE (2Q 2023)	1100
First Previous Quarter MUWE (1Q 2023)	1100
Current Year MUWE (average)	1115.8

(a) The values are taken from "CPI for All Urban Consumers (CPI-U): Series ID: CUUR0000SA0, Not Seasonally Adjusted" (Reference 4-14)

$$\text{Real Income Growth} = \frac{\text{MUWE}_{\text{Current year}}}{\text{MUWE}_{\text{Base year}}} \times 100\%$$

Equation 4-2

$$\text{Real Income Growth} = \frac{1115.8}{791} \times\ 100\% = 141.06\%$$

$$Dollar/Person\text{-}rem_{Current\ year} = Dollar/Person\text{-}rem_{Base\ year} \times Inflation \times Real\ Income\ Growth^{Income\ Elasticity}$$

Equation 4-3

$$Low\ Dollar/Person\text{-}rem = 2{,}600 \times 1.2873 \times 1.4106^{0.5} = \$3{,}975$$

$$Best\ Dollar/Person\text{-}rem = 5{,}200 \times 1.2873 \times 1.4106^{0.5} = \$7{,}950$$

$$High\ Dollar/Person\text{-}rem = 7{,}800 \times 1.2873 \times 1.4106^{0.5} = \$11{,}925$$

Table 4-5 Sensitivity Values of a Statistical Life (VSL)

$Low\ Dollar/Person\text{-}rem$	\$6.7 M
$Best\ Dollar/Person\text{-}rem$	\$13.4 M
$High\ Dollar/Person\text{-}rem$	\$20.1 M

4.8.2 Building Materials Evaluation

The total cost ($Cost_T$) of remediation will be calculated using the following equation:

$$Cost_T = Cost_R + Cost_{WD} + Cost_{ACC} + Cost_{TF} + Cost_{WDose} + Cost_{PDose}$$

Equation 4-4

These terms are defined, and their values calculated as follows:

4.8.2.1 Cost of Performing Remediation Work ($Cost_R$)

- $Cost_R$ is the summation of the industry labor factors.
- This remedial process is assuming that good housekeeping is being performed in the area. If other remedial activities are considered, then that may necessitate a reevaluation.
- It is assumed the project is large enough to require mobilization of personnel and equipment (e.g., scabblers, etc.).
- As a conservative scenario, the cost of remediating one square meter of a larger project is calculated. A smaller project would have planning and administration costs that would dominate the cost (remediating a 1 m^2 area of a larger project would be bounding since remediating a smaller area by itself would cost more and be more cost prohibitive). Estimated industry labor factors contributing to $Cost_R$ are identified in Table 4-2.
- The initial estimate for $Cost_R$ is based on remediation of 1 m^2 of concrete to a depth of 1 inch (2.54 cm).
- $Cost_R = \$1{,}414/m^2$

Table 4-6 Cost Estimate for Building Remediation Work

	Time (hrs)	Rate ($/hr)	Cost
Const. Planner, Rad Engineer	10	$104	$1,040
Supervision/Management	1	$78	$78
Resurvey	1	$62	$62
Equip. + Deconners (2)	2	$55	$110
RP Coverage	2	$62	$124
Total Cost			**$1,414**

4.8.2.2 Cost of Waste Disposal ($Cost_{WD}$)

- Using the same assumptions of $Cost_R$, it is assumed that 1 m^2 of surface is to be remediated to a depth of 1 inch (2.54 cm). Building surface contamination is assumed to be in the top 1 inch (2.54 cm).
- The estimated waste volume is therefore 2.54 cm times the area of 1 m^2. This comes to 2.54E-02 m^3 (8.97E-01 ft^3).
- It is assumed that this waste will fit in a 55-gal shipping container and be shipped to Waste Control Specialist (WCS) for burial at a cost of \$11,406/m^3.
- $Cost_{WD} = Vol. x\ Burial\ cost = \$289.71$

4.8.2.3 Cost of Workplace Accident ($Cost_{ACC}$)

$$Cost_{ACC} = \$13.00E{+}06 \times 1.80E\text{-}08/hr \times Remediation\ Time(hr)$$

Equation 4-5

Where:

- \$13.00E+06 is the statistical monetary value of a life (or fatality).
- 1.80E-08/hr is the workplace accident fatality rate.
- Remediation time is assumed to be 5 person-hours for a 1 m^2 area.
- $Cost_{ACC} = \$13.00\text{E+}06 \times 1.80\text{E-}08/hr \times 5\ hr = \$1.17$
- $Cost_{ACC} = \$1.17$

4.8.2.4 Cost of Traffic Fatality ($Cost_{TF}$)

$$Cost_{TF} = \$13.00E{+}06 \times 1.85E\text{-}09/km \times Volume \times Distance/V_{SHIP}$$

Equation 4-6

Where:

- \$13.00E+06 is the statistical monetary value of a life (or fatality).
- 1.85E-09 is the transportation fatality rate.
- Volume is the waste volume of the shipment. Determined in $Cost_{WD}$ determination (2.54E-02 m^3)
- Distance is the round-trip distance from OCNGS to Andrews, TX (6018 km from Google Maps).
- V_{SHIP} is the total amount of waste volume per shipment (13.6 m^3).
- $Cost_{TF} = \$13.00E{+}06 \times 1.85E\text{-}09/km \times 2.54E\text{-}02\,m^3 \times 6018\ km/13.6\ m^3 = \$0.27$
- $Cost_{TF} = \$0.27$

4.8.2.5 Cost of Worker Dose ($Cost_{WDose}$)

$$Cost_{WDose} = \$7{,}950/person\text{-}REM \times Worker\ Dose\ Rate \times Time$$

Equation 4-7

Where:

- \$7,950/person-REM is the value of averted dose and value of statistical life.
- Worker Dose Rate is assumed to be 1.00E-04 person-REM/hr (0.1 mrem/hr).
- Time is the amount of time exposed to work area dose rate and is assumed to be 5 person-hours.
- $Cost_{WDose} = \$7{,}950/person\text{-}REM \times 1.00E\text{-}04\ REM/hr \times 5\ hr = \$3.98$
- $Cost_{WDose} = \$3.98$

4.8.2.6 Cost of Dose to the Public ($Cost_{PDose}$)

- $Cost_{PDose}$ is assumed to be no more than $Cost_{WDose}$
- $Cost_{PDose} = \$3.98$

4.8.2.7 Total Cost ($Cost_T$)

- $Cost_T$ is calculated using Equation 4-4.
  - $Cost_T = \$1{,}414 + \$289.71 + \$1.17 + \$0.27 + \$3.98 + \$3.98 = \$1{,}713.11$
  - $Cost_T = \$1{,}713.11$

4.8.2.8 ALARA Action Level

$$AL = \frac{Conc}{DCGL_W} = \frac{Cost_T}{\$7{,}950 \times PD \times 0.025 \times F \times A} \times \frac{r + \lambda}{1 - e^{-((r+\lambda)N)}}$$

Equation 4-8

Where:

- $Cost_T$ is the total cost of remediation determined above ($1,714.13).
- $7,950 is the monetary value of one person-rem.
- P_D is the population density for the critical group (0.09 people/m2).
- 0.025 is the NRC annual dose in rem to an average member of critical group from residual radioactivity.
- F is the removable fraction, and the most conservative value is used (1).
- A is the area being evaluated (1 m2).
- r is the monetary discount rate = 0.07/yr based on special considerations for intergenerational consequences. Reducing the discount rate to 0.00 reduces the AL to 2.44
- λ is the decay constant of the most conservative radionuclide of concern. The most conservative radionuclide of concern is that with long half-live and highest relative abundance, Cs-137, with a half-life of 30.17 years and a decay constant (λ) of 0.023 yr^{-1}.
- N is the number of years over which the collective dose is calculated = 70 yr

Therefore:

$$AL = \frac{1{,}713.11}{7{,}950 \times 0.09 \times 0.025 \times 1 \times 1} \times \frac{0.07 + 0.023}{1 - e^{-((0.07+0.023)70)}} = 8.9$$

Since AL is greater than 1, remediation is not cost beneficial. Also, if the NJAC's 15 mrem/year was used the AL would increase to 14.9.

4.8.3 Soil Evaluation

The total cost ($Cost_T$) of remediation will be calculated using Equation 4-4. These terms are defined, and their values calculated as follows:

4.8.3.1 Cost of Performing Remediation Work ($Cost_R$)

- $Cost_R$ is the summation of the industry labor factors.
- It is assumed that the project is large enough to require mobilization of personnel and equipment (e.g., shovels, etc.).
- As a conservative scenario, the cost of remediating one square meter of a larger project is calculated. A smaller project would have planning and administration costs that would dominate the cost. Estimated industry labor factors contributing to $Cost_R$ are identified in Table 4-3.
- The initial estimate for $Cost_R$ is based on remediation of 1 m^3 of soil.
- $Cost_R = \$1524/m^3$

Table 4-7 Cost Estimate for Soil Remediation Work

	Time (hrs)	Rate ($/hr)	Cost
Const. Planner, Rad Engineer	10	$104	$1,040
Supervision/Management	1	$78	$78
Resurvey	1	$62	$62
Equip. + Deconners (2)	4	$55	$220
RP Coverage	2	$62	$124
Total Cost			**$1,524**

4.8.3.2 Cost of Waste Disposal ($Cost_{WD}$)

- Using the same assumptions of $Cost_R$, it is assumed that 1 m^3 of soil is to be remediated.
- The estimated waste volume is therefore 1 m^3 (35.31 ft^3).
- It is assumed that this waste will fit into 5 - 55-gal shipping containers and be shipped to WCS for burial at a cost of $11,406/$m^3$.
- $Cost_{WD} = \$11{,}406$

4.8.3.3 Cost of Workplace Accident ($Cost_{ACC}$)

- $Cost_{ACC}$ is calculated using Equation 4-5, the variables are defined as:
  - $13.00E+06 is the statistical monetary value of a life (or fatality).
  - 1.80E-08/hr is the workplace accident fatality rate.
  - Remediation time is assumed to be 7 person-hours for 1 m^3.
- $Cost_{ACC} = \$13.00E{+}06 \times 1.80E{-}08/hr \times 7\ hr = \$1.64$
- $Cost_{ACC} = \$1.64$

4.8.3.4 Cost of Traffic Fatality ($Cost_{TF}$)

- $Cost_{TF}$ is calculated using Equation 4-6, the variables are defined as:
  - $13.00E+06 is the statistical monetary value of a life (or fatality).
  - 1.85E-09 is the transportation fatality rate.
  - Volume is the waste volume of the shipment. Determined in $Cost_{WD}$ determination (1 m^3).
  - Distance is the round-trip distance from OCNGS to Andrews, TX (6018 km from Google Maps).
  - V_{SHIP} is the total amount of waste volume per shipment (13.6 m3).
- $Cost_{TF} = \$13.00E+06 \times 1.85E\text{-}09/km \times 1\ m^3 \times 6018\ km/13.6\ m^3 = \$10.64$
- $Cost_{TF} = \$10.64$

4.8.3.5 Cost of Worker Dose ($Cost_{WDose}$)

- $Cost_{WDose}$ is calculated using Equation 4-7, the variables are defined as:
  - $7,950/person-REM is the value of averted dose and value of statistical life.
  - Worker Dose Rate is assumed to be 1.00E-04 person-REM/hr (0.1 mrem/hr).
  - Time is the amount of time exposed to work area dose rate and is assumed to be 7 person-hours.
- $Cost_{WDose} = \$7{,}950/person\text{-}REM \times 1.00E\text{-}04\ REM/hr \times 7\ hr = \$5.57$
- $Cost_{WDose} = \$5.57$

4.8.3.6 Cost of Dose to the Public ($Cost_{PDose}$)

- $Cost_{PDose}$ is assumed to be no more than $Cost_{WDose}$.
- $Cost_{PDose} = \$5.57$

4.8.3.7 Total Cost ($Cost_T$)

- $Cost_T = Cost_R + Cost_{WD} + Cost_{ACC} + Cost_{TF} + Cost_{WDose} + Cost_{PDose}$
- $Cost_T = \$1524 + \$11{,}406 + \$1.64 + \$10.64 + \$5.57 + \$5.57 = \$12{,}952.42$
- $Cost_T = \$12{,}952.42$

4.8.3.8 ALARA Action Level

- AL is calculated using Equation 4-8, the values for the variables are defined as:
    - $Cost_T$ is the total cost of remediation determined above ($12,952.42).
    - $7,950 is the monetary value of one person-rem.
    - PD is the population density for the critical group (0.0004 people/m^2).
    - 0.025 is the annual dose in rem to an average member of the critical group from residual radioactivity.
    - F is the removable fraction, and the most conservative value is used (1).
    - A is the area being evaluated (1 m^2).
    - r is the monetary discount rate = 0.00/yr based on special considerations for intergenerational consequences.
    - λ is the decay constant of the most conservative radionuclide of concern. The most conservative radionuclide of concern is that with long half-live and highest relative abundance, Cs-137, with a half-life of 30.17 years and a decay constant (λ) of 0.023 yr^{-1}.
    - N is the number of years over which the collective dose is calculated = 1000 yr

$$AL = \frac{12{,}952.42}{7{,}950 \times 0.0004 \times 0.025 \times 1 \times 1} \times \frac{0.00 + 0.023}{1 - e^{-((0.00+0.023)1{,}000)}} = 3{,}747.24$$

Since AL is greater than 1, remediation is not cost beneficial. Also, if the NJAC's 15 mrem/year was used the AL would increase to 6,245.40.

4.8.4 ALARA Evaluation Conclusion

With the ALARA Action Level at 8.9 for Building Surfaces and 3,747 for Soils are both greater than one and the assumption that the DCGL fraction for Cs-137 equals 1, the conclusion is that remediation of building structure surfaces and soils, where residual plant-related radioactivity is at or below the LTP release criteria, is not cost-beneficial to perform.

4.9 References

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5

FINAL STATUS SURVEY PLAN

Revision: 0

July 31, 2024

LIST OF ACRONYMS

Acronym	Full Form
AF	Area Factor
ALARA	As Low As Reasonably Achievable
CAD	Computer Aided Design
Co-60	Cobalt-60
COC	Chain Of Custody
Cs-137	Cesium-137
CsI	Cesium Iodide
DCA	Discharge Canal Area
DCGL	Derived Concentration Guideline Levels
DOD	Department Of Defense
DQA	Data Quality Assessment
DQO	Data Quality Objective
DRP	Discrete Radioactive Particles
EMC	Elevated Measurement Comparison
EPA	Environmental Protection Agency
ETD	Easy-to-Detect
FSS	Final Status Survey
GIS	Geographic Information System
GPS	Global Positioning System
GWPP	Groundwater Protection Program
H_0	Null Hypothesis
H_a	Alternate Hypothesis
HDI	Holtec Decommissioning International
HPGe	High Purity Germanium
HSA	Historical Site Assessment
HTD	Hard-to-Detect
ISFSI	Independent Spent Fuel Storage Installation
ISO	International Organization of Standardization
ISOCS	In Situ Object Counting System
IU	Industrial Use
LBGR	Lower Boundary of the Gray Region
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectible Concentration
MDCR	Minimum Detectible Count Rate
MeV	Megaelectron Volts

Acronym	Full Form
mrem	millirem
NaI	Sodium Iodide
NAVD	North American Vertical Datum
NIST	National Institute of Standards and Technology
NMSS	Nuclear Material Safety and Safeguards
NPA	North Protected Area
NRC	Nuclear Regulatory Commission
OCNGS	Oyster Creek Nuclear Generating Station
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCA	Radiologically Controlled Area
REMP	Radiological Environmental Monitoring Program
ROC	Radionuclides-of-Concern
SOF	Sum of Fractions
SPA	South Protected Area
Sr-90	Strontium-90
TBD	Technical Basis Document
TEDE	Total Effective Dose Equivalent
TSD	Technical Support Document
USGS	US Geological Survey
VSP	Visual Sample Plan
WRS	Wilcoxon Rank Sum

5 FINAL STATUS SURVEY PLAN

5.1 Introduction to the Final Status Survey Plan

The Oyster Creek Nuclear Generating Station (OCNGS) Final Status Survey (FSS) Plan has been prepared using the applicable regulatory and industry guidance. Survey unit-specific plans control FSS activities for an area. The survey plan design is addressed in Section 5.2.

The survey unit documents survey results in corresponding survey packages. These packages include a specific survey unit plan, survey results, assessments, etc.

5.1.1 Purpose

The FSS Plan describes the final survey process used to demonstrate that the OCNGS 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), 10 CFR 50.82(11)(ii), and 10 CFR 20.1501(a) and (b).

5.1.2 Scope

Holtec Decommissioning International, LLC (HDI) intends to perform a partial site release from the 10 CFR 50 license. The Independent Spent Fuel Storage Installation (ISFSI) will remain under the Part 50 license until, at such time, the spent fuel is removed from the site. This Plan addresses only facilities and land areas identified as containing or potentially containing residual plant-related radioactive materials.

5.1.3 Final Status Survey Program Overview

The overall FSS process includes several major elements:

- survey planning and design,
- survey implementation and data collection,
- data assessment and determination of compliance, and
- reporting.

The FSS Plan in this chapter will be used to develop FSS procedures and processes associated with final status surveys. Figure 5-1 illustrates the FSS process.

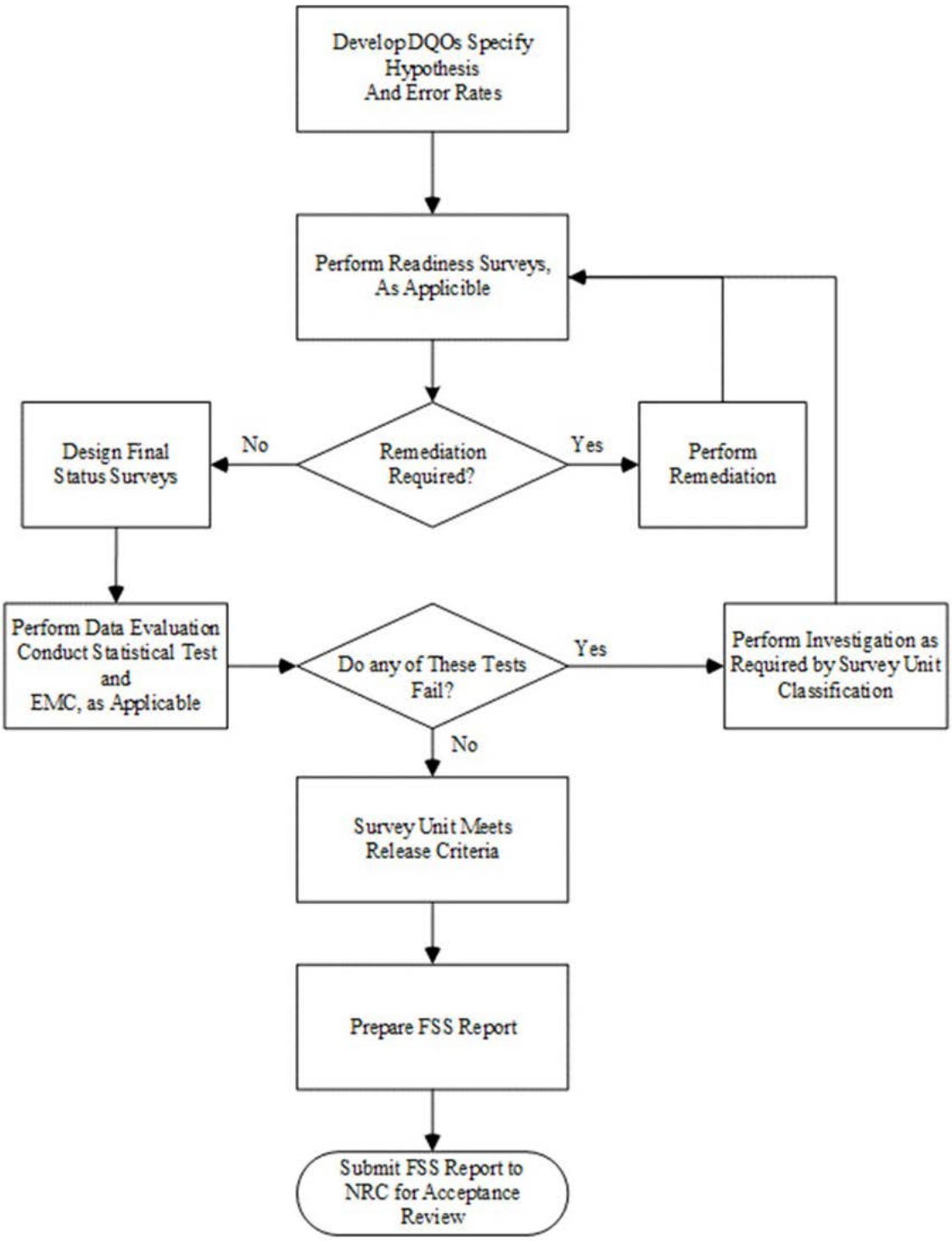


Figure 5-1 FSS Process Overview

5.1.4 OCNGS Site Areas

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 and boundaries established for the characterization process were modified to accommodate an efficient FSS process.

Table 5-1 Survey Area Summary

Survey Area Name	Survey Area	Total Area (m^2)	Classification
North Owner Controlled Area-1	NOCA-01	180,100	3
North Owner Controlled Area-2	NOCA-02	35,700	1
South Owner Controlled Area-1	SOCA-01	81,700	3
South Owner Controlled Area-2	SOCA-02	87,900	3
East Owner Controlled Area-1	EOCA-01	46,000	2
East Owner Controlled Area-1A	EOCA-02	7,027	3
East Owner Controlled Area-1B	EOCA-03	19,900	3
Discharge Canal Area	DCA	37,700	2
North Protected Area	NPA	73,900	2
South Protected Area	SPA	51,300	2
Radiologically Controlled Area	RCA	22,000	1

EOCA02 and EOCA03 open land areas are considered Class 3 in the table above, but waste travel routes through the EOCA01 area are treated as Class 2. Initial NPA and SPA characterization surveys indicate minimal excavation or soil remediation in these areas is expected. However, a Class 2 MARSSIM classification has been initially assigned based on proximity to decommissioning activity in Class 1 structures in the RCA. Water covering Survey Area DCA will preclude scanning. This Survey Area will require increased sampling density to account for the absence of scanning.

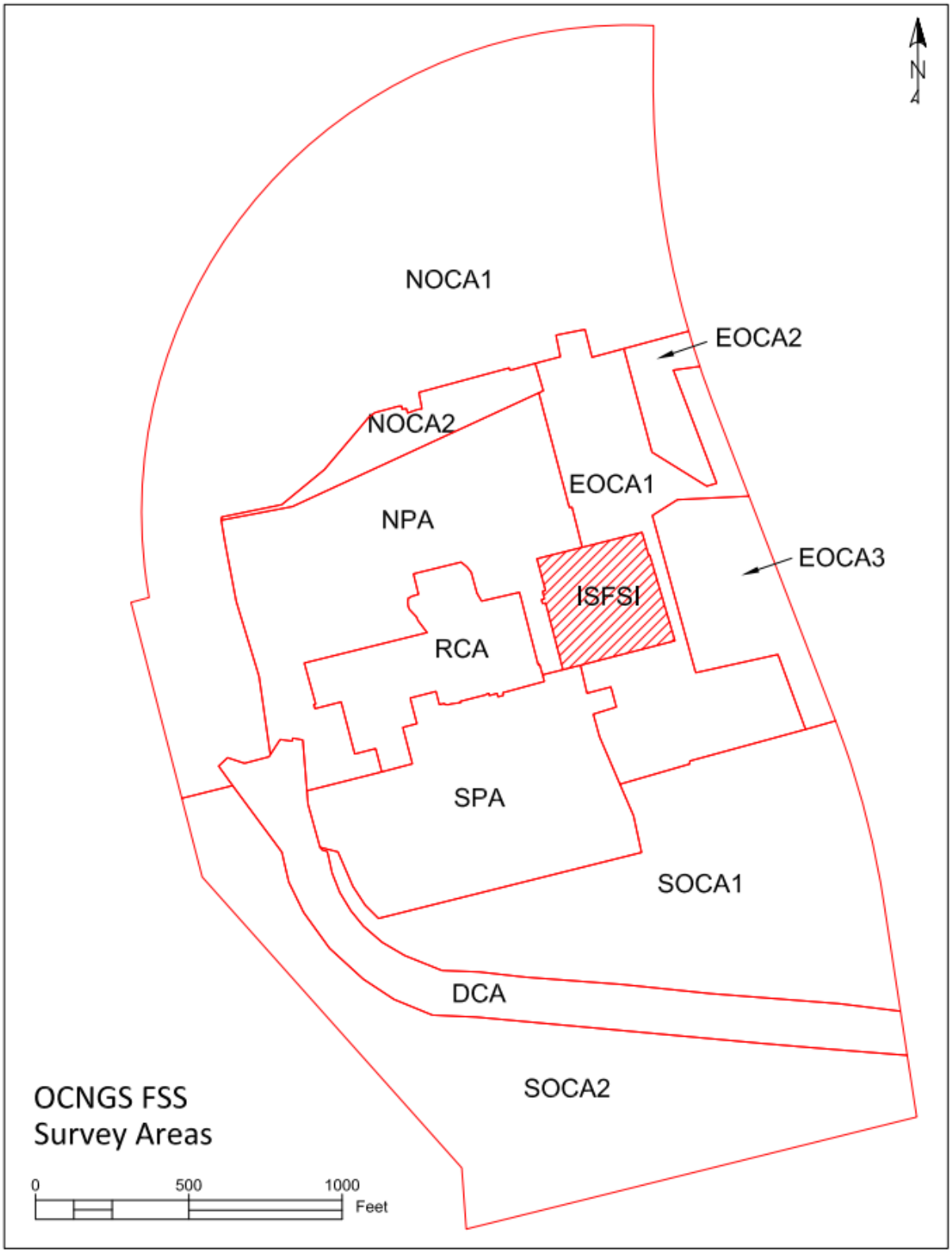


Figure 5-2 OCNGS Survey Area Map

5.1.5 Radionuclides-of-Concern for the OCNGS Site

A site-specific suite of radionuclides potentially present at OCNGS has been developed (Reference 5-10). This suite contains 21 radionuclides of concern (ROCs) potentially present in OCNGS environs, structures, and systems/components. The development of this site-specific suite of radionuclides is described in Chapter 6 of the OCNGS LTP, *Compliance with the Radiological Criteria for License Termination*. A detailed description of the methodology is provided in *TBD 20-6002-1362 Rev 0* (Reference 5-10). HDI has conducted radiological characterization of the site property to identify and document residual contamination from nuclear plant operation and decommissioning activities. The characterization efforts included reviews of historical information and radiological survey measurements of onsite soils and structures. Chapter 2 of the OCNGS LTP contains a detailed discussion of this effort. Table 5-2 lists the Site-Specific suite ROCs for the OCNGS site assessed during FSS.

Table 5-2 OCNGS Site-Specific Radionuclides of Concern

ROC	Half-Life (y)
Am-241	4.32E+02
C-14	5.70E+03
Cm-243	2.91E+01
Cm-244	1.81E+01
Co-60	5.30E+00
Cs-137	3.00E+01
Eu-152	1.30E+01
Eu-154	8.60E+00
Fe-55	2.70E+00
H-3	1.20E+01
Mn-54	8.50E-01
Nb-94	2.00E+04
Ni-63	1.00E+02
Np-237	2.14E+06
Pu-238	8.77E+01
Pu-239	2.40E+04
Pu-240	6.58E+03
Pu-241	1.40E+01
Sb-125	2.76E+00
Sr-90	2.90E+01
Tc-99	2.10E+05

5.1.6 Acceptance Criteria for License Termination

Derived concentration guideline levels (DCGL) were developed as acceptance criteria for assessing residual radioactivity in soils and on-site structures. A DCGL for the average residual radioactivity in a survey unit is called a $DCGL_w$. DCGL and $DCGL_w$ are used interchangeably throughout this LTP. Values of the $DCGL_w$ may then be increased by using area factors (AF) to obtain a DCGL that represents the same dose to an individual for residual radioactivity over a smaller area within a survey unit. This scaled value is called the $DCGL_{EMC}$, where EMC stands for elevated measurement comparison. The $DCGL_{EMC}$

derivation is provided in Section 5.2.7.7. The DCGL values ensure compliance with the NRC 25 mrem per year criterion for unrestricted use. The OCNGS LTP Chapter 6 provides a detailed discussion of developing the OCNGS DCGL values.

Dose models allow the translation of residual radioactivity levels into potential radiation doses to the public. For the OCNGS 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 during unrestricted release. The dose modeling approach for the OCNGS 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 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, 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 DCGL values were developed using the approach outlined previously. The scenarios described in NUREG/CR-5512, Volume 1, were selected for the OCNGS site to estimate potential radiation doses from radioactive material in buildings established on building occupancy and soil based on occupancy and future land use. The basement fill model DCGLs were derived using three scenarios:

1. Instantaneous Release
2. Drilling Spoils
3. Excavated Concrete

The methodology for the Basement Fill DCGLs is provided in detail in Chapter 6 of this LTP.

Table 5-3 provides a list of ROCs that may be present in onsite soils, structural surfaces, buried and embedded pipe, and subsurface concrete structures, along with their corresponding single nuclide 25 mrem per year DCGL values derived in Chapter 6. The DCGL values have been rounded down to two significant figures.

OCNGS soil DCGL accounts for a depth of 3 meters. The DCGLs are considered conservative because they account for a contaminated zone of up to 3 meters. The thickness is determined using actual on-site data to a depth of approximately 3 meters and is considered to be bounding to simplify the demonstration of compliance.

Table 5-3 DCGLs by Radionuclide and Media Type

Nuclide	Industrial Use Scenario	Building Occupancy Scenario	Industrial Use Scenario	Industrial Use Scenario	Industrial Use Scenario
	Soils 25 mrem/y DCGL (pCi/g) [1]	Building Surface 25 mrem/y DCGL (dpm/100 cm2) [2]	Basement Fill Model 25 mrem/y $DCGL_{W/F}$ (pCi/m^2) [3]	Embedded Pipe 25 mrem/y $DCGL_{EP}$ (pCi/m^2) [4]	Buried Pipe 25 mrem/y $DCGL_{BP}$ (pCi/m^2) [5]
Am-241	7.3E+02	7.4E+04	1.5E+09	2.0E+11	6.0E+10
C-14	2.1E+03	2.9E+08	3.4E+09	3.6E+09	1.7E+09
Cm-243	1.8E+02	1.1E+05	3.8E+08	1.0E+12	6.2E+11
Cm-244	1.8E+03	1.4E+05	3.8E+09	4.2E+11	2.3E+11
Co-60	7.9E+00	6.1E+05	1.7E+07	7.9E+13	7.1E+12
Cs-137	3.6E+01	2.1E+06	7.5E+07	4.4E+12	4.9E+11
Eu-152	1.8E+01	1.2E+06	3.7E+07	1.3E+14	1.5E+13
Eu-154	1.6E+01	1.2E+06	3.4E+07	1.3E+14	1.2E+13
Fe-55	8.4E+06	1.7E+09	1.8E+13	9.2E+16	6.9E+15
H-3	5.0E+04	9.5E+09	1.1E+11	6.9E+15	8.1E+15
Mn-54	3.4E+01	2.4E+06	7.2E+07	2.4E+15	1.6E+14
Nb-94	1.3E+01	8.3E+05	2.6E+07	1.5E+14	5.0E+13
Ni-63	7.8E+06	7.3E+08	1.6E+13	1.8E+15	6.2E+14
Np-237	5.8E+01	6.0E+04	1.2E+08	2.4E+10	1.2E+10
Pu-238	1.1E+03	8.5E+04	2.4E+09	2.9E+09	5.8E+08
Pu-239	2.4E+02	7.7E+04	4.6E+08	1.1E+09	4.3E+08
Pu-240	1.1E+03	7.7E+04	1.7E+09	1.1E+09	4.4E+08
Pu-241	2.5E+04	3.0E+06	5.2E+10	4.4E+13	5.7E+10
Sb-125	5.6E+01	3.4E+06	1.2E+08	5.2E+13	4.0E+11
Sr-90	4.2E+03	3.7E+06	8.9E+09	4.6E+12	1.2E+12
Tc-99	1.4E+04	2.3E+08	2.9E+10	1.0E+13	1.3E+13

[1] ENG-OCS-008, Derived Concentration Guideline Levels Values for Soil – Industrial Use Scenario Oyster Creek Station.
[2] ENG-OCS-004, RESRAD Building Surface DCGL Values Oyster Creek Station.
[3] TSD 24-063, Basement Fill Model: Calculation of $DCGL_{W/F}$ Values Assuming Industrial Use Scenario Exposure Pathways.
[4] ENG-OCS-015, Basement Fill Model: Calculation of Embedded Pipe DCGL Value
[5] ENG-OCS-016, Calculation of Buried Pipe DCGL Values

5.1.7 Regulatory 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), Revision 1, August 2000
- NUREG-1505, A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys, Revision 1, June 1998
- NUREG-1507, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions, Revision 1, August 2020
- NUREG-1700, Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans, Revision 2, April 2018

- NUREG-1757, Vol. 2, Consolidated NMSS Decommissioning Guidance Characterization, Survey, and Determination of Radiological Criteria, Final Report, Revision 2, July 2022
- Regulatory Guide 1.179, Standard Format and Content of License Termination Plans for Nuclear Power Reactors, Revision 2, July 2019

The full list of references used in the preparation of this plan are listed in Section 5.11.

5.2 Final Status Survey Planning and Survey Design

5.2.1 Data Quality Objectives

The appropriate design for a given survey area is developed using the 7-step data quality objective (DQO) process as outlined in MARSSIM, Appendix D.

1. State the problem.

   The first step of the planning process is defining the problem. This step provides a clear description of the problem, identification of planning team members (especially the decision-makers), a conceptual model of the hazard to be investigated, and estimated resources. The problem associated with FSS is determining whether a given survey unit meets the radiological release criterion of 10 CFR 20.1402.

2. Identify the decision.

   This step of the DQO process consists of developing a decision statement based on a principal study question (i.e., the stated problem) and determining alternative actions that may be taken based on the answer to the principal study question. Alternative actions identify those measures to resolve the problem. The decision statement combines the principal study question and alternative actions into an expression of choice among multiple actions.

3. Identify inputs to the decision.

   The information required depends on the media type under consideration (e.g., soil, structure) and whether existing data are sufficient or new data are needed to decide. If the decision can be based on existing data, the source or sources will be documented and evaluated to ensure reasonable confidence that the data are acceptable. If new data are needed, then the type of measurement (e.g., scan, direct measurement, and sampling) will need to be determined.

   Sampling methods, sample quantity, sample matrix, types of analyses, and analytic and measurement process performance criteria, including detection limits, are established to ensure adequate sensitivity relative to the release criteria.

4. Define the study boundaries.

   This step of the DQO process includes identifying the target population of interest, the spatial and temporal features of the population pertinent to the decision, the time frame for collecting the data, practical constraints, and the scale of decision-making. In FSS, the target population is the set of samples or direct measurements that constitute an area of interest (i.e., the survey unit). The medium of interest (e.g., soil, structure) is specified

during the planning process. The spatial boundaries include the area of interest, including soil depth, area dimensions, water bodies, and natural boundaries, as needed. Temporal boundaries include those activities impacted by time-related events, including weather conditions, seasons, equipment operation under different environmental conditions, resource loading, and work schedules.

5. Develop a decision rule.

   This step of the DQO process develops the binary statement that defines a logical process for choosing among alternative actions. The decision rule is a clear statement using the "If...then..." format and includes action-level conditions and the statistical parameter of interest (e.g., mean of data). Decision statements can become complex depending on the survey objectives and the affected area's radiological characteristics. For FSS, the decision rule will be based on the question pertaining to whether or not the radioactivity concentration of residual radioactivity in a survey unit exceeds the applicable DCGL value.

6. Specify limits on decision errors.

   This step of the DQO process incorporates hypothesis testing and probabilistic sampling distributions to control decision errors during data analysis. Hypothesis testing is a process based on the scientific method that compares a baseline condition to an alternate condition. The baseline condition is technically known as the null hypothesis. Hypothesis testing rests on the premise that the null hypothesis is true and that sufficient evidence must be provided for rejection. The primary consideration during FSS will be demonstrating compliance with the release criterion. For FSS, the null hypothesis is expressed as "the survey unit exceeds the criteria for unrestricted release."

7. Optimize the design for obtaining data.

   The first six steps of the DQO process develop the survey's performance goals. This final step leads to the development of an adequate survey design.

   Using an on-site analytical laboratory, sampling and analysis processes are designed to provide near real-time data assessment during field activities and FSS implementation. Gamma scans provide information on soil areas with residual radioactivity greater than the background and allow appropriate selection of biased sampling and measurement locations. This data will be evaluated and used to refine the scope of field activities to optimize the implementation of the FSS design and ensure the DQOs are met.

The DQO process will be used to design and conduct the final status surveys at OCNGS. Each survey package will contain the appropriate information, statistical parameters, and contingencies to support the DQO process described in OCNGS procedure FSS-002 (Reference 5-14).

5.2.2 Classification of Survey Units

The survey units within the areas are divisions with similar characteristics and contamination levels. Each unit is assigned only one classification. The site is surveyed and evaluated on a survey unit basis and released on a survey area basis (i.e., through survey area FSS reports).

Before beginning the FSS, a characterization of the radiological status and a historical review of the site is performed. Additional data may be collected and evaluated throughout the decommissioning. The methods and results from site characterization, surveys, and evaluations delineating between non-impacted and impacted areas are described in OCNGS LTP Chapter 2. 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 are commensurate with the potential for residual contamination to exceed the unrestricted use criteria.

Reclassification to a more restrictive classification will be performed under Section 5.8.4 of this FSS Plan. New DQOs will be developed with a new survey plan. Reclassification to a more restrictive classification does not require prior NRC notification, provided that the Type I error has not been increased. The reclassification will be addressed in the new survey plan and the final report on the survey area. Reclassification to a less restrictive classification is controlled under procedure FSS-001 and is subject to NRC notification requirements in LTP Section 1.10.

5.2.2.1 Non-Impacted Areas

Non-impacted areas have no reasonable potential for residual contamination because site operations had no demonstrable impact. These areas are not required to be surveyed beyond what has already been completed as a part of the Historical Site Assessment (HSA) unless impacted by site decommissioning processes as described in Chapter 2 or site characterization surveys performed to confirm the area's non-impacted classification. No non-impacted areas are located within the licensed boundary of OCNGS.

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 following definitions are from NUREG-1757, Volume 2, Page A2.

- Class 1 Areas: These are impacted areas expected to have concentrations of residual radioactivity exceeding the DCGL.
- Class 2 Areas are impacted areas that are unlikely to have concentrations of residual radioactivity exceeding the DCGL.
- Class 3 Areas: These are impacted areas with a low probability of containing residual radioactivity.

If the available information is insufficient to designate an area as a particular class, it will be classified as Class 1 or further characterized. Areas that are on the borderline between classes receive the more restrictive classification.

Site characterizations described in Chapter 2 have sufficiently identified areas of residual radioactivity except for non-accessible areas. These areas will be further characterized as access is available during decommissioning activities. Those characterization results will be documented in characterization reports or final status survey reports for areas where those areas existed.

5.2.2.3 Changes in Classification

Initial classification of site areas is based on historical information 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 for that area as long as the classification reflects the levels of residual radioactivity present or that existed before remediation was performed. Remediation should not be required for most survey areas. Units within initial survey areas may be upgraded in classification due to future requirements for laydown and storage areas during demolition activities or as actual radiological conditions warrant. Once the FSS of a given survey unit begins and the collected data indicate that a more restrictive classification is warranted, the basis for the reclassification is documented, the survey unit package is redesigned to the more restrictive classification, and the redesigned survey package is implemented. If, during FSS, sufficient evidence is accumulated to warrant an investigation and reclassification of the survey unit in accordance with Section 5.8.4, the survey may be terminated without completing the current survey unit package and the investigation documented in the station corrective action system.

5.2.3 Survey Unit Size

The survey units within the survey areas are divisions with 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).

Survey unit sizes will be selected based on area classification, survey execution logistics, and applicable regulatory guidance documents. Suggested survey unit sizes for structural surfaces and open land area soil are listed in Table 5-4. Survey unit sizes are consistent with NUREG-1575. Class 1 and 2 areas described in Table 5-1 will be, to the extent practical, further subdivided into smaller survey units to meet the guidelines present in Table 5-4. If survey unit areas are larger than the sizes in Table 5-4, a technical evaluation justifying the survey unit size will be presented in the FSS Package for the specific survey unit.

Table 5-4 Suggested Survey Unit Sizes

Class	Structural Surfaces	Open Land Soil Area
1	100 m^{2*}	2,000 m^2
2	100 m^2 to 1,000 m^2	2,000 m^2 to 10,000 m^2
3	No Limit	No Limit

* Based on floor area.

Table 5-5 provides the estimated open land survey units for each OCNGS survey area. The number of structure survey units is determined using the guidance in column 2 of Table 5-4 for any remaining above-grade structures at the time of license termination.

Table 5-5 Estimated Number of Open Land Survey Units in Each Survey Area

OCNGS Survey Area	Estimated Number of Survey Units
NOCA-01	1
NOCA-02	20
SOCA-01	1
SOCA-02	1
EOCA-01, -02 and -03	7
RCA	4
NPA	15
SPA	11
DCA	4

5.2.4 Sample Size Determination

NUREG-1757, Volume 2, Appendix A, describes the process for determining the number of survey measurements/samples necessary to ensure a data set sufficient for statistical analysis. The sample size is based on the relative shift, the Type I and II errors, the standard deviation, and the specific statistical test used to evaluate the data.

5.2.4.1 Relative Shift

The relative shift (Δ/σ) is calculated. Delta (Δ) equals the $DCGL_w$ minus the Lower Boundary of the Gray Region (LBGR). When preliminary data are unavailable, NUREG-1575 states that assuming a coefficient of variation value of 0.30 may be reasonable. The sigma values used for the relative shift calculation may be recalculated based on the most current data from actual radiological conditions or post-demolition surveys. The LBGR is initially set at 0.5 times the DCGL but may be adjusted to obtain an optimal value for the relative shift, normally between 1 and 3.

Lower Boundary of the Gray Region

The LBGR is the point at which the Type II (β) error applies. During the DQO process, the LBGR is selected to be one-half the $DCGL_w$ as an arbitrary starting point for developing an acceptable survey design. The LBGR will be adjusted later in the optimization process to the mean concentration in the Survey Unit as determined during characterization or remedial action. 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 are used as the minimum sample size (i.e., the number of samples). If the minimum sample size results in a sample population density less than the required minimum population density, the sample size is increased accordingly. The Upper Bound of the Gray Region is set at the applicable DCGL or 1 if the unity rule is invoked for multiple radionuclides or media. Additionally, the UBGR is the $DCGL_{OP}$ for the sampled media (i.e., DCGL less any adjustment for insignificant contributors).

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. Using the sigma

values from the characterization data is conservative for the sample size determination since the post-remediation sigma values are expected to be smaller.

5.2.4.2 Establishing Decision Errors

The probability of making decision errors is controlled by hypothesis testing. The survey results are used to select between one condition of the environment (the null hypothesis) or an alternate condition (the alternative hypothesis). The 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.

OCNGS will use the Null Hypothesis concept to design all final status surveys.

A Type I decision error would result in releasing 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.

5.2.4.3 Determining Which Statistical Test Will Be Used

Appropriate tests are used for the statistical evaluation of survey data. At OCNGS, the Sign Test will normally be used to evaluate the survey data statistically for soil and the Sign Test and/or WRS for building surfaces. The Sign Test will be implemented using the unity rule, surrogate methodologies, or combinations described in MARSSIM and Chapters 11 and 12 of NUREG-1505.

The Sign Test is the most appropriate test for soil FSS at OCNGS, as background is expected to constitute a small fraction of the $DCGL_w$ based on the results of characterization surveys. Consequently, the Sign Test will be applied when demonstrating compliance with the unrestricted release criterion without subtracting background (other than ambient background for buildings and piping as discussed in Section 5.2.6).

5.2.4.4 Wilcoxon Rank Sum Test Sample Size

For the Wilcoxon Rank Sum (WRS) Test, the number of data points, N, to be obtained from each reference area or survey unit is determined using Table 5-3 in MARSSIM. This table includes the recommended 20 percent adjustment to ensure an adequate sample size.

5.2.4.5 Sign Test Sample Size

Table 5-5 in MARSSIM determines the number of data points for applying the Sign Test. This table includes the recommended 20 percent adjustment to ensure an adequate sample size.

5.2.4.6 Sample Size Adjustment

If the Scan Minimum Detectible Concentration (MDC) is greater than the $DCGL_{EMC}$, the sample size is calculated in accordance with MARSSIM guidance (i.e., section 5.5.2.4 in NUREG 1575). The MDC of the scan procedure—needed to detect an area of elevated activity at the limit determined by the area factor—is calculated as follows:

$$Scan\ MDC\ (Required) = DCGL_W \times (Area\ Factor) \qquad \textbf{Equation 5 - 1}$$

If the actual scan MDC is less than the required scan MDC, no additional sampling points are necessary to assess small areas of elevated activity. In other words, the scanning technique exhibits adequate sensitivity to detect small areas of elevated activity. If the actual scan MDC is greater than the required scan MDC (i.e., the available scan sensitivity is not sufficient to detect small areas of elevated activity), then it is necessary to calculate the area factor that corresponds to the actual scan MDC:

$$Area\ Factor = \frac{Scan\ MDC\ (Actual)}{DCGL} \qquad \textbf{Equation 5 - 2}$$

The size of the area of elevated activity (in m^2) that corresponds to this area factor is then obtained from Table 5-13 or Table 5-14. The data needed for assessing small areas of elevated activity can then be determined by dividing the area of elevated activity into the survey unit area. The calculated number of survey locations, n_{EA}, determines a revised spacing, L, of the systematic pattern. Specifically, the spacing, L, of the pattern (driven by the areas of elevated activity) is given by the equation in 5.2.4.7. If the number of data points required to identify areas of elevated activity (n_{EA}) is greater than the number of data points calculated using Equation 5-1 or 5-2 of MARSSIM, L should be calculated using the equation in 5.2.4.7. This value of L is then used to determine the measurement locations. The statistical tests are performed using this larger number of data points.

5.2.4.7 Measurement Locations

Measurement locations within the survey unit are identified and documented for reproducibility. Tags, labels, flags, stakes, paint marks, geo-positioning units, or photographic records identify actual measurement locations. 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 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 5-3 (i.e., MARSSIM Equation 5-5) for a triangular grid:

$$L = \sqrt{\frac{A}{0.866 n_{EA}}} \qquad \textbf{Equation 5 - 3}$$

Where:

A = Area of the survey unit
n_{EA} = Calculated number of survey locations

A row of points is identified at the random starting coordinate, 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 FSS Supervisor, FSS Engineer, or designee.

5.2.5 Reference Coordinate Systems

5.2.5.1 Reference Coordinate System for Open Land Areas

A reference coordinate system is used for impacted areas to identify sample points within the survey unit. The reference coordinate system is an X-Y plot of the site area referenced by utilization of a Global Positioning System (GPS) referenced to the New Jersey State Plane Coordinate System, NAD83. Elevations are in North American Vertical Datum (NAVD) 88. Once the reference points are established, grids may be overlaid parallel to lines of latitude and longitude.

5.2.5.2 Reference Coordinate System for Building Surfaces

A reference coordinate system (X-Y plot of the survey unit referenced to a local origin) is used for the FSS of impacted above-ground buildings and blow-grade basements to identify sample points within the survey unit.

5.2.6 Background Reference Area

Background reference area measurements are required when the WRS Test is used, and paired observations may be used with the Sign Test in accordance with NUREG-1505 Section 12.3. Reference area measurements are collected using the same survey instruments and procedures used in impacted areas if needed. However, the sample/measurement locations in background areas are selected based on a random selection process. Reference areas at OCNGS apply to building surfaces. Reference areas will not be considered for soils because the soils in the entire site have been modified by soil-disturbing construction activities.

Paired observations are used when the ambient background impairs the collection of surface measurements. Protocols for collecting ambient background measurements are established during FSS planning. The detector must be positioned at a distance or have sufficient attenuation from the surface to prevent beta particles from reaching it. At this specific location, the background radiation will come only from ambient gamma radiation and will be

a part of the overall surface measurements. The average background measured at this location is considered a conservative estimate, supported by the expectation that it will be lower than the background specific to the material in the area.

If paired observation is performed, the sigma value used accounts for the variability of the material background.

5.2.7 Application of DCGL Values

5.2.7.1 Direct Comparisons

Measurement results are converted to comparable units for direct comparisons with the DCGL values listed in Table 5-3.

5.2.7.2 Multiple Radionuclide Evaluations

The Cs-137 to Co-60 (or other gamma nuclide) ratio will vary in the final survey soil samples, and this is 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 Equation 5-4.

$$Unity\ Rule\ Equivalent\ 1 \leq \frac{Cs-137}{DCGL_{Cs-137s}} + \frac{Co-60}{DCGL_{Co-60}} + \cdots + \frac{R_n}{DCGL_n} \qquad \textbf{Equation 5-4}$$

Where:

Cs-137 and Co-60 are the gamma results
$DCGL_{Cs\text{-}137s}$ = the surrogate Cs-137, DCGL, as applicable
$DCGL_{Co\text{-}60}$ = the Co-60 DCGL
R_n = any other identified gamma-emitting radionuclide
$DCGL_n$ = the DCGL for radionuclide N

The unity rule equivalent results are used to demonstrate compliance, assuming the DCGL is equal to 1.0 using the criteria listed in Table 5-16 and Table 5-17. If the WRS or Sign Test is necessary, these tests are applied using the unity rule equivalent results and assuming that the DCGL equals 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 or paired observation were used with the Sign Test, background concentrations would also be converted to Unity Rule Equivalents before performing the test). The Sign Test may be used to directly compare the Cs-137 concentration in the survey unit to the DCGL when background Cs-137 in soils is not considered a significant fraction of the DCGL.

Note that the surrogate Cs-137 DCGL is used for both the statistical tests and comparisons with the criteria in Table 5-16 and Table 5-17. The same general surrogate and unity rule methods described previously for soil would be applied to other materials, such as activated concrete, where sample gamma spectroscopy is used for the final survey instead of gross beta measurements.

5.2.7.3 Deselection of Insignificant Contributing Radionuclides

The guidance in NUREG-1757, Vol. 2, Section 3.3, states, “It is reasonable that radionuclides or pathways that are insignificant contributors to dose may be eliminated from further detailed

consideration." The guidance further states, "NRC staff considers radionuclides and exposure pathways that contribute no greater than 10 percent of the dose criteria to be insignificant contributors." Because the dose criteria are performance criteria, this 10 percent limit for insignificant contributors is an aggregate limitation only. The sum of the dose contributions from all radionuclides and individual scenario pathways considered insignificant should be no greater than 10 percent of the dose criteria. No limitation on either single radionuclides or pathways is necessary.

However, once it has been demonstrated that radionuclides or exposure pathways are insignificant, then (a) the dose from the insignificant contributors and pathways must be accounted for in demonstrating compliance, but (b) the insignificant contributors and pathways may be eliminated from further detailed evaluations. Therefore, it is necessary to calculate the potential dose from undetected radionuclides and compare the aggregate potential dose to ensure that it does not exceed 10% of the dose limit (i.e., 2.5 mrem/year TEDE).

Derivation of a site-specific suite of radionuclides potentially present at OCNGS is discussed in Chapter 6, *Compliance with the Radiological Criteria for License Termination*, of the OCNGS LTP. This suite of potential radionuclides contains a total of 21 radionuclides. Site characterization data show that the Hard-to-Detect (HTD) nuclides in the suite are consistently below or slightly above the MDC in laboratory results, which supports classifying them as insignificant. Negative values were not considered when evaluating radionuclide fractions used as input to insignificant contributor determinations.

Five soil samples from the OCNGS Radiologically Controlled Area (RCA), where the residual plant radioactivity was greatest during the Phase 1 site characterization, were collected and sent off-site for analysis of HTD nuclides. Except for Sr-90, the analytical results showed that the concentrations of all other HTD nuclides were below their respective MDC values in all samples. The HTD nuclide values were set at the maximum of the MDC values, except for Sr-90, which was set at the identified analysis value and then compared to the OCNGS Industrial Use (IU) DCGLs discussed in the OCNGS LTP Chapter 6.

Details of the selection and dose assessment process are provided in OCNGS Technical Basis Document No. 24-01-12-2888 Revision 0 "*Dose Contribution from Insignificant Radionuclides in the Oyster Creek Site-Specific Suite of Radiological Nuclides*."

To ensure that HTDs are verified as insignificant contributors throughout the decommissioning process, at least 5% of the samples for soil, concrete, and groundwater media collected will be analyzed for the full suite of ROCs.

5.2.7.4 Surrogate Ratio DCGLs

If necessary, surrogate ratio DCGLs may be developed and applied to land areas and materials with surficial or volumetric residual radioactivity where, through the DQO process, consistent radionuclide concentration ratios can be demonstrated to exist. They should be derived using post-remediation site characterization data collected before the FSS. The established ratio among the radionuclide concentrations allows the concentration of selected radionuclides to be expressed in terms of one of them. Likewise, a surrogate ratio DCGL may allow the DCGLs specific to 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. A surrogate radionuclide used in any survey area or unit should be established through the DQO process.

Measurements from different media types may not be mixed to derive the ratio. The conservative test for using a surrogate would be a conservative ratio for the initial DCGL tests (i.e., meets acceptance criteria or warrants further investigation). However, the mean ratio may be a more accurate assay of the dose from the overall survey unit. Once an appropriate surrogate ratio is determined, the DCGL of the measured radionuclide is modified to account for the represented radionuclide according to Equation 5-5 (MARSSIM Equation 4-1).

$$DCGL_{SR} = DCGL_{SUR} \times \frac{DCGL_{REP}}{[(C_{REP} \div C_{SUR})(DCGL_{SUR})] + DCGL_{REP}} \qquad \textbf{Equation 5 - 5}$$

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
C_{SUR} = Concentration of surrogate radionuclide

The following process will be applied to assess the need to use surrogate ratios for final status surveys:

- Based on process knowledge and historical data or characterization, determine whether HTD radionuclides (e.g., TRU, Sr-90, H-3) will likely be present in the survey unit.
- When HTD radionuclides are expected to be present, it is crucial to establish a relationship using a representative number of samples determined through the DQO process. The samples may come from another survey unit if the source of the contamination and expected concentrations can be established to be reasonably the same. These samples will be analyzed for Easy-To-Detect (ETD) and HTD radionuclides using gamma spectroscopy and radiochemistry techniques (gross alpha, beta, liquid scintillation, and alpha spectroscopy analysis as required).

Physical or chemical differences between the radionuclides may produce different migration rates, causing the radionuclides to separate and changing the radionuclide ratios. Remediation activities have a reasonable potential to alter the surrogate ratio established before remediation. Thus, post-remediation samples should be included to ensure that the data used to establish the ratio are appropriate and representative of the existing site condition for the FSS.

- When surrogate relationships are applied, the DQA of the FSS samples shall also review the validity of the surrogate relationship. FSS samples are held in storage on-site until the survey unit is approved for release by the NRC.
- An Insignificant Contributor dose contribution of 0.075 mrem/y from the soil will be added to the FSS survey unit total dose, as provided in OCNGS Technical Basis Document No. 24-01-12-2888 Revision 0 "*Dose Contribution from Insignificant Radionuclides in the Oyster Creek Site-Specific Suite of Radiological Nuclides*."
- If additional information regarding the presence of insignificant radionuclides becomes available during remediation activities or FSS, the potential dose contribution/analysis frequency will be reevaluated and adjusted as appropriate.

- Gross activity DCGLs outlined below will be developed for gross alpha and gross beta measurements on building surfaces. A conservative mix of alpha and beta radionuclides will be used for the measurements.

FSS samples will be held in storage to reconfirm HTD ratios when required.

5.2.7.5 Gross Activity DCGLs

As a rule, gross activity DCGLs ($DCGL_{GA}$) 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 $DCGL_{GA}$ is determined in a manner similar to surrogate DCGLs and considers nuclide detectability to enable field measurement of gross activity rather than the determination of individual radionuclide activity. The $DCGL_{GA}$ value for surfaces with multiple radionuclides is calculated using the following Equation 5-6 (MARSSIM, Equation 4-4):

$$DCGL_{GA} = \frac{1}{\frac{f_1}{DCGL_1} + \frac{f_2}{DCGL_2} + \cdots \frac{f_n}{DCGL_n}} \qquad \textbf{Equation } 5-6$$

Where:

f_n= fraction of the total activity contributed by radionuclide n
$DCGL_n$ = 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 $DCGL_{GA}$. $DCGL_{GA}$ values are calculated using the relative nuclide fractions determined from samples of building surface or plant system material, as appropriate, before remediation. The most conservative distribution resulting in the lowest DCGL will be used for areas where the radionuclide distribution has not been determined. The distributions are based on the radionuclides identified in samples collected from the specific areas before FSS. If new radionuclide distribution data are obtained and determined to be more appropriate for use, i.e., determined to be more conservative, the $DCGL_{GA}$ will be reevaluated and altered during the FSS; however, the single nuclide DCGLs will not be revised without NRC approval. If the reevaluated DCGLs affect previously FSS areas, then those areas will be reassessed to determine if the new DCGLs affect the compliance decision. Details of the development of the $DCGL_{GA}$ are provided in TSD 24-062 *OCNGS Structure Nuclide Fractions and Gross Activity DCGLs ($DCGL_{GA}$)*.

5.2.7.6 Operational DCGLs ($DCGL_{OP}$)

The $DCGL_{OP}$ is used for the FSS design of a survey unit (calculation of surrogate DCGLs, investigation levels, etc.). At OCNGS, compliance is demonstrated through the dose summation from various distinct media in the end-state (basement floor/walls, basement embedded pipe, basement fill, above-ground buildings, soils, buried pipe). When applied to backfilled basement floor/walls, embedded pipe, and penetrations, the DCGLs are expressed in units of activity per unit of area (pCi/m^2). When applied to soil and basement fill, the DCGLs are expressed in units of activity per unit of mass (pCi/g). For buried piping and above-ground buildings, DCGLs are calculated and expressed in units of activity per surface area ($dpm/100\ cm^2$).

The dose contribution from each ROC in each media is accounted for using the Sum of Fraction (SOF) method. The SOF is calculated for each media using the $DCGL_{OP}$ adjusted for the

insignificant contributor dose. A $DCGL_{OP}$ established for the average residual radioactivity in a survey unit is equivalent to a $DCGL_w$. For soils, the $DCGL_w$ can be multiplied by AFs to obtain a $DCGL_{OP}$ representing the same dose to an individual for residual radioactivity over a smaller area within a survey unit. The scaled value is defined as the $DCGL_{EMC}$. The $DCGL_{EMC}$ will only be applied to Class 1 open land (soil) survey units.

The reduced DCGLs, or $DCGL_{OP}$ will be calculated and included in the Survey Unit-Specific FSS Plans using the following Equation:

$$DCGLOP\ m,i\ = DCGLm,iFa\ priori,m \qquad \textbf{Equation } 5-7$$

Where:

$DCGL_{OP}$ = Operational DCGL for media *m* and radionuclide *i*
$DCGL_{m,i}$ = DCGL for media *m* and radionuclide *i*
F*a priori,,m*= *a priori* dose fraction for media *m*

Dose fractions used in developing operational decontamination/remediation objectives will be documented in radiological survey plans supporting the decontamination/remediation actions. After decontamination/remediation activities are completed, *a priori* dose fractions may be re-evaluated and revised for application in FSS activities. Dose fractions applied during FSS will be documented in Survey Unit FSS Plans.

5.2.7.7 Elevated Measurement Comparison Evaluations

During final surveys, areas of elevated activity may be detected, and they must be evaluated 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, the elevated areas are combined and evaluated under the unity rule.

The average activity of each elevated area and the average value for the survey unit are determined. 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 5-8.

$$\frac{\delta}{DCGL} + \frac{\bar{C}_{elevated} - \delta}{(Area\ Factor) \times DCGL} < 1 \qquad \textbf{Equation } 5-8$$

Where:

δ = average concentration outside the elevated area
$\bar{C}_{elevated}$ = average concentration in the elevated area
A separate term will be used for each elevated area identified in a survey unit.

5.3 Survey Measurement Methods

Survey measurements and sample collection are performed by personnel trained and qualified in accordance with the applicable OCNGS procedures. The techniques for performing survey measurements or collecting samples are specified in approved OCNGS 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, OCNGS will give NRC 30 days' notice to provide an opportunity to review the associated technical support document (TSD) provided on the Advanced Survey Technology(s).

The TSD for the "*Application of In Situ Object Counting System (ISOCS) and Advanced Radiological Survey Instruments at Oyster Cre*ek" describes the equipment, limitations on use, calibration, precision and accuracy criteria, and operational and performance check protocols.

Onsite and offsite laboratory facilities are used for gamma spectroscopy, liquid scintillation, and gas proportional counting in accordance with applicable procedures. Approved off-site facilities, as required by Section 5.10, are used as necessary. No matter which facilities are used, analytical methods will be administratively established to detect MDC levels of radioactivity at 10 percent to 50 percent of the DCGL value.

5.3.1 Scan Surveys

Scanning is performed 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 5-7. The measurements are typically performed as close to the surface as practical and at a nominal scan speed of 5 cm/sec for hand-held instruments. Scan speed adjustments may be made per the approved survey unit FSS plan.

Scan surveys and sampling are used as needed to confirm the effectiveness of radiological remediation of soil and structural surfaces. Scan instrumentation selection and scan speed are adjusted appropriately to detect elevated activity at approximately 50% of the area's DCGL.

5.3.1.1 Soil Scan Surveys

Soils in open land areas are scanned for gamma-emitting nuclides. The gamma scan indicates the presence of elevated activity that, if sampled, may identify licensed material. If the licensed material concentrations approach an investigation threshold, surrogate ratios may be applied, or further analysis for HTDs may ensue. Sodium iodide detectors are typically used for scanning. For detectors such as the Ludlum 44-10, the detector is held within 2.5 to 7.5 cm off the ground surface and is moved at a speed of 0.5 m/sec or less while traversing each square meter three times. The area covered by scan measurements is based on the survey unit classification, as described in Section 5.3.1 of this LTP provides more details on open land area scans.

5.3.1.2 Building Surface Scan Surveys

The surfaces of standing structures will be scanned for beta and gamma radiation with appropriate instruments, such as those listed in Table 5-7. Scan measurements will be performed at a distance of ½ inches or less from the surface and at a scan speed applicable to the instrument and background to be determined through the survey unit sample planning DQO process. Audible and visual signals will be monitored.

5.3.1.3 Scan Survey Coverage

The area covered by scan measurement is based on the survey unit classification described in NUREG-1757 and as shown in Table 5-6. The accessible area scan required of Class 1 survey units is 100 percent. For Class 2 survey units, the emphasis is placed on scanning the higher-risk

areas such as soils, floors, and lower walls. Scan percentage of Class 3 survey units is performed based on the professional judgment of the FSS Engineer.

Table 5-6 Scan Survey Coverage Requirements

	Class 1	Class 2	Class 3
Scan Coverage	100%	10-100 %*	Judgmental

* 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, the site will use historical information and the results of individual measurements collected during characterization to correlate this activity potential to scan coverage levels.

5.3.2 Direct Measurements for Structures

Direct measurements are performed to detect surface activity levels. They are conducted by placing the detector on or near the surface to be counted and acquiring data over a predetermined count time. A count time of one minute is typically used for surface measurements and generally provides detection levels well below the DCGL (the count time may be varied provided the required detection level is achieved).

Structures remaining on-site receive scan surveys, direct measurements, and, when necessary, volumetric sampling. Volumetric sampling is necessary to support an investigation of elevated measurements.

5.3.3 Volumetric Measurements

5.3.3.1 Volumetric Concrete Sampling

Volumetric sampling of contaminated concrete, instead of direct measurements, may be necessary if the efficiency or uncertainty of the gross beta measurements is too high (i.e., greater than three sigma). Volumetric sampling on standing concrete structures is not anticipated unless it is to support remedial action activities.

The surface layer is removed from the known area using a commercial stripping agent (coated surfaces) or physically abrading the surface. The removed coating material is analyzed for activity content, and the level is converted to appropriate units (i.e., dpm/100 cm^2) to compare with surface activity DCGLs. Note: This process does not apply to areas of activated concrete. Activated concrete will be removed and dispositioned as radioactive waste. Direct measurements or additional surface sampling can then be performed on the underlying surface after removal of the coating to determine removal effectiveness.

Activated concrete will be removed and shipped to a suitable burial site.

5.3.3.2 Volumetric Soil Sampling

Volumetric samples are taken at designated locations. Surface soil samples are normally taken at 0 to 15cm depth. Samples are collected and prepared in accordance with approved procedures. The surface soil sampling is done to a depth of 15cm. In the case of asphalt-covered soils, soils below the covering are also sampled to a depth of up to 15cm to assess that constituent of soils. In an excavation or remediated area, the “new surface” soils at the bottom or walls of the excavation are assessed. The RESRAD assumption is that the observed soil concentration exists

to a depth of 3m to avoid a less conservative DCGL for "at depth" ROCs attenuated by overburden and simplify the acceptance criteria determination. The 3m assumption effectively maximizes the potential source term in RESRAD.

Soil materials are analyzed by gamma spectroscopy. Soil samples of approximately 1,500g are normally collected from the surface layer (top 15cm). 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 FSS Quality Assurance Project Plan (QAPP). If a survey area has already been excavated and remediated to the soil DCGL, this area is treated as surface soil, and the FSS will be performed on the excavated area. Volumetric soil samples for Characterization, Remedial Action, and FSS will be collected at the surface of the excavation area and treated as surface soils.

The conservative statistical MARSSIM approach for surficial soils may face limitations due to the potential for waste to migrate along lineations to subsurface locations, necessitating a more comprehensive investigation considering these pathways. Areas with subsurface activities that challenge meeting release criteria will necessitate remedial action.

5.3.3.3 Excavations

Over the course of the decommissioning project at OCNGS, there are instances where deep excavations are made. These are necessary to remove radiologically contaminated soils, clean and contaminated foundations, and underground utilities. All soil excavations will undergo an FSS before backfilling. The FSS of the excavation will be designed as an open land area surface survey. Soil samples will be collected to a depth of 15cm. NaI or ISOCS will be used to scan exposed soils for elevated areas of residual radioactivity. The data from the survey will provide confidence that the excavation meets unrestricted release criteria.

Due to the instability of the soils, shoring or trench boxes may be required for personnel access to ensure the safety of personnel entering the excavation. The shoring and/or trench boxes may prevent the survey. To safely assess the residual activity in areas where shoring or trench boxes limit scanning, sidewall soils are evaluated through a combination of methods: removing and testing soils from within the trench, testing soils attached to the exterior of the shoring or trench boxes as they are removed, or conducting specific depth sampling of soils behind the shoring on a case-by-case basis. NRC will be notified of an excavation before FSS

5.4 Specific Survey Area Considerations

5.4.1 Pavement-Covered Areas and Shallow Concrete Slabs

Surveys of paved areas are required along the roadways, providing ingress and egress to OCNGS. The survey design of paved/concrete areas is based on soil survey unit sizes since they are outdoor areas where the exposure scenario is most likely direct radiation from surface soil. The applicable DCGL is the soil DCGL. Scan and static gamma and beta-gamma surveys are determined by the survey unit design. Samples are obtained not only of the asphalt/concrete but also of the soil present under the asphalt/concrete. Paved areas may be separate survey units or incorporated into surveys of adjacent open land areas of like classification.

No contaminated shallow concrete slabs will remain at license termination. Any shallow concrete slab remaining at license termination, including slabs constructed after shutdown, will be unconditionally released. The remaining subsurface slabs are assessed via the basement fill model DCGLs. The dose for insignificant contributors is addressed in the TBD. No. 24-01-12-2888 Revision 0 "Dose Contribution from Insignificant Radionuclides in the Oyster Creek Site-Specific Suite of Radiological Nuclides."

5.4.2 Bulk Materials

Controls are instituted to prevent the mixing of soils from different survey areas before evaluation. Soils satisfying the criteria for unrestricted release will be stockpiled for use as onsite backfill material. Soils surveyed under 5.3.3 above may be stockpiled for later use with proper controls to prevent recontamination. 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. Should Class 1 material enter a Class 2 or 3 area, that area will become a Class 1 area and be surveyed in accordance with Class 1 requirements. The radiological evaluation of soils resulting from minor trenching and digging efforts in Class 3 defined areas (no reasonable potential for subsurface contamination) will be performed by characterization survey in accordance with site procedures. Excavated soils demonstrating residual radioactivity consistent with Class 3 status are released for onsite excavation backfill.

Soil stockpiles at OCNGS are permitted under Ocean County Soil Erosion and Sediment Control Permit #22499A and site stormwater procedures and best management practices), establishing standards for soil erosion and sediment control.

5.4.3 Embedded Piping and Buried Piping

Embedded and buried piping may remain after decommissioning OCNGS. Separate FSS survey plans are developed for embedded/buried piping, which includes survey unit DQOs. These FSS plans include the following items:

- 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

The residual radioactivity remaining in each section of embedded piping/penetration applicable to each FSS unit is assessed and quantified by direct survey. Shallow penetrations or short lengths of embedded pipe that are directly accessible are surveyed using hand-held portable detectors, such as a gas-flow proportional or scintillation detector. Lengths of embedded pipe or penetrations that cannot be directly accessed by hand-held portable detectors are surveyed using applicable-sized Sodium Iodide (NaI) or Cesium Iodide (CsI) detectors that are inserted and transported through the pipe using flexible fiber composite rods, robots, or equivalent. The detectors used to survey the pipe/sleeve interior surfaces are maneuvered through the pipe/sleeve

by robotics or by manipulating fiber-composite rods, which are manually pushed or pulled to provide locomotion. The detectors are deployed into the pipe/sleeve, and measurements are acquired at specified distance intervals. This distance is determined as a DQO based on the contamination potential in the pipe/sleeve. As an example, based upon a conservative "area of detection" for the detectors used, a measurement interval of one measurement for each foot of pipe conservatively provides 100% areal coverage of accessible pipe/sleeve interior surfaces.

The survey of buried pipe is achieved in the same manner as the survey of embedded pipe, as discussed above. The radiological survey of pipe system interiors involves the insertion of appropriately sized detectors into the pipe interior by a simple "push-pull" methodology or robotics, whereby the position of the detector in the piping system can be easily determined in a reproducible manner. The detectors are configured in a fixed geometry relative to the surveyed surface, thus creating a situation where a defensible efficiency can be calculated. The detectors are then deployed into the actual pipe, and timed measurements are acquired at intervals commensurate with the contamination potential of the pipe. A conservative "area of detection" is assumed for each pipe size. It is also conservatively assumed that any activity is uniformly distributed in the area of detection.

Accessible internal surfaces are surveyed in the same way as other structural surfaces. Scale and sediment samples are obtained, if appropriate, as well as smears and wipes to assist in identifying the total radionuclide deposits within the piping. Embedded piping DCGLs are developed, and survey results are compared to these DCGLs. Dose contributions from these embedded/buried piping will be included in the survey unit release evaluation (Table 5-3 contains DCGLs for embedded and buried pipe). Some buried piping, storm drains, sewer systems, plumbing, and floor drains may be unconditionally free released. The remaining embedded and buried piping is grouted after surveying unless it is to be used as an active system (e.g., drainage piping).

5.4.4 Cracks, Crevices, Wall-to-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 the background, these surface blemishes may be assumed to have the same residual activity as that found on adjacent surfaces. The accessible surfaces are surveyed like 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 are collected. Radionuclide-specific analysis, coupled with applying the unity rule, may be an alternative method. Volumetric samples analyzed by gamma spectroscopy detect the presence of radioactivity below the surface. Typically, such sampling is performed following the removal of paint and other surface coatings during remediation. After analysis, the data may be converted to equivalent surface activity.

5.4.5 Paint Covered Surfaces

No special consideration is given to wall or ceiling areas painted before plant startup and not subjected to repeated exposure to materials that would have penetrated the painted surface. Any painted surfaces to mitigate the spread of contamination must be evaluated for adjustments in

survey instrument efficiency, or the painted surface must be removed prior to the survey. If the thickness of the coating can be determined with certainty, then a source efficiency correction may be applied to the measurement as described in NUREG-1507.

5.4.6 Exterior Surfaces of Building Foundations

Exterior surfaces of below-grade foundations are evaluated using the historical site assessment and other pertinent records to determine the potential for sub-surface contamination on the exterior surfaces of below-grade foundations. One method available to evaluate the exterior surfaces is using core bores through the foundation or walls and taking soil samples at locations with a high potential for accumulating and migrating radioactive contamination to sub-surface soils. These biased soil and concrete assessment locations could include stress cracks, floor wall interfaces, penetrations through walls and floors for piping, run-off from exterior walls, leaks or spills in adjacent outside areas, etc. If the soil is found to be free of residual radioactivity at the biased locations, it is assumed that the exterior surface of the foundation is also free of residual activity. Otherwise, additional sampling may be necessary to determine the extent of decontamination and remediation efforts. Soil in biased locations next to the exterior of the buildings may be evaluated using this technique. This technique can provide for rapid isotopic analysis of soils without sampling. Sampling of soils below structures or adjacent to structures would be compared with the surface soil DCGLs for final compliance assessment.

5.5 Suspected Discreet Radioactive Particle Areas

Discrete Radioactive Particles (DRPs) are tiny, concentrated specks of radioactive material. They can be activated products, such as cobalt-60 and Europium-152/154, or minute fragments of irradiated fuel, each with significant radioactivity levels, often around 100,000 disintegrations per minute (dpm) or higher, necessitating detailed detection and management protocols. Although extensive controls are utilized to prevent the spread of contamination during decommissioning, previous decommissioning projects have had issues with DRPs migrating to soil areas. This section provides guidance should DRPs be discovered during decommissioning. The approach outlined below is derived from past decommissioning projects and regulatory guidance concerning DRPs contained within NRC IN 2024-01. Special survey techniques and actions must be considered in open land (soil) survey units where DRPs are suspected. DQOs will be developed to address instrument sensitivity requirements, increased sample densities, and DRP-focused survey methodologies. Soil scan speeds will be decreased from one-half meter/second to a maximum of one-quarter meter/second. A soil sample will be obtained if an alarm is verified by re-scan. The void space created by the sample will be surveyed to ensure the source of activity was removed after taking the sample. The remaining soils will be investigated if elevated readings are still encountered to isolate and capture the potential DRP. If radioactivity levels remain constant during the investigation, then sample analyses or a portable gamma spectroscopy system may be used to identify the source of radioactivity. If the investigations do not identify plant-related derived radionuclides, the increased radioactivity may be deemed to originate from natural radioisotopes, and the investigation may cease.

In the laboratory, the characteristics of the DRP are ascertained and documented (e.g., dimensions, weight, material composition, appearance, activity levels). The information gathered in the laboratory will be documented in the OCNGS Corrective Action Program. DRPs are analyzed using gamma spectroscopy at the on-site laboratory, then sent to an accredited off-site laboratory and analyzed for the full suite of OCNGS radionuclides, if necessary (e.g., as part of an investigation). Upon discovery of DRPs in site soils, the NRC will be notified and kept abreast of changes to the survey methodologies for these areas.

5.6 Groundwater

Historically, assessments of residual activity in groundwater at OCNGS used groundwater monitoring wells under the groundwater monitoring program implementing NEI 07-07. The NEI 07-07 well network has been modified to accommodate decommissioning. OCNGS LTP Chapter 2 describes the existing groundwater monitoring program. Additional wells may be incorporated to support the program as decommissioning proceeds.

OCNGS will continue the monitoring program until it is deemed necessary to close these wells to prevent potential contamination of the groundwater or until soil disturbing activities are complete. The data obtained from the groundwater monitoring network is utilized to calculate a groundwater dose.

Positive detectable concentrations (i.e., above the achieved MDA value for the analysis), conservative values for determining the annual intake of contaminated material in aquatic foods, and ingestion dose conversion factors from FGR 11 are used to determine a dose from groundwater. Groundwater dose focuses on the aquatic food ingestion exposure because under the IU scenario, the aquatic food ingestion pathway is the only pathway opened for doses from site groundwater.

The dose for groundwater from an ROC is calculated using the following equations:

$$Dgw,i = (Faf)(Caf)(FTFi)(GWi)(DCFi) \qquad \textbf{Equation } 5-9$$

Where:

$D_{gw,i}$ = Dose for ROC "i" via ingestion of aquatic food, mrem/y
F_{af} = Fraction of contaminated aquatic food, 0.609, unitless (from Table 6-28 in Chapter 6)
C_{af} = Fish and other aquatic food consumption, 21.5 kg/y (from Table 6-28 in Chapter 6)
FTF_i = Fish transfer (bioaccumulation) factor for ROC "i", pCi/kg per pCi/L (from Table 6-28 in Chapter 6)
GW_i = Detectable groundwater concentration of ROC "i", pCi/L

DCF_i = Ingestion DCF for ROC "i", mrem/pCi (from FGR 11, Table 2.2)

If laboratory analyses show no positive results for a given ROC, the dose assigned to the ROC is zero. The calculated dose is believed to be a conservative estimate for the aquatic food dose because of conservatism in values F_{af} and $FTF_{i,}$ and the measured groundwater concentration is assumed constant over an exposure period of 1 year.

As described in Chapter 6 Section 6.13 of this document, the dose contribution from groundwater is included in the calculation of the compliance dose.

5.7 Instrumentation

Radiation detection and measurement instrumentation for the FSS is selected to provide reliable operation and adequate sensitivity to detect the radionuclides identified 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, (3) and spectroscopy of soil and other bulk materials, such as concrete.

OCNGS procedures control the issuance and use of instrumentation. Records supporting the instrumentation program are maintained in accordance with OCNGS procedures.

5.7.1 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 can detect the radiation of concern below the applicable DCGL. MDCs of less than 50 percent of the DCGL allow the 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 detect radioactive material at the $DCGL_{EMC}$. The instrumentation currently proposed for use in the OCNGS FSS is listed in Table 5-7. Instrument MDCs are discussed in Section 5.7.7, and nominal MDC values are listed in Table 5-8. Other measurement instruments or techniques may be used. 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 30 days before use. An instrument technical analysis includes 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 5-8
- Demonstration that the instrument provides sufficient sensitivity for measurement below the release criteria with Type I error equivalent to 5 percent or less.

Table 5-7 Typical FSS Instrumentation

Measurement Type	Detector Type	Effective Detector Area and Window	Instrument Model	Detector Model
Alpha Scan	Gas-flow Proportional	126 cm^2 0.8 mg/cm^2 Aluminized Mylar	Ludlum 3003	Ludlum 43-68
Alpha Scan	ZnS (Ag) Scintillation	88 cm^2 1.2 mg/cm^2 Metalized Polyester	Ludlum 3002	Ludlum 43-93

Measurement Type	Detector Type	Effective Detector Area and Window	Instrument Model	Detector Model
Beta-gamma static and scan	Gas-flow Proportional	126 cm^2 0.8 mg/cm^2 Aluminized Mylar	Ludlum 3003	Ludlum 43-68
Beta-gamma static and scan	ZnS (Ag) Scintillation	88 cm^2 1.2 mg/cm^2 Metalized Polyester	Ludlum 3002	Ludlum 43-93
Beta-gamma scan	Gas-flow Proportional	584 cm^2 0.8 mg/cm^2 Aluminized Mylar	Ludlum 3003	Ludlum 43-37
Gamma scan	Scintillation	2in. x 2in. NaI	Ludlum 3003	Ludlum 44-10
Soil, structure surface	High purity germanium	N/A	Onsite and off-site Laboratory	N/A

Table 5-8 Typical FSS Detection Sensitivities

Detector Model	Radiation	Bkg. Count Time (min.)	Background (cpm)	Instrument Efficiency (2pi)	Count Time (min.)	Static MDC (dpm/100cm^2)	Scan MDC
Ludlum 43-68	Alpha	1	2	0.1500	5	61	N/A
Ludlum 43-93	Alpha	1	2	0.2000*	1	64	N/A
Ludlum 43-68	Beta-Gamma	1	300	0.3200	1	920	1329 dpm/100 cm^2
Ludlum 43-93	Beta-Gamma	1	300	0.1500*	1	557	1030 dpm/100 cm^2
Ludlum 43-37	Beta-Gamma	1	600	0.2800	1	320	7,267 dpm/100 cm^2
Ludlum 44-10	Gamma	1	4000	0.0350	0.04	N/A	904 ccpm
Ludlum 44-157	Gamma	1	9750	0.1000	1	900**	N/A
Ludlum 44-159	Gamma	1	750	0.0500	1	120**	N/A
Ludlum 44-162	Gamma	1	2200	0.2900	1	2300**	N/A
HPGe	Gamma	Up to 60	N/A	0.40 Relative	10-60	0.15[1]	N/A

Detector Model	Radiation	Bkg. Count Time (min.)	Background (cpm)	Instrument Efficiency (2pi)	Count Time (min.)	Static MDC (dpm/100cm^2)	Scan MDC
iMatic Low Bkg. Counter	Alpha Beta	10 10	0.01 5	0.3839 0.1129	1 1	0.30 0.22	N/A N/A

[1] Units of pCi/gm
[*] 4 pi Efficiency
[**] Units of cpm/uR/hr

5.7.2 HPGe Spectrometer Analysis

The onsite chemistry laboratory maintains gamma isotopic spectrometers calibrated to various sample geometries, including one-liter and 1.4-liter Marinelli geometries for soil analysis. These systems are calibrated following approved procedures using a NIST traceable mixed gamma source. Approved off-site laboratories may also be used to perform gamma analyses. When vendor services are used, these will be obtained in accordance with purchasing requirements for quality-related services to ensure the same level of quality. The sensitivity goal for offsite laboratory analyses used for FSS is sufficient (and verified) sensitivities to detect radiation levels that are 10% of the applicable measurement criterion. If the 10% goal is unobtainable, then the detection instrumentation sensitivity must possess sufficient (and verified) sensitivities to detect radiation levels that are at least 50% below the applicable acceptance criteria.

The following table provides the offsite laboratory analyses, techniques, and their typical MDCs:

Table 5- 9 Offsite Laboratory Methods and Typical MDCs

Nuclide(s)	Technique	Method	Typical MDC (pCi/g)
ETD (Gamma)	Gamma Spectroscopy	DOE HASL,300, 4.5.2.3/Ga-01-R	0.1
H-3	Liquid Scintillation	EPA 906.0 Modified	6.0
C-14	Liquid Scintillation	EPA EERF C-01 Modified	2.0
Fe-55	Liquid Scintillation	DOE RESL Fe-1 Modified	5.0
Ni-59	Low Energy Gamma Spectroscopy	DOE RESL Ni-1	10
Sr-90	Gas Flow Proportional	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	2.0
Tc-99	Liquid Scintillation	DOE EML HASL-300, Tc-02-RC Modified	5.0
Np-237	Alpha Spectroscopy	ASTM C 1475-00 Modified	1.0
Pu-238	Alpha Spectroscopy	DOE EML HASL-300, Pu-11-RC Modified	1.0
Pu- 239/240	Alpha Spectroscopy	DOE EML HASL-300, Pu-11-RC Modified	1.0
Pu-241	Liquid Scintillation	DOE EML HASL-300, Pu-11-RC Modified	15
Am-241	Alpha Spectroscopy	DOE EML HASL-300,	1.0

Nuclide(s)	Technique	Method	Typical MDC (pCi/g)
		Am-05-RC Modified	
Cm- 243/244	Alpha Spectroscopy	DOE EML HASL-300, Am-05-RC Modified	1.0

5.7.3 Pipe Survey Instrumentation

Accessible portions of any remaining embedded or buried piping are evaluated and, as appropriate, physically surveyed to ensure residual activity is less than the DCGL. Pipe survey instruments selected at OCNGS are scintillation detectors and/or Geiger-Mueller (GM) arrays. These instruments have a level of sensitivity adequate to detect residual activity below the embedded or buried piping DCGLs.

Class 1 piping is surveyed at 1-foot intervals with 100 percent coverage. Inaccessible portions are made accessible by cutting access ports in the piping. In Class 2 and Class 3 piping professional judgement is used to evaluate the percentage of the pipe survey.

5.7.4 Advanced Technologies

Prior to the use of any advanced technologies (e.g., ISOCS, etc.), a TSD is developed and justifies the methodology. The TSD will be made available to the Regulator for review upon request. The TSD contains a description of the equipment, limitations on use, calibration, precision and accuracy criteria, and operational and performance check protocols.

5.7.5 Calibration and Maintenance

Instruments and detectors are calibrated for the radiation types and energies of interest at the site. Approved suppliers calibrate instruments, as necessary, that are utilized for analysis under their approved Quality Assurance Program as described in Section 5.10. The calibration source for beta survey instruments is Cs-137 because the average beta energies approximate the beta energy of the radionuclides found on surfaces at the site. The alpha calibration source is Am-241, which 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 using characterized High Purity Germanium (HPGe) detectors, approved procedures and suitable NIST-traceable sources are used for onsite calibration as applicable, and the desired geometry is set up appropriately using the software.

5.7.6 Response Checks

Instrumentation response checks are conducted to ensure proper field survey instrument response and operation. An acceptable response for field instrumentation is an instrument reading within plus or minus 20 percent of the established check source value as documented on a control chart. Response checks are performed daily before instrument use and again after use. Check sources contain the same type of radiation 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" to prevent inadvertent use. It is removed from service until the problem is corrected in accordance with applicable OCNGS procedures. Measurements between the last acceptable and failed checks are evaluated to determine if they should remain in the data set.

5.7.7 Minimum Detectable Concentration (MDC)

The MDC is determined by the instruments and techniques used for final status surveys (Table 5-8). The MDC is the concentration of radioactivity that an instrument can be expected to detect 95 percent of the time.

5.7.7.1 Static MDC for Structure Surfaces

For static (direct) surface measurements with conventional detectors, such as those listed in Table 5-8, the MDC is calculated by Equation 5-10 as follows:

$$MDC_{static} = \frac{3 + 4.65\sqrt{B}}{(K)(t)} \qquad \textbf{Equation 5 - 10}$$

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)
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.

5.7.7.2 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 are computed by Equation 5-10. For determining Scan MDCs, a rate of 95 percent of correct detections is required, and a rate of 60 percent of false positives is deemed acceptable. The 1.38 was deemed acceptable since the Site accepts using a higher probability of false detection during the 1st stage of scanning, which is conservative since it drives the surveyor to stop scanning and perform the second stage scan for a longer observation period. Therefore, Equation 5-11 becomes:

$$MDC_{structural\ surface\ scan}\left(\frac{dpm}{100\ cm^2}\right) = \frac{1.38\sqrt{B}}{\sqrt{p}\,e_i e_s \left(\frac{A}{100}\right) t} \qquad \textbf{Equation 5 - 11}$$

Where:

B = number of background counts during the count interval t
p = surveyor efficiency
e_i = instrument efficiency (2π) for the emitted radiation (cpm per dpm)
e_s = source efficiency (intensity) in emissions per disintegration
A = sensitive area of the detector (cm^2)
t = time interval of the observation while the probe passes over the source (minutes)

The numerator in Equation 5-10 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 cm2. In the case of a scan measurement, the counting interval is the time the probe is 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.

5.7.7.3 Efficiency Coefficients 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 OCNGS TBD *Instrument Efficiency Determination for Use in Minimum Detectable Concentration Calculations in Support of the Final Status Surveys at OCNGS*, Revision 0. Table 5-9 best reflects the predetermined geometry.

Table 5-10 Source to Detector Distance Effects on Instrument Efficiencies

Source to Detector Distance (in)	Instrument Efficiency (e_i)	
	Tc-99	Th-230
Contact	1	1
0.5	0.8494	0.0134
1.0	0.5975	0.0007
2.0	0.3567	6.12E-05

Source efficiency (es) reflects the physical characteristics of the surface and any surface coatings. Source efficiency is the ratio between the number of particles emerging from the surface and the total number of particles released within the source. The source efficiency accounts for attenuation and backscatter. Source efficiency (es) is nominally 0.5 (no self-absorption/attenuation, no backscatter). Backscatter increases the value, and self-absorption decreases the value. Source efficiencies may either be derived empirically or selected from the guidance of the International Organization for Standardization (ISO) 7503-1 (Reference 5-8). ISO 7503-1 takes a conservative approach by recommending factors to correct for alpha and beta self-absorption/attenuation when determining surface activity. However, this approach may be too conservative for radionuclides with max beta energies marginally lower than 0.400 MeV, such as Co-60 with a βmax of 0.318 MeV. In this situation, determining the source efficiency may be more appropriate by considering the energies of other beta-emitting radionuclides. Using this approach, it is possible to determine weighted average source efficiency. For example, assume a source efficiency of 0.375 may be calculated based on a 50/50 mix (weighted average source efficiency would be determined on a case-by-case basis when used) in this example 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 percent for each, the weighted average source efficiency for the mix may be calculated in the following manner:

$$(0.25)(0.50) + (0.50)(0.50) = 0.375 \qquad \textbf{Equation 5 – 12}$$

Table 5-11 lists the ISO 7503-1 source efficiencies.

Table 5-11 Source Efficiencies as Listed in ISO 7503-1

	>0.400 Mev_{max}	≤0.400 Mev_{max}
Beta Emitters	$e_s = 0.50$	$e_s = 0.25$

	>0.400 Mev$_{max}$	**≤0.400 Mev$_{max}$**
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 are shown in Equation 5-13.

$$e_t = (e_i)(e_s) \qquad \textbf{Equation } 5-13$$

Where:

e_t = Total efficiency
e_i = Instrument efficiency
e_s = Source efficiency

5.7.7.4 Structural Surfaces Alpha Scan MDCs

In cases where alpha scan surveys are required, MDCs must be quantified differently from 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 are 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 of around 1 to 3 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 (see MARSSIM Section 6.7.2.2 and Appendix J for details). Doing so, 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 percent 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 percent. Choosing appropriate values for surveyor efficiency, instrument, and surface efficiencies will yield MDCs for alpha surveys for structure surfaces. If lower MDCs are desired, scan speeds may be adjusted within practicable limits via Section 6.7.2.2 and Appendix J of MARSSIM.

5.7.7.5 Open Land Area Gamma Scan MDCs

The Scan MDC (in pCi/g) for land areas is based on the extent of the elevated area, depth of the elevated area, and the radionuclide (i.e., energy and yield of gamma emissions). The Scan MDC may be reduced to a function of the radionuclide, provided the detector's field of view is consistent. Evaluating open land areas requires a sufficient sensitivity detection methodology for identifying small areas of potentially elevated activity. Scan measurements are performed by passing a 2inch x 2inch 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 forward velocity of 0.5 m/sec. This serpentine scan pattern is designed to cross each survey cell (1 m^2) a minimum of three times in approximately 10 seconds with a maximum separation of less than 150 cm between passes. 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 Stage 1 and Stage 2 surface scanning process for land areas defined in NUREG-1507. It is the basis for calculating the scanning detection sensitivity to demonstrate compliance with NRC requirements. The

sensitivity is only slightly affected by the relative amounts of Cs-137 and Co-60 in the soil, giving typical Scan MDC values of 5 to 6 pCi/g for instrument backgrounds of 8,000 to 10,000 cpm. Alternative methods of sufficient sensitivity for identifying 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 can 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 can detect at specified performance levels and surveyor efficiency.

The Scan MDC value (in pCi/g) for open land area surface scanning with a desired performance level of 95 percent correct detections and 60 percent false positive rate, the sensitivity index has a value of 1.38, resulting in the following MDCR Equation 5-14:

$$MDCR = 1.38\sqrt{b_i} \times \left(\frac{60\ sec}{1\ min}\right) \qquad \textbf{Equation 5 - 14}$$

Where:

b_i = background counts in the observation interval

Introducing the human factor performance element of surveyor efficiency, the surveyor minimum detectable count rate results in Equation 5-15:

$$MDCR_{surveyor} = \frac{MDCR}{\sqrt{p}} \qquad \textbf{Equation 5 - 15}$$

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 (Ei) 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 5-12 provides the photon efficiencies (E_i) for OCNGS predominant gamma-emitting radionuclides as determined by OCNGS TBD *Instrument Efficiency Determination for use in Minimum Detectable Concentration Calculations in Support of the FSS at OCNGS*.

Table 5-12 Efficiency for Photon Emitting Radionuclides

Isotope	E_i [1] (cpm/pCi/ g)
Mn-54	289
Co-60	478
Nb-94	546
Sb-125	320
Cs-137	238
Eu-152	413
Eu-154	387

[1] Efficiencies presented above are for a 2" x 2" NaI Detector

5.8 Final Status Survey Implementation and Data Collection

5.8.1 Turnover and Access Control

Some surveys will be performed in parallel with dismantlement activities and require a systematic approach before acceptance of a survey unit for FSS. The following conditions should be satisfied in accordance with applicable procedures:

- Decommissioning activities with the potential to contaminate a survey unit shall be completed, and measures shall be taken to eliminate such potential.
- Tools and equipment that would impede the FSS of the survey must be removed, and housekeeping and cleanup shall be completed.
- Decontamination activities in the area shall be complete.
- Access control or other measures to prevent recontamination must be implemented.
- Turnover or remediation surveys may be performed and documented to the same standards as FSS so that data can be used for the FSS.

When an area is turned over for FSS, an FSS Area Turnover Sheet is initiated. The FSS Manager, or designee, ensures decommissioning activities in areas adjacent to the area to be isolated or that could otherwise impact it is either complete or deemed not to have the potential to spread plant-related radioactive material to the area. The FSS Manager will concur with what combination of measures are employed to prevent recontamination of the FSS area in accordance with OCNGS procedures (HOLTEC-ENG-FSS04 or equivalent).

Consider the following measures as appropriate:

a. Personnel briefings and training (e.g., classroom lectures, handouts, departmental e-mail notifications, and other routed information provided during tailboard briefings).

b. Physical barriers to control access or prevent the migration of contamination from adjacent or overhead areas. Examples of physical barriers include:
   - Fences
   - Locking entrances to surveyed areas of the facility
   - Installation of tamper-evident devices at entrance points

c. Postings

d. Personnel contamination surveys are conducted at access locations in the area.

e. Equipment used to support the FSS effort is evaluated so it does not pose the potential to introduce plant-related radioactive material into the survey unit.

f. Secure nearby sources of residual radioactivity to prevent migration from weather events or personnel actions.

5.8.1.1 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 are identified for accessing the survey area and obtaining support functions necessary to conduct FSS, such as interference removal or dewatering. Industrial safety and environmental concerns should also be identified during this walkdown.

5.8.1.2 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 OCNGS Radiation Protection (RP) Department to the FSS group. Access control and isolation methods are described in the following subsection.

5.8.1.3 Isolation and Control Measures

Since site decommissioning activities will not be completed before the start of the FSS, measures are implemented to protect survey units from contamination during and after the FSS. Decommissioning activities creating a potential for the spread of contamination are completed within each survey unit before the FSS. Additionally, decommissioning activities that create a potential for the spread of contamination to adjacent areas are evaluated and controlled. Upon commencement of the FSS for survey units where there is a potential for recontamination, 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
- Periodic surveillance/inspection to monitor and verify the 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 for a survey unit indicates that the adequacy of isolation and control

measures have been compromised, with the potential for recontamination of the area, post-FSS radiation survey locations will be determined based on technical or site-specific knowledge and current conditions in or near the survey area. The selected locations will be surveyed using the same instruments and techniques used during the original FSS, and the results will be compared with those from the surveillance FSS to determine whether recontamination has occurred. The primary function of these surveys is to detect contaminants' potential migration from decommissioning activities in adjacent areas.

OCNGS will employ designated waste haul paths to transport radioactive waste within the site. These specified haul paths will undergo routine surveys conducted by the Radiological Protection (RP) Department to assess potential impacts on these areas. After completing waste transport activities, comprehensive Class 1 FSS Surveys will be conducted along the designated haul paths to assess compliance with regulatory requirements.

5.8.2 Reference Grid and Sample Location

Sample location is a function of the number of measurements required, the survey unit classification, and the contaminant variability.

5.8.2.1 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 is performed only when necessary. A randomly selected sample start point will be identified for the sample grid in Class 1 and Class 2 survey units. A row of points is identified at the random starting coordinate, parallel to the X-axis, at intervals of L, the grid spacing. 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. Sample locations for Class 3 survey units are randomly selected based on the reference grid point(s).

GPS instruments are used in open land areas to determine reference or sample grid locations within the survey area, and Visual Sample Plan (VSP) software generates site maps (New Jersey State Coordinate System). Locations within a survey area may also be tied to a site United States Geological Survey (USGS) survey benchmark. Digital cameras can provide a record of survey locations within the survey unit and may be used extensively at OCNGS.

Building surfaces or inside structures may use laser technology or physical measurements from a reference coordinate system specific to the building to determine sample locations in areas unsupported by GPS (e.g., basements, excavations, etc.).

5.8.3 Investigation Levels and Elevated Areas Test

During survey unit measurements, levels of radioactivity may be identified that warrant investigation. Depending on the investigation's results, the survey unit may require no action, remediation, and/or reclassification and resurvey. The following subsections describe the investigation process and investigation levels.

5.8.3.1 Investigation Process

During the FSS process, locations with residual activity exceeding investigation levels are documented and marked for further investigation. The elevated survey measurement is verified

by the resurvey. For Class 1 areas, size and average activity level in the elevated area are acceptable if they comply with the area factors and other criteria that may apply to evaluating the DCGL for elevated measurements $DCGL_{EMC}$. As discussed later in this section, the $DCGL_{EMC}$ only applies to Class 1 areas. If any location within a Class 2 area exceeds the DCGL, scanning coverage in the vicinity is increased 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 new classification criteria. Survey unit investigations will be conducted following the applicable FSS DQOs.

Investigations should address the following items:

- Bound the elevated area
- The assumptions made in the survey unit classification
- The most likely or known cause of the contamination
- The effects of summing multiple areas with elevated activity within the survey unit

Depending on the investigation results, 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 resurveying the (new) area(s). The results of the investigation process are documented in the survey package. Section 5.8.4 provides additional discussion regarding the potential reclassification of the survey unit.

5.8.3.2 Investigation Levels

Technicians respond to instrument indications of elevated activity while surveying. Upon receiving an indication, the technician stops and resurveys the last square meter of the area surveyed to verify the increase. Technicians are cautioned, in training, about the importance of the verification survey and are given specific directions in the procedure as to survey extent and scan speed. If the indication is verified, the technician marks 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 rescan of the area, direct measurements, and soil sample collection (for land surveys). Each investigation will be evaluated and reported in the FSS survey area report. Investigation levels are shown in Table 5-13.

Table 5-13 Investigation Levels

Classification	Scan Investigation Levels	Direct Investigation Levels
Class 1	> $DCGL_{EMC}$	>$DCGL_{EMC}$ or >$DCGL_W$ and > a value deemed to be an outlier, a statistical parameter-based value (MARSSIM 5.5.2.6)
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 elevated area's size and average activity level are 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 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.

5.8.3.3 Elevated Measurement Comparison

Open Land Areas and Structural Surfaces

The elevated measurement comparison (EMC) is applied to Class 1 survey units when one or more verified scans or static measurements exceed 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 analysis measurements with residual radioactivity levels exceeding 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 activity level 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:

$$DCGL_{EMC} = Area\ Factor \times DCGL_W \qquad \textbf{Equation 5 - 16}$$

The area factor is the multiple of the $DCGL_W$ 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. Area factor calculations are described in Chapter 6 and summarized in Table 5-14 and Table 5-15. 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 5-16. If more than one elevated area is identified in a given survey unit, the unity rule with Equation 5-17 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 5-14 Soil Area Factors

ROC	Area Factor for Area Contaminated Zone (m^2)							
	2000	1000	500	100	50	10	5	1
Am-241	1	1	2	3	3	5	6	12
C-14	1	2	4	12	26	104	181	585
Cm-243	1	1	1	1	1	2	3	9
Cm-244	1	1	1	1	1	11	13	16
Co-60	1	1	1	1	1	2	3	9
Cs-137	1	1	1	1	1	2	3	9
Eu-152	1	1	1	1	1	2	3	9
Eu-154	1	1	1	1	1	2	3	9
Fe-55	1	1	2	10	19	75	124	278
H-3	1	1	2	4	6	14	20	45
Mn-54	1	1	1	1	1	2	3	9
Nb-94	1	1	1	1	1	2	3	9
Ni-63	1	1	2	9	18	63	95	176
Np-237	1	1	1	1	1	2	3	9
Pu-238	1	1	2	5	7	11	13	16
Pu-239	1	1	2	6	8	14	16	21
Pu-240	1	1	2	6	8	14	16	21
Pu-241	1	1	2	8	11	17	19	24
Sb-125	1	1	1	1	1	2	3	9
Sr-90	1	1	1	1	1	2	3	11
Tc-99	1	2	3	3	4	6	9	27

Table 5-15 Building Surface Area Factors

ROC	Building Surface Area Factor Values (m^2)					
	64	50	10	5	2.5	1
Am-241	1	1	6	13	25	63
C-14	1	1	6	12	25	62
Cm-243	1	1	6	12	24	59
Cm-244	1	1	6	13	26	64
Co-60	1	1	2	3	5	11
Cs-137	1	1	2	3	6	12
Eu-152	1	1	2	3	5	11
Eu-154	1	1	2	3	5	11
Fe-55	1	1	6	13	26	64
H-3	1	1	6	13	26	64
Mn-54	1	1	2	3	5	11
Nb-94	1	1	2	3	5	11
Ni-63	1	1	2	13	26	64
Np-237	1	1	6	12	24	59
Pu-238	1	1	6	13	26	64
Pu-239	1	1	6	13	26	64
Pu-240	1	1	6	13	26	64
Pu-241	1	1	6	13	26	64
Sb-125	1	1	2	3	5	11
Sr-90	1	1	6	12	23	57
Tc-99	1	1	6	12	24	58

Equation 5-16 applies to a single radionuclide contaminant. When multiple radionuclides are present, the calculation in Equation 5-17 is made with a unitized DCGL.

$$\frac{\delta}{DCGL_W} + \frac{(Conc_{AVE} - \delta)}{(Area\ Factor)(DCGL_W)} < 1 \qquad \textbf{Equation 5 - 17}$$

Where:

δ = Estimate of the average concentration of residual radioactivity, and
$Conc_{AVE}$ = average concentration in an elevated area.
If more than one elevated area exists in the survey unit, a separate term will be included for each in Equation 5-17 (refer to Section 5.2.7.7).

5.8.3.4 Discrete Particle Identification

Elevated reading investigations will be carefully performed to identify discrete particles that are the source of the elevated readings. When such discrete particles are identified, an attempt will be made to isolate them and have them analyzed for size and radiological constituents.

A log of identified discrete particles shall be maintained. The log should contain an assigned number, location found, particle size, radiological constituents, determination of respirability, dose assessment if respirable or ingested, other notes as appropriate, and ultimate resolution (saved or discarded).

5.8.4 Remediation and Reclassification

Post-remediation surveying will be accomplished utilizing instrumentation and methodologies consistent with FSS surveying:

- Open land area field screening will be performed using Ludlum 3003 with NaI detectors or equivalent. Scanning rates will be determined so that activity at the $DCGL_W$ will be detected. Scanning may be performed using the ISOCS, provided the assay sensitivity allows for detecting a 1 m^2 area to 15 cm depth at the edge of the FOV at the $DCGL_{EMC}$ for Class 1 areas. Field sampling analysis will be performed to the MDC requirements addressed in Section 5.7.7.
- Building surface field screening will be performed with Ludlum 3002 coupled to a proportional detector, large area ZnS 43-93, or equivalent.

To indicate effectiveness, the remedial action support survey relies on a simple radiological parameter, such as direct radiation near the surface (i.e., surface scans using a 44-10 detector). The investigation level (the level below which there is an acceptable level of assurance that the established DCGLs have been attained) is determined and used for immediate, in-field decisions. There are radionuclides and media that cannot be evaluated at the $DCGL_W$ using field monitoring techniques. Field samples will be collected, analyzed, and compared to the release DCGLs for these cases.

Remedial action support surveys are performed in the remediated areas to determine if the area is ready for an FSS (i.e., the area will pass an FSS). Alternatively, the remedial action support survey can be designed to meet the objectives (to the rigors) of an FSS.

As shown in Table 5-16, 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 evaluated for a classification change 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 5-16 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 re-survey 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	Reclassify portions as necessary and resurvey, increase

Area Classification	Action if Investigation Results exceed:		
	$DCGL_{EMC}$	$DCGL_W$	0.5 $DCGL_W$
		coverage, and investigate**	scan coverage, and investigate**

* Provided that the Sign Test will be conducted on the survey unit and an EMC evaluation is performed for individual measurements above DCGL.

** Requires an investigation of the initial classification process and a survey unit evaluation of sufficient intensity to satisfy the requirements of new classification status.

5.8.4.1 Resurvey

Following an investigation, if a survey unit is reclassified to a more restrictive classification or remediation activities are performed, a resurvey is performed per 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 percent 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.

5.8.5 Sample Handling

A chain-of-custody (COC) record will accompany each sample from the collection point through obtaining the final results to ensure the validity of the sample data. COC records are controlled and maintained in accordance with applicable procedures.

5.9 Data Quality Assessment (DQA)

An assessment is performed on the FSS data to ensure they are adequate to support the determination to release the survey unit. Simple DQA methods are first performed, such as comparing the survey data to the DCGL or the mean value to the DCGL. 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.

5.9.1 Data Verification and Validation

The FSS data are reviewed as a part of the DQA process to ensure they are complete, fully documented, and technically acceptable. The review criteria for data acceptability includes, at a minimum, the following items:

- The instrumentation MDC for fixed or volumetric measurements should be less than 10% of the DCGL (preferable), while MDCs up to 50% of the DCGL are acceptable.
- The instrument calibration was current and traceable to NIST standards.
- The field instruments were source checked with satisfactory results before and after use each day data were collected, or data were evaluated in accordance with Section 5.7.6.
- The MDCs and assumptions used to develop them were appropriate for the instruments and techniques used to perform the survey.
- The survey methods used to collect data were appropriate for the types of radiation and the media being surveyed.

- The sample was controlled from the point of sample collection to obtaining results.
- The data set is comprised of qualified measurement results collected in accordance with the survey design, which accurately reflects the radiological status of the facility.
- The data have been properly recorded.

If the data review criteria are not met, the discrepancy will be reviewed, and the decision to accept or reject the data will be documented, reviewed, and approved by the FSS Supervisor.

5.9.2 Graphical Data Review

All survey data will be graphed to identify patterns, relationships, and other anomalies. Posting and frequency plots will be produced for all data sets. The FSS Engineer or designee will review the data for acceptance.

5.9.2.1 Posting Plots

Posting plots are 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 areas of elevated radioactivity or local areas where 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 data may result from residual, undetected activity or may reflect background variability.

5.9.2.2 Frequency Plots

Frequency plots are 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 skewness and bimodality (having two peaks). Skewness may result from a few areas of elevated activity or little activity 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 construction materials. Variability may also indicate the need to match background reference areas to survey units more carefully or to subdivide the survey unit by material or soil type.

5.9.2.3 Contour and 3-D Surface Plots

Contour and 3-D surface plots may represent graphically a trend in collected survey data. This can aid in visualizing the location of activity outside the area that affects the collected data. Contour and 3-D surface plots typically require a plotting algorithm to interpolate data at a predetermined frequency.

5.9.3 Statistical Analysis

The results of the survey measurements are evaluated to determine whether the survey unit meets the release criteria. In some cases, the determination can be made without performing complex statistical analyses. For example, since the Sign Test is passed, if none of the data values exceed the $DCGL_W$, performing the test is unnecessary as it is passed by inspection.

An assessment of the measurement results is used to determine quickly whether the survey unit passes or fails the release criteria or whether one of the statistical analyses must be performed. The evaluation matrices are presented in Table 5-17 and Table 5-18.

Table 5-17 Interpretation of Sample Measurements when the Sign Test is Used

Measurement Results	Conclusion
All concentrations less than $DCGL_W$	The Survey Unit meets the release criteria
An 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

Table 5-18 Interpretation of Sample Measurements when the WRS Test is Used

Measurement Results	Conclusion
The difference between maximum survey unit concentration and minimum reference area concentration is less than $DCGL_W$	The Survey Unit meets the release criteria
The Difference between survey unit average concentration and reference average concentrations greater than $DCGL_W$	Survey Unit fails
The difference between any survey unit concentration and any reference area concentration is greater than $DCGL_W$, and the difference between the survey unit average concentration and reference area average concentration is less than $DCGL_W$	Conduct WRS Test and elevated measurements test

When required, one of four non-parametric statistical tests will be performed on the survey data:

- WRS Test
- Sign Test
- WRS Test Unity Rule
- Sign Test Unity Rule

In addition, survey data are evaluated against the EMC criteria described in Section 5.8.3.3 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 that the survey unit meets the site release criterion for dose. Statistical analyses are performed using Excel or other software application(s).

5.9.3.1 Sign Test

The Sign Test and Sign Test Unity Rule are one-sample statistical tests used for situations where the radionuclide of concern is not present in the background or at acceptable low fractions compared to the $DCGL_W$. If present in the 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 unnecessary. 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 measurements below the $DCGL_W$, proving 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 the survey design. If S+ exceeds the critical value 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.

5.9.3.2 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 that are not radionuclide-specific are used. 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 the W_r exceeds the critical value, the survey unit meets the site release dose criterion. If the W_r is less than or equal to the critical value, the survey unit fails to meet the criterion.

5.9.4 Drawing Conclusions

The results of the statistical tests, including the 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 do not show that the residual radioactivity is less than the release criterion. The data are analyzed further to determine the reason for the failure.

Possible reasons include the following:

- 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.
- 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 Appendix 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 the procedure. A greater number of measurements increases the probability of passing if the survey unit meets the release criterion. Retrospective power analyses will be developed for each completed OCNGS survey unit, whether the unit passes FSS criteria or not.

If failure was due to residual radioactivity in excess of the release criterion, the survey unit should be remediated and reclassified. Survey unit failure due to inadequate design or implementation shall require investigation and re-initiation of the FSS process.

5.9.5 Determination of Compliance

The FSS is designed to demonstrate that licensed radioactive materials have been removed from the OCNGS site to the extent that the 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 Section 5.8.3 and the elevated areas evaluated per Section 5.8.3.3 pass the elevated measurement comparison, the survey unit is suitable for unrestricted release. An investigation is performed if survey measurements do not meet the criteria specified in Table 5-17 and Table 5-18 Investigations include evaluating survey design, instrumentation used, and calculations, as necessary. They are documented in accordance with the OCNGS FSS QA Plan.

5.9.6 Record Keeping

Each survey unit has an associated document package that covers the design and field implementation of the survey requirements. Survey unit records are considered quality records.

5.9.7 Data Management

FSS data is managed and controlled using a user-restricted electronic format.

Survey data are collected from several sources during the data life cycle and are evaluated for validity throughout the collection process. QC replicate measurements are used as confirmatory measurements but are not used as part of the FSS statistical data set when performing the DQA. Measurements performed during turnover and investigation surveys can be used as FSS data if they were performed according to the same requirements as the FSS data, as follows:

- Survey data shall reflect the as-left survey unit condition (i.e., no further remediation required).
- Isolation measures are being applied to the survey unit to prevent recontamination and maintain the final configuration.
- The data collection and design follow the 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 to determine 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. The QC measurements required for FSS surveys are detailed in OCNGS procedure "Split Sample Assessment for Final Status Survey." ENG-FSS-11, Revision 0 (Reference 5-19).

5.9.8 Final Status Survey Reporting

Survey results and a brief operating history are documented in the FSS Report. HDI anticipates the NRC may choose to conduct confirmatory measurements during OCNGS FSS activities.

5.9.8.1 FSS Report Content

Survey results will be described in a written report for each Survey Area submitted to the NRC containing a definitive statement that OCNGS concludes that the area or structure meets the radiological criteria for unrestricted use. Upon completion of each survey area, the FSS report also summarizes the results used to demonstrate that the area or structure meets the radiological clearance criteria. Information such as the number and type of measurements, basic statistical quantities, graphical depictions when applicable, and statistical analysis results are included in the report. The detail level is sufficient to describe the FSS program and certify the results. The format of the final report will contain, as a minimum, the following topics:

- Operating History
- Overview of the results
- Discussion of changes to FSS, particularly where different from what was described in the LTP
- FSS Methodology

- Survey unit sample size
- Justification for sample size
- Survey percentages
- FSS Results
- A summary of the DCGLs used
- The parameters used to determine the number of samples (e.g., the width of the grey region, estimated variance or standard deviation, decision errors)
- a justification for the parameter selection
- Number of measurements taken
- Survey maps
- Sample concentrations
- Statistical evaluations and associated parameters
- Judgmental and miscellaneous data sets
- Scan data (area percentages and elevated area investigations)
- Anomalous data (corrective action reports for failed surveys, equipment failures, etc.)
- Conclusion for each survey unit
- Any changes from initial assumptions on the extent of residual activity, contamination depth, or radionuclide profile change. The basis for those changes is summarized in the report, and supporting documentation is available for inspection.
- Third-party confirmatory reporting
- Other reports relating to FSS activities may be prepared and submitted as necessary.

The final report will provide the survey unit's specific or generic ALARA evaluation and any investigation performed, regardless of whether the survey unit failed.

5.10 Final Status Survey Program Quality

Quality is built into 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 ensures that the site is surveyed, evaluated, and determined to be acceptable for unrestricted release if the residual activity results in an annual TEDE to the average member of the critical group of 25 mrem/year or less for all pathways and is ALARA. The following sections provide a description of applicable OCNGS quality programs and specific quality elements of the FSS Program.

5.10.1 FSS Quality Assurance Project Plan

The objective of the FSS Quality Assurance Project Plan (QAPP) (Reference 5-25) is to ensure that the survey data collected are of the type and quality needed to demonstrate with sufficient confidence that the site is suitable for unrestricted release. The objective is met through the use of the DQO process for FSS design, analysis, and evaluation. The plan ensures the following items are accomplished:

- The elements of the FSS plan are implemented in accordance with approved procedures and survey instructions.
- Surveys are conducted by trained personnel using calibrated instrumentation.
- The quality of the data collected is adequate.
- All package design and survey phases are properly reviewed, with management oversight provided. Ensure that a minimum of 5% of the collected soil, concrete, and groundwater media samples are analyzed for the full suite of ROCs. (Reference 5-14)
- Corrective actions, when identified, are implemented in a timely manner and are determined to be effective.
- Controls are in place to prevent recontamination of previously Final Status Surveyed areas.

5.10.2 Project Management and Organization

The project management team supports the FSS program by coordinating activities, implementing controls to prevent recontamination, implementing the Corrective Action Program (CAP), and implementing FSS communication with the project workforce on FSS issues and requirements.

Compliance with the QAPP and the LTP shall be the responsibility of personnel involved with FSS activities. The OCNGS staff performs the following specific responsibilities. Outside vendors may be contracted to perform specific review activities such as the following:

- Perform 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 OCNGS FSS Organization is responsible for the quality of those activities necessary to achieve a final status of unrestricted use for the OCNGS site.

The following are key FSS positions. As appropriate, a designee may be assigned the responsibilities for these positions.

- Site Closure Manager
- FSS/LTP Manager
- FSS Engineering Supervisor
- FSS Engineer
- FSS Supervisor

Figure 5-3 provides an organizational chart of the projected OCNGS License Termination Organization.

5.10.3 Training and Qualifications

Personnel performing FSS measurements are trained and qualified. Training includes the following topics:

- Procedures governing the conduct of the FSS,
- Operation of field and laboratory instrumentation used in the FSS and
- Collection of FSS measurements and samples.

Qualification is obtained upon satisfactory demonstration of proficiency in implementing procedural requirements. The extent of training and qualification is commensurate with the individual's education, experience, and proficiency and the scope, complexity, and nature of the activity required to be performed by that individual. Records of training and qualification are maintained in accordance with approved training procedures.

5.10.3.1 Program Controls

Program Controls shall be established for performing specific FSS activities. Activities are accomplished using suitable instructions, procedures, and drawings incorporating appropriate regulatory and industry guidance.

Personnel conducting activities shall be appropriately trained and qualified. Administrative procedures or instructions will define training, qualification, and any appropriate maintenance of proficiency requirements. Professional resumes, other verifiable credentials, and/or discrete certification packages, as applicable, shall be used to document personnel qualifications.

5.10.3.2 Design Controls

Design control requirements are established to ensure that the applicable regulatory bases, codes, technical standards, and quality standards are identified in the FSS program. Design controls also include independent verification and design interface control. These design controls are implemented to determine the DCGLs, MDCs, area factors, and other DQO and FSS elements.

5.10.3.3 Procurement Document Control

Procurement documents related to the FSS shall be prepared in accordance with approved procedures and instructions. These procedures and instructions shall contain provisions to ensure that procurement documents address the quality of the purchased service, equipment, or material.

5.10.3.4 Instructions, Procedures, and Drawings

The performance of the FSS will require procedures for personnel training, survey implementation, data collection, COC, instrument calibration, storage, response checks, maintenance, verification, and record storage. These procedures ensure compliance with the LTP and meet applicable quality requirements. These quality requirements include the development and approval in accordance with the site controls.

5.10.3.5 Document Control

Instructions, Procedures, and Drawings shall be controlled to ensure FSS personnel can access and implement the most recent revision of the approved procedures or instructions. Controlled copies shall be available at specified locations for personnel performing activities affecting the FSS Program. These controls shall ensure that only current information is issued and used. The results of the FSS are retained at least for the duration of the 10 CFR 50 facility license.

5.10.3.6 Control of Purchased Material, Items, and Services

Vendors may be used for the performance of the FSS and laboratory activities. Quality-related services, such as laboratory analysis, are procured from qualified vendors whose internal QA program is subject to approval in accordance with approved procedures. Additionally, audits and surveillances of these contractors should be performed to provide an adequate assurance that the quality activities are being effectively performed and conform to the requirements of the procurement document.

5.10.3.7 Control of Special Processes

Procedures are developed to implement any special processes that may be used in support of FSS implementation. The special processes will be validated and implemented by trained, qualified individuals using approved procedures.

5.10.3.8 Inspections

Inspections and verification activities are delineated in implementing procedures. These programs and procedures are used to verify that sampling and surveying protocols are appropriately performed. Appropriate members of the line organization who are qualified or an independent organization as described in administrative procedures may perform these inspections. Routine surveys are implemented to determine the effectiveness of cross-contamination controls.

Line organization personnel performing self-assessment activities should not be directly responsible for the assessed area.

5.10.3.9 Control of Measuring and Test Equipment

Approved procedures are developed for the control, use, calibration, and testing of the FSS equipment, including laboratory and field use equipment. These procedures ensure confidence in the data obtained. Instrument calibrations are performed periodically in accordance with appropriate industry standards.

5.10.3.10 Handling, Storage, and Shipping

Some of the material samples will be transported to offsite laboratories for analysis. The process for controlling this material is sufficient to ensure that a COC is maintained. Measures shall be established to ensure that samples are received, handled, stored, packaged, and shipped in accordance with approved procedures or instructions. These procedures or instructions shall be responsive to the applicable industry or manufacturer's requirements and include controls for the "shelf life" of sensitive products. Additionally, protocols are established to ensure no cross-contamination between samples and sample packaging. Administrative procedures define appropriate controls to ensure that sample integrity is maintained.

Radiological instrumentation storage is maintained under environmental conditions to prevent degradation to instrument performance. Instruments shipped to vendors are procedurally controlled from shipment to receipt, and response checked for performance upon return from the vendor.

5.10.3.11 Control of Nonconformance

During FSS, radiation detection equipment or services may identify non-conforming conditions. The data associated with the non-conforming condition are controlled until it is accepted, rejected, or reworked in accordance with an appropriate procedure. Nonconforming radiation detection equipment is not used until conformance with applicable requirements has been established.

5.10.3.12 Corrective Action Program

The existing OCNGS Corrective Action Program is used for the FSS Program to ensure conditions adverse to quality are promptly identified and corrected.

5.10.3.13 Records

Measures have been established to ensure that FSS records are maintained as quality records. These measures also include procedures by which the records are reviewed and approved, and procedures that ensure the records can be retrieved within a reasonable period. The controls shall also provide for the protection of the records to ensure they are not lost or subject to degradation over time.

5.10.3.14 Audits

Audits of FSS activities are performed periodically, in accordance with approved site procedures or instructions, to verify the implementation of quality activities such as procedure adherence, data quality assessments, and data manipulations. Where line organization personnel may be used for audits, the auditing personnel should have or have direct responsibility for the area being audited.

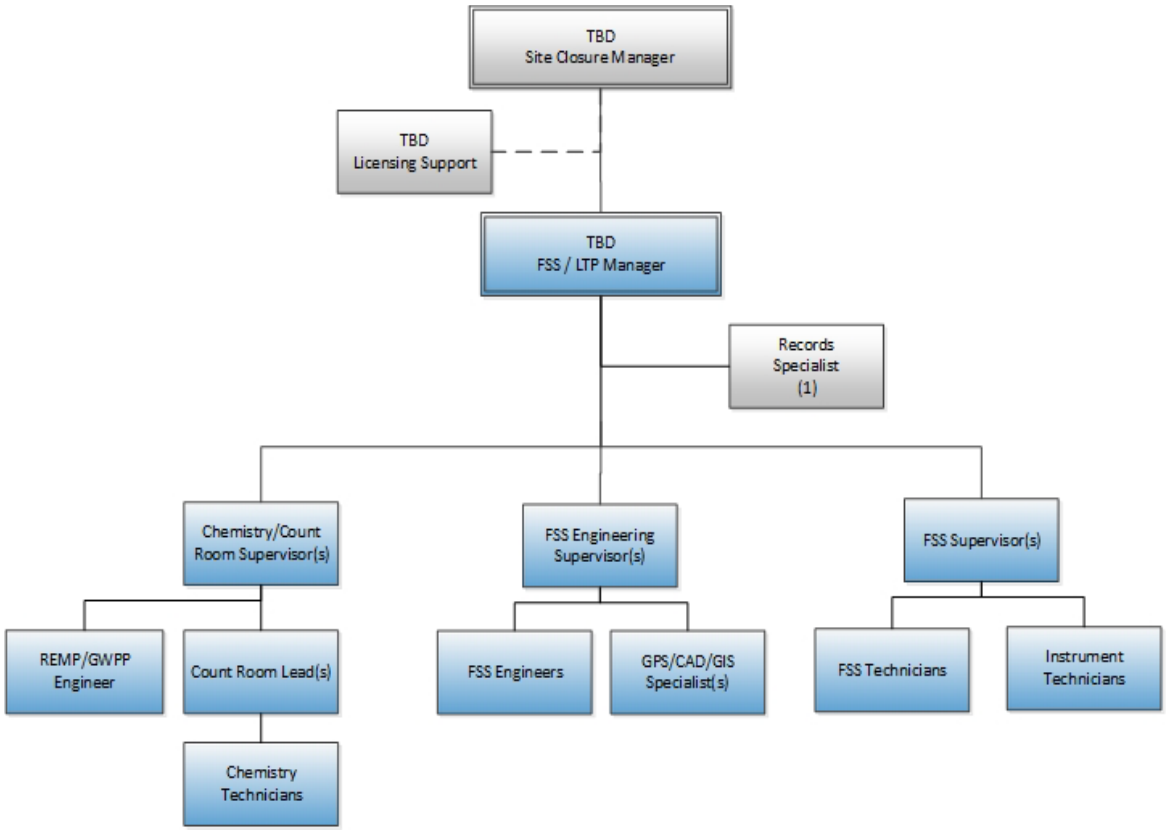


Figure 5-3 Projected OCNGS FSS Organization

5.11 References

5-1 Nuclear Regulatory Commission (NRC). 2022. *Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria*. NUREG-1757, Revision 2, Volume 2, NRC, Office of Nuclear Material Safety and Safeguards, Washington, D.C.

5-2 Department of Defense (DOD), Department of Energy (DOE), Environmental Protection Agency (EPA), and Nuclear Regulatory Commission (NRC). 2000. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).* NUREG-1575, Revision 1, EPA 402-R-97-016, Revision 1, DOE/EH-0624, Revision 1, NRC, Washington, D.C.

5-3 Nuclear Regulatory Commission (NRC). 1998. *A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys*. NUREG-1505, Revision 1, Draft Report for Use and Comment, NRC, Office of Nuclear Material Safety and Safeguards, Washington, D.C.

5-4 Nuclear Regulatory Commission (NRC). 2020. *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*. NUREG-1507, Revision 1, NRC, Office of Nuclear Material Safety and Safeguards, Washington, D.C.

5-5 Nuclear Regulatory Commission (NRC). 2018. *Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans*. NUREG-1700, Revision 2, NRC, Office of Nuclear Material Safety and Safeguards, Washington, D.C.

5-6 Nuclear Regulatory Commission (NRC). 2019. *Standard Format and Contents for License Termination. Plans for Nuclear Power Reactors*. Regulatory Guide 1.179, Revision 2, NRC, Washington, D.C.

5-7 Pacific Northwest Laboratory. 1992. *Residual Radioactive Contamination From Decommissioning*. NUREG/CR-5512, PNL-7994, Volume 1, Pacific Northwest Laboratory, Richland, WA

5-8 International Organization for Standards. 1988. *Evaluation of Surface Contamination - Part 1: Beta Emitters and Alpha Emitters*. ISO 7503-1. International Organization for Standards.

5-9 Brodsky, A. 1992. Exact Calculation of Probabilities of False Positives and False Negatives for Low Background Counting, Health Physics, 63(2), 198-204.

5-10 Technical Basis Document No 20-6002-1362 R0, *Radiological Selection for DCGL Development*.

5-11 Technical Basis Document, "*Instrument Efficiency Determination for Use in Minimum Detectable Concentration Calculations in Support of the Final Status Surveys at OCNGS", Revision 0*

5-12 Technical Basis Document No. 24-01-12-2888 Revision 0 "*Dose Contribution from Insignificant Radionuclides in the Oyster Creek Site-Specific Suite of Radiological Nuclides*".

Applicable Site Procedures for FSS:

5-13 Westinghouse - Engineering Services. *Survey Unit Classification.* ENG-FSS-001, Revision 0. Unpublished internal company document.

5-14 Westinghouse- Engineering Services. *Preparation of FSS Survey Plans.* ENG-FSS-002, Revision 0. Unpublished internal company document.

5-15 Westinghouse- Engineering Services. *Background Assessment.* ENG-FSS-003, Revision 0. Unpublished internal company document.

5-16 Westinghouse- Engineering Services. *Isolation and Control of Areas for FSS.* ENG-FSS-004, Revision 0. Unpublished internal company document.

5-17 Westinghouse- Engineering Services. *Determination of the Number and Locations of FSS Samples.* ENG-FSS-007, Revision 0. Unpublished internal company document.

5-18 Westinghouse- Engineering Services. *Collection of Site Characterization and FSS Samples.* ENG-FSS-008, Revision 0. Unpublished internal company document.

5-19 Westinghouse- Engineering Services. *QA Assessment for Final Status Survey.* ENG-FSS-011, Revision 0. Unpublished internal company document.

5-20 Westinghouse- Engineering Services. *Area Surveillance Following FSS.* ENG-FSS-013, Revision 0. Unpublished internal company document.

5-21 Westinghouse- Engineering Services. *Data Quality Assessment.* ENG-FSS-014, Revision 0. Unpublished internal company document.

5-22 Westinghouse- Engineering Services. *Statistical Tests.* ENG-FSS-015, Revision 0. Unpublished internal company document.

5-23 Westinghouse- Engineering Services. *ALARA Evaluations for Final Status Survey Areas.* ENG-FSS-009, Revision 0. Unpublished internal company document.

5-24 Westinghouse- Engineering Services. *Preparation of FSS Reports.* ENG-FSS-012, Revision 0. Unpublished internal company document.

5-25 Westinghouse- Engineering Services. *OCNGS Final Status Survey Quality Assurance Project Plan (QAPP).* ENG-FSS-005, Revision 0. Unpublished internal company document.

6

COMPLIANCE WITH THE RADIOLOGICAL CRITERIA FOR LICENSE TERMINATION

LIST OF ACRONYMS

Acronym	Full Form
AF	Area Factor
ANL	Argonne National Laboratory
BFM	Basement Fill Model
CF	Conversion Factor
CV	Contaminated Volume
CZ	Contaminated Zone
DCGL	Derived Concentration Guideline Level
DOE	United States Department of Energy
DS	Drilling Spoils
EC	Excavated Concrete
EP	Embedded Pipe
EPA	United States Environmental Protection Agency
FGR	Federal Guidance Report
FSS	Final Status Surveys
ISFSI	Independent Spent Fuel Storage Installation
IR	Instantaneous Release
IU	Industrial Use
LCZPAQ	length parallel to aquifer flow
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
NRC	United States Nuclear Regulatory Commission
OCNGS	Oyster Creek Nuclear Generating Station
ORB	Old Radwaste Building
PA	Protected Area
POM	Peak of the Mean (dose)
PRCC	Partial Rank Correlation Coefficient
RB	Reactor Building
ROC	Radionuclide of Concern
SA/V	Surface Area to Volume (ratio)
SZ	Saturated Zone
TB	Turbine Building
TEDE	Total Effective Dose Equivalent
UZ	Unsaturated Zone

6 COMPLIANCE WITH THE RADIOLOGICAL CRITERIA FOR LICENSE TERMINATION

6.1 Radiological Criteria for Unrestricted Use

The United States Nuclear Regulatory Commission (NRC) has established radiological criteria for the unrestricted use in 10 CFR §20.1402:

> *A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25mSv) per year, including that from groundwater sources, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially results from decontamination and waste disposal*.

The site-specific derived concentration guideline level (DCGL) values developed for the Oyster Creek Nuclear Generating Station (OCNGS) site correspond to the dose criterion in 10 CFR §20.1402; that is, a total effective dose equivalent (TEDE) less than 25 mrem per year. DCGL values are tools to demonstrate compliance that "residual radioactivity that is distinguishable from background radiation" at the OCNGS site meets the 10 CFR §1402 dose criterion. The NRC's definition of background radioactivity in 10 CFR §20.1003 can assist licensees with identifying residual radioactivity from plant operations:

> *Background radiation 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 that 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 Commission*.

The OCNGS DCGL values have been developed for each potential radionuclide of concern (ROC) that may be present at the time of license termination to support assessments of residual plant-related radioactive contamination in site soil, above-grade buildings, and below-grade structures that will be left in place. Using the OCNGS DCGL values provides a regulatory-acceptable means for demonstrating compliance with the site release criteria in 10 CFR §20.1402.

6.1.1 Conditions Satisfying the Site Release Criteria

For NRC licensees, compliance with 10 CFR §20.1402 is demonstrated when the following conditions are met:

- The average residual radioactivity distinguishable from background is less than the applied DCGL value(s). For contamination with a mixture of radionuclides, the sum of the fractions of the contaminants' concentrations over the contaminants' DCGL values must be less than one.
- An individual survey measurement representing a small area of residual contamination within a survey area that exceeds the DCGL value but does not exceed the elevated measurement comparison DCGL and the average

concentration of residual radioactivity passes statistical testing recommended in NUREG/CR-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (Reference 6-1).

- The final (compliance) dose to demonstrate compliance with the NRC radiological criterion for unrestricted release (25 mrem/y) is the summation of the dose contributions from all OCNGS site end-state media within a survey unit. It is calculated as described in section 6.13.

6.1.2 Potential Radionuclides of Concern for the OCNGS Site

Identifying the radionuclides that may be present during the final status survey (FSS) and at the time of license termination for the OCNGS site is essential for developing site-specific Derived Concentration Guideline Levels (DCGLs). The radionuclide selection method applied to the OCNGS site consisted of a systematic approach to identify all potential radionuclides and a deselection protocol for excluding radionuclides unlikely to be present at the time of the final survey of the OCNGS site. The deselection protocol included evaluations of the half-life values, potential activity concentrations, and assessments of contributions to the total dose at the OCNGS site. Radionuclides surviving the deselection process formed the site-specific suite of potential ROCs for the OCNGS site. The ROC selection process is documented in *Radionuclide Selection for DCGL Development - Oyster Creek Station Site Characterization Project* (Reference 6-2). The site-specific suite of potential ROCs for the OCS site is provided in Table 6-1.

Table 6-1 OCNGS Site-Specific Suite of Potential ROC

ROC	Half-Life (y)
Am-241	4.32E+02
C-14	5.70E+03
Cm-243	2.91E+01
Cm-244	1.81E+01
Co-60	5.30E+00
Cs-137	3.00E+01
Eu-152	1.30E+01
Eu-154	8.60E+00
Fe-55	2.70E+01
H-3	1.20E+01
Mn-54	8.50E-01
Nb-94	2.00E+04
Ni-63	1.00E+02
Np-237	2.14E+06
Pu-238	8.77E+01
Pu-239	2.43E+04
Pu-240	6.58E+03
Pu-241	1.40E+01
Sb-125	2.76E+00
Sr-90	2. 90E+01

ROC	Half-Life (y)
Tc-99	2.10E+05

6.2 End State Vision for OCNGS Site

The end-state vision for the OCNGS site is described in Chapters 1 and 3 of the License Termination Plan. Demolition to 3ft below grade with the removal of masonry structures consisting of exterior walls, internal load-bearing walls, and floors is planned for the Reactor Building (RB), Turbine Building (TB), Old Radwaste Building (ORB), and the stack area structures. The concrete foundations and structures below 3ft will be subjected to FSS, backfilled, and left in place. After FSS and backfilling, the below-grade concrete foundations and excavations will be returned to the existing site grade.

Following completion of decommissioning activities and verification that radiological criteria for license termination are met, the existing Part 50 license will be amended to reduce the site footprint to only that portion required for operation of the Independent Spent Fuel Storage Installation (ISFSI), with the remainder of the site being released for unrestricted use conforming to the compliance scenario selection. In addition to the infrastructure required to support the operation of the ISFSI, the following facilities, structures, and components will also remain:

- Administration Building
- Site Emergency Building
- Main Access Facility
- Materials Warehouse
- Low-Level Radwaste Storage Facility
- Demineralized Water Storage Tank
- Intake, Discharge, and Dilution Water Structures and canals
- Roads, pathways, and parking areas

The Oyster Creek Nuclear site is owned by Holtec International, a green energy company with plans to reuse the site in a capacity for the business Holtec is in. It is Holtec's intent to remediate the Oyster Creek Nuclear site to unrestricted release criteria and repurpose the site, focusing on environmentally friendly energy sources or other commercial or industrial uses that are consistent with Holtec's business interests and that create jobs that can benefit the community.

6.3 Selection Site Compliance Scenario

Several potential uses of the OCNGS site following decommissioning and license termination were reviewed and evaluated to determine the most likely use and a correspondingly appropriate compliance scenario. The evaluation focused on the plausibility and likelihood of retaining an industrial setting and the plausibility and likelihood of transitions to a farming, residential, and recreational setting in the near future.

A study, *100 Year Land Use Outlook – Categorization and Justification* (Reference 6-3), was conducted to support and justify the selection of the OCNGS compliance scenario. The study documents the suitability of the OCNGS site under several reasonably foreseeable use scenarios following license termination. The study covers a wide range of information, including current local and state zoning plans, existing site infrastructure, surrounding environment, area

hydrogeologic attributes, site adaptability for various uses, economic viability, job creation, and continued revenue generation for the local community.

The selection of the OCNGS compliance scenario is based on the most plausible and likely use of the site after license termination. The estimated annual dose to the critical receptor that demonstrates compliance with NRC's criteria for unrestricted use depends on the selected compliance scenario because the open exposure pathways are not the same for each potential land use setting. The land use with the most open exposure pathways is likely to result in the most conservative annual dose estimate, but its plausibility and likelihood may be greatly reduced due to:

- the end state envisioned for the OCNGS site at license termination (described in Section 6.2) and/or
- challenges associated with transitioning to a site that supports the new potential land use (described below). Table 6-2 provides a summary of open exposure pathways for potential land use scenarios for the OCNGS site following decommissioning.

Table 6-2 Plausible Scenarios for the Future Use of the OCNGS Site

Exposure Pathway	Plausible Land use			
	Industrial	Resident Farming	Residential	Recreational
External Radiation	✓	✓	✓	✓
Inhalation	✓	✓	✓	✓
Plant Ingestion		✓	✓	
Meat Ingestion		✓		
Milk Ingestion		✓		
Aquatic Food Ingestion	✓	✓	✓	
Groundwater Ingestion		✓	✓	
Soil Ingestion	✓	✓	✓	✓

6.3.1 Most Likely and Plausible Scenario Assessment

The most likely use of the OCNGS site following decommissioning is an industrial setting, which is supported by many findings in the 100-Year Land Use Outlook study.

Holtec officials are working with the Lacey Township Committee to develop strategies for using the Oyster Creek property to create carbon-free energy. The focus is on what the property may look like when decommissioning is completed and how it may be an economic driver again for the community.

Options for the site include:

- Construction of one or more SMR-300 Small Modular Reactors, a new generation of nuclear reactors developed by Holtec to again produce power at the plant.
- Construction and operation of Holtec's Green Boiler technology
- Utilization of technology approved by the Mid-Atlantic Hydrogen Hub, a coalition of seven states, including New Jersey, for hydrogen production.
- A green energy park or hub
- Battery development and storage facilities
- Wind and Solar generating facilities
- A training complex

Lacey Township is additionally working with an economic planning firm to examine options for the future use of the site with industry and infrastructure that would replace tax revenue lost as a result of the closure of the nuclear power plant. Industries that officials seek to attract are selected by how well they would fit into the township and surrounding area, along with the number of well-paying jobs created that would keep people in the community. The goal is to attract and retain jobs and residents by attracting industries that make sense for Lacey and show strong growth potential. The development would primarily be on Holtec land, as well as a few other township-owned lots that are underutilized and would complement the site. Initial target industries, selected with input from township officials and a steering committee of residents, include:

- Electric power transmission and distribution
- Pharmaceutical manufacturing
- Alternative and renewable power generation light industrial manufacturing (for offshore wind industry)
- Waterfront marinas and recreation (on the Finnegar Farm or other property)
- Refrigerated warehousing

Consistent with goals and objectives associated with planning for future use of the Oyster Creek site, Holtec Decommissioning International's decommissioning strategy includes the preservation of site infrastructure that could support future construction activities and industrial use of the property and facilities. These decommissioning strategies include preservation of, and in many cases improvement to, the following:

- Roads and parking facilities.
- Intake and discharge canals connected to Barnegat Bay and associated in-water structures
- Two multi-story buildings with ample office and equipment space
- A large warehouse with space for storage of large equipment or conduct of manufacturing operations, in addition to office space
- A large multi-story concrete building that could be used to support storage, manufacturing or operational activities

- A main gatehouse facility with a vehicle portal, in addition to fencing and barriers for management of site access
- A large stainless steel storage tank previously used for storage of demineralized water
- Yard lighting and stormwater management infrastructure
- Municipal domestic potable water supply header and distribution piping
- A deep production well and distribution piping for non-potable water
- Fire water supply and distribution piping
- Electrical distribution transformers and components

Holtec has no plans to sell the Oyster Creek Nuclear site. The end state of the site is specifically planned - and decommissioning activities are being conducted - to support future industrial use with a focus on job creation and not to support future housing, farming, recreation or other activities with less potential for economic development.

Additional factors supporting an industrial setting as the reasonably foreseeable and plausible site use are:

- The OCNGS site is currently zoned industrial and will remain zoned industrial for the foreseeable future.
- The majority of the OCNGS site is located within Lacey Township and is zoned as industrial zone M-100. The southern portion of the site, located within Ocean Township, is zoned as an Environmental Conservation District.
- Lacey Township's industrial zones allow for a wide variety of uses, including manufacturing, corporate, institutional and research, which allows a variety of potential industrial uses beyond nuclear power generation.
- The road and water routes are readily available for the movement of heavy equipment.
- The site infrastructure, including buildings and structures that will remain, can support industrial reuse applications such as warehousing, office space, and possible industrial surface water/cooling water.
- Electrical transmission facilities are available close to the site.
- Based on the above conditions, the site is a prime candidate for manufacturing, constructing, and operating Small Modular Reactors.
- Industrial gas power production installation and support facilities are adjacent to the site.

Other considerations supporting the selection of IU as the compliance scenario include:

- A feasibility study conducted by Lacey Township in 2012 examined the potential of constructing a new non-nuclear power generation facility to offset the Township's employment and power supply needs. The study identified that a gas-fired combined cycle power generation facility would

be the most feasible option in terms of time, statewide energy goals, and existing infrastructure.

- The recommendation in the Lacey Township feasibility study to change the zoning of the OCNGS site to make it more inclusive for a wider variety of uses, providing the town with flexibility in planning future industrial uses, which was confirmed in the Township of Lacey Planning Board's 2012 and 2018 Municipal Master Plan Re-Examination Reports.
- Additionally, Lacey Township identifies in its Master Plan a deficit of industrial lands compared to the national average and an insufficiency of higher-skilled jobs. The 2018 Master Plan Re-examination identified the need to make additional investments and designate more areas to industrial nodes to reverse some of these regional trends.
- Industrial land use generates revenue through property taxes and leasing agreements, which can be reinvested into the community and used to fund infrastructure improvements, public services, and educational programs.
- Industrial zones often lead to increased job opportunities, stimulating the local economy and benefiting the community.
- The presence of the ISFSI and supporting facilities and structures listed in Section 6.2, which will remain onsite until the spent fuel is transferred to the United States Department of Energy (DOE). Following the DOE's acceptance of the spent fuel, the ISFSI and its supporting structures will remain in place until they undergo decommissioning, FSS, and termination of the Part 50 license.

6.3.2 Less Likely but Plausible Scenario Assessments

An industrial setting is the reasonably foreseeable land use immediately following license termination for the reasons described in section 6.3.1. However, the farming setting, residential setting, and recreational setting were determined to be less likely but plausible land uses for the OCNGS site in the distant future. The likelihood and plausibility of these non-industrial settings after license termination depends on several events, including zoning changes and decommissioning and removal of the ISFSI, supporting facilities and components, and the roads, pathways, and parking lots. Factors discussed in the 100-Year Land Use Outlook study that make these non-industrial land uses less likely are provided below.

Farming has been determined as a less likely land use for the following reasons:

- The presence of the ISFSI and supporting facilities and structures listed in Section 6.2, which will remain on site until the spent fuel is transferred to the DOE. Following the DOE's acceptance of the spent fuel, the ISFSI and supporting structures will remain until decommissioned, FSS, and termination of the Part 50 license.
- The OCNGS site is currently zoned industrial, and a change in zoning is unlikely, considering the feasibility study conducted by Lacey Township.
- Portions of the site are not available for development due to wetlands or protected woodlands.

- Figure 2.4 in section 2.3.1 in the 100-Year Land Use Outlook study shows that no farmland is assessed in Lacey Township areas surrounding the OCNGS site.
- None of the soils identified on the site are considered prime farmland. Section 2.2.5 in the 100-Year Land Use Outlook study provides a discussion regarding the suitability of site soils for farming and presents the conclusions that (i) site soils are not favorable for agricultural uses as none are categorized as prime farmland or farmland of statewide importance and (ii) the OCNGS site is not located within or in proximity to any planning areas that prioritize agriculture under local or State land use planning policies. Furthermore, the 100-Year Land Use Outlook study states that "due to land use trends, soil conditions, and groundwater use restrictions, using the Site for commercial agriculture or to support raising livestock for meat and milk production is not considered plausible." Soil conditions and land use trends make it clear that using the site for agricultural purposes is unlikely.
- Due to land use trends, soil conditions, and groundwater use restrictions, using the site for commercial agriculture or to support raising livestock for meat and milk production is not considered plausible.
- The site is not well suited to agricultural uses due to the existing soil conditions (i.e., soil characteristics, absence of prime farmland and limited farmland of statewide or unique importance), lack of agricultural industries nearby to support synergies, and absence of agriculturally designated areas within its vicinity.

Residential development within the next 100 years may be a plausible future land use but not a reasonably foreseeable land use immediately after license termination. Although plausible, a residential setting has been determined as a less likely land use for the following reasons:

- The presence of the ISFSI and supporting facilities and structures listed in Section 6.2, which will remain on site until the spent fuel is transferred to the DOE. Following the DOE's acceptance of the spent fuel, the ISFSI and supporting structures will remain until decommissioned, FSS, and termination of the Part 50 license.
- Portions of the site are not available for development due to wetlands or protected woodlands.
- The OCNGS site is currently zoned industrial and likely will remain zoned industrial for the reasonably foreseeable time after license termination. A change in zoning is unlikely, considering the feasibility study conducted by Lacey Township.
- Existing qualities of the OCNGS site are less attractive for residential development.
- The 100-Year Land Use Outlook study states that the area surrounding the OCNGS site has experienced rapid population growth in the last several decades. Numerous multi-family developments are under construction or

have recently been completed within a five-mile radius of the site, and additional land is available to support future build-out.

- Adequate land is available nearby for residential development, making it more likely that residential development will occur in those locations. Given that adequate land is available nearby for residential and commercial development and considering the attractive qualities of the OCNGS site for industrial development, it is unlikely that the site would be a likely candidate for residential development.

A recreational setting has been determined as a less likely land use for the following reasons:

- The presence of the ISFSI and supporting facilities and structures listed in Section 6.2, which will remain on site until the spent fuel is transferred to the DOE. Following the DOE's acceptance of the spent fuel, the ISFSI and supporting structures will remain until decommissioned, FSS, and termination of the Part 50 license.
- Portions of the site are not available for development due to wetlands or protected woodlands.
- The OCNGS site is currently zoned industrial, and a change in zoning is unlikely, considering the feasibility study conducted by Lacey Township.
- There are numerous park facilities nearby with recreational access to water for swimming, fishing, and boating.
- The site is small and does not offer any unique shoreline, boat launch, inland features, flora, or fauna that would be attractive for recreational purposes.

6.3.3 OCNGS Compliance Scenario: Industrial Use Scenario

The selection of the Industrial Use (IU) scenario as the OCNGS site compliance scenario is based on a land use review indicating that an industrial setting is the most probable site setting after license termination and for the foreseeable future. In the IU scenario, the average member of the critical group is a hypothetical full-time industrial site worker who also catches and consumes fish from the intake/discharge canal. Under the IU scenario, the critical receptor receives a dose from residual radioactive contamination in soil and on building surfaces.

For dose from residual contamination in site soil (open land areas), the critical receptor is assumed to spend most of the time outdoors at the site (i.e., 7 hours out of an 8-hour workday for 50 work weeks) exposed to residual contamination in site soil. Weather and seasonal conditions that would prevent outdoor work are not considered. The exposure pathways contributing to the annual dose are:

- Direct external radiation exposure pathway
- Inhalation exposure pathway
- Inadvertent ingestion of contaminated soil
- Ingestion exposure via aquatic food from the intake/discharge canal

In addition to surface soils, the IU scenario and its exposure pathways apply to other site media, such as below-grade concrete structures, embedded piping, and buried pipes.

For dose from residual contamination on interior surfaces (walls, floors, and ceilings) of buildings that will remain in place after license termination, the Building Occupancy scenario was selected as an appropriate scenario for an Industrial site. The critical receptor in the Building Occupancy scenario is a hypothetical adult individual who receives a dose from exposure to residual radioactive contamination on the floor, walls, and ceiling while working in a room for a full year of employment following the site's decommissioning. The exposure pathways considered are:

- direct external exposure from radioactive contamination on the floor, walls, and ceiling,
- external exposure due to air submersion,
- exposure due to inhalation of airborne radioactive material, and
- ingestion of radioactive material deposited on the surfaces.

6.4 Addressing Uncertainty in Modeling of Compliance Scenarios

Probabilistic analysis is a method for identifying risk-sensitive parameters (i.e., parameters that produce significant changes in the calculated dose with changes in the input values) and determining reasonably conservative values to account for the uncertainty in input for those parameters. Uncertainty in the modeling of a site is reduced by using input data that closely represents site conditions. The uncertainty in the input data in the RESRAD-Onsite modeling of the OCNGS site was reduced by:

- Using an input selection process that reviewed, vetted, and justified data.
- Using available site-specific data as input.
- Using relevant NRC-published statistical distributions as input for parameters when site-specific values are unavailable.
- Performing probabilistic analysis to identify risk-sensitive RESRAD-Onsite parameters.
- Determining reasonably conservative input values to capture a large portion of uncertainty associated with the identified risk-sensitive parameters.

The primary sources of values for RESRAD-Onsite parameters were OCNGS site documents, NRC documents, and RESRAD documents. The information provided in these documents was reviewed in detail prior to selection as input to assure representativeness for the OCNGS site.

Site-specific information documented in OCNGS documents provided justifiable values for several RESRAD-Onsite parameters, including the area of the contaminated zone, thickness of the contaminated and unsaturated zones, site soil type, hydraulic conductivity, effective porosity in the saturated zone, site run-off, field capacity, meteorological parameters, and site drainage. NRC documents and RESRAD documents provided justifiable values for parameters such as soil K_d, density, and porosity because site-specific information was not available for these parameters. In addition, NRC documents provided input values for non-site-specific parameters, such as bioaccumulation factors, shielding factors, soil ingestion rate, and the contaminated fraction of

aquatic food in the critical receptor's diet. The basis for the selected input value assigned to each RESRAD code parameter is provided in the tables found in Sections 6.6 through 6.9.

The OCNGS *Hydrogeologic Investigation Report* (Reference 6-4), the *OCS Historical Site Assessment* (Reference 6-5), and well-installation logs identify sand as the soil type for the OCNGS site. However, site-specific data for parameters related to soil type, such as regarding K_d value, soil density, and porosity, are not found in OCNGS site documents. The uncertainty associated with input values for these parameters was evaluated by using the NRC-published statistic distributions for K_d, soil density, and porosity corresponding to sand. This selection is consistent with the statement in NUREG/CR-7267 (Reference 6-6) that if the soil type is known, then K_d distributions for the known soil type from ANL/EVS/TM-14/4 (Reference 6-7) can be used.

The K_d distributions provided in NUREG/CR-7267 and ANL/EVS/TM-14/4 have been derived from soil data reported in professional publications. Recognizing that K_d values for a specific element (and the radioactive forms of that element) can range over several orders of magnitude depending on soil type, the authors of ANL/EVS/TM-14/4 reduced the uncertainty due to different types of soil by grouping the K_d distributions based on the properties of the soil types.

Uncertainty can also exist in the input for K_d for a given soil type, depending on soil conditions. The K_d distributions listed in ANL/EVS/TM-14/4 for sand range over several orders of magnitude for the listed elements. For example, the Am K_d distribution ranges from 67 to 37,000, the Co K_d distribution ranges from 5 to 37,756, the Cs K_d distribution ranges from 10 to 35,210, and the Sr K_d distribution ranges from 0.4 to 2,424. Such wide distribution range values likely capture the conditions of sand at the OCNGS site. These wide ranges also demonstrate the uncertainty associated with using a deterministic K_d value (whether a site-specific value or from literature) and the importance of performing probabilistic analysis for this parameter when stochastic input is used.

When modeling a site with the RESRAD-Onsite code, uncertainty exists with the input values of many "non-soil type"-related RESRAD-Onsite parameters. Probabilistic analyses evaluated the uncertainty for every parameter for which a distribution from NUREG/CR-7267 and ANL/EVS/TM-14/4 was used as input, including "non-soil type" parameters such as external gamma shielding factor, mass loading for inhalation, soil ingestion rate, contaminated fraction of aquatic food, and bioaccumulation (transfer) factors for fish.

A large portion of the uncertainty associated with the input value for a risk-sensitive RESRAD parameter is likely captured by assigning a reasonably conservative input value, such as the 75^{th} or 25^{th} percentile value in the parameter's distribution, particularly if the distribution covers a wide range of values. The approach of assigning 75^{th} and 25^{th} percentile values of a risk-sensitive parameter's distribution to account for uncertainty in DCGL values has been accepted in past decommissioning projects (e.g., Yankee Rowe, Zion, Connecticut Yankee, Humboldt Bay, Fort Calhoun Station, and SMUD) by the NRC and State regulators.

The OCNGS probabilistic analyses performed for the RESRAD-Onsite and RESRAD-Build parameters (discussed in detail in the Sections below) identified several risk-sensitive parameters. Assigning the 75^{th} and 25^{th} percentile values of distributions that cover wide value ranges to risk-sensitive parameters increases conservatism in input and scenario modeling. When multiple parameters are identified as risk-sensitive (as is the case with the modeling of the OCNGS site), the collective conservatism in input values provides confidence that the annual dose is not

underestimated. If the uncertainty associated with one risk-sensitive parameter (e.g., K_d) is underestimated by the 75th or 25th percentile value, the impact of that single underestimation may be offset by the potential overestimated uncertainty in the 75th or 25th percentile value for other risk-sensitive parameters (e.g., transfer/bioaccumulation factors, contaminated fraction of aquatic food).

6.4.1 Computer Code Selection

The RESRAD Family of Codes has been selected to determine DCGL values at the OCNGS site. The RESRAD computer codes are pathway-analysis models developed at Argonne National Laboratory (ANL). This family of computer codes includes RESRAD-Onsite 7.2 and RESRAD-Build 3.5. Both codes were developed by ANL as multifunctional tools to assist in developing radiological criteria for unrestricted release and assessing the dose associated with residual radioactive material. The NRC approved the use of the RESRAD codes for DCGL value development.

The RESRAD-Onsite 7.2 code is designed to support evaluations of the potential radiological dose associated with residual radioactive material in soil, whereas the RESRAD-Build 3.5 computer code supports evaluations of the potential radiological dose associated with radioactive contamination on building surfaces. Both RESRAD-Onsite 7.2 and RESRAD-Build 3.5 incorporate probabilistic modules that permit the user to evaluate dose as a function of parameter distributions and identify "risk-sensitive" parameters; that is, parameters that have a significant impact on dose with changes in input value. The results from probabilistic analyses are used to determine input that increases confidence that the uncertainty associated with input values for "risk-sensitive" parameters is considered in DCGL calculations.

Information in NUREG/CR-6676 (Reference 6-8), NUREG/CR-6755 (Reference 6-9), NUREG/CR-7267, ANL/EVS/TM-18/1 (Reference 6-10), ANL/EVS/TM-14/4, and NUREG/CR-6697 (Reference 6-11) guided the use and applications of the RESRAD codes.

6.5 Development of DCGLs

DCGLs are radionuclide-specific concentration limits used by a licensee during decommissioning to achieve the regulatory dose standard that permits the release of the property and termination of the license. For the OCNGS site, DCGL values were developed based on media-specific exposure scenarios and as tools for demonstrating compliance with the NRC radiological criteria for unrestricted release (i.e., 25 mrem/y). DCGL values have been developed to support assessments for above-grade buildings, surface soils, below-grade concrete, embedded piping, and buried piping at the OCNGS site.

6.6 Development of DCGLs for Above-Grade Buildings

The Building Occupancy scenario described in NUREG/CR-5512 (Reference 6-12) was selected as the basis for developing ROC-specific DCGL values for assessing the radiological status of buildings remaining in place following license termination. The Building Occupancy scenario provides a regulatory-acceptable, conservative estimate of radiation exposure from residual radioactive contamination on surfaces in those buildings to individuals working in those buildings after license termination.

The DCGL values for building surfaces will be used to assess residual surface activity on the following buildings and structures remaining in place to support the ISFSI:

- Administration Building
- Site Emergency Building
- Materials Warehouse
- Main Access Facility
- Low-Level Radwaste Storage Facility
- Demineralized Water Storage Tank

6.6.1 Conceptual Site Model for Buildings

The critical receptor in the Building Occupancy scenario is a hypothetical adult individual who receives a dose (TEDE) from exposure to residual radioactive contamination on the floor, walls, and ceiling of a room while performing work activities for a full year of employment following decommissioning of the site.

The exposure pathways considered are:

- direct external exposure from radioactive contamination on the surfaces of floor, walls, and ceiling,
- external exposure due to air submersion,
- exposure due to inhalation of airborne radioactive material, and
- ingestion of radioactive material deposited on the surfaces.

The hypothetical worker is assumed to perform activities inside an office room for a full occupational year with 5 hours per week as overtime for 45 hours per week for 52 weeks. The representative room modeled for the OCNGS site is based on the room described for the occupancy scenario in Volume 1 of NUREG/CR-5512 and in NUREG/CR-6755: an 8m-by-8m room with 3m walls. The modeled room includes 6 area sources (i.e., floor, 4 walls, and ceiling).

6.6.2 Probabilistic Analyses of RESRAD-Build Input Parameters

Probabilistic analyses were performed to identify "risk-sensitive" RESRAD-Build input parameters in the modeling of the building occupancy scenario. A "risk-sensitive" parameter is one that produces a significant change in the calculated dose with a change in their input value. Identifying risk-sensitive input parameters is necessary to account for uncertainty in input values. The uncertainty associated with risk-sensitive input parameters is then addressed in subsequent DCGL calculations by determining and assigning reasonably conservative input values from the results of RESRAD-Build probabilistic analyses. Thus, the results of probabilistic analyses supported the development of building surface DCGL values for the OCNGS site.

The RESRAD-Build Probabilistic Output Report provides regression and correlation coefficients for the average doses at the user-defined evaluation times. The Partial Rank Correlation Coefficient (PRCC) was used to identify risk-sensitive parameters. PRCC values greater than zero (positive value) or less than zero (negative value) identify whether risk-sensitive parameters are positively or negatively correlated to dose, respectively.

The criterion for identifying sensitivity was a PRCC value with an absolute value equal to or greater than 0.1. To address the uncertainties associated with the input parameters identified as "risk-sensitive," the 75th percentile value of the parameter's distribution was selected as a reasonably conservative input value for a risk-sensitive parameter that had a positive PRCC value and the 25th percentile value of the parameter's distribution was selected as reasonably conservative input a for a risk-sensitive parameter that had a negative PRCC value.

6.6.2.1 Selection of Input

Input for the Building Occupancy scenario included deterministic values from NUREG/CR-5512, NUREG/CR-7267, and NUREG/CR-6755, and parameter distributions from NUREG/CR-7267 and NUREG/CR-6755. Input parameters were treated as either deterministic (a single value is assigned) or stochastic (a probability distribution is assigned). Treatment depended on parameter type, availability of site-specific data, and the relevance of the parameter in the dose calculations.

Input for ingestion included two potential pathways for ingesting contaminated material: indirect and direct ingestion. The indirect ingestion parameter represents the transfer of contamination (via radioactive dust particles) from building surfaces to the mouth via contact with hands, food, or other objects. This rate is different from the direct ingestion rate because an individual does not need to be in the same room as the source to be exposed by this pathway. The direct ingestion rate accounts for incidental ingestion of contaminated material directly from the source, such as during maintenance or renovation activities that involve physical contact with the source. Direct ingestion is possible only if the receptor and the source are in the same room. The value from NUREG/CR-6755 was used as input for direct ingestion to account for light maintenance or renovation activities performed within the modeled room.

The calculations and derivations of the input values used in the probabilistic analyses are provided in Engineering Calculation ENG-OCS-002 (Reference 6-13). Table 6-3 summarizes the classification, prioritization, values, and their bases for the probabilistic analysis of the RESRAD-Build parameters.

6.6.2.2 RESRAD-Build Probabilistic Analyses Results

The RESRAD-Build Probabilistic Output Report provides regression and correlation coefficients for the average doses at the user-defined evaluation times. The PRCC has been used to identify risk-sensitive parameters. NUREG/CR-7267 and NUREG/CR-6697 recommend using the PRCC for cases where non-linear relationships exist. PRCC values greater than zero (positive value) or less than zero (negative value) identify whether risk-sensitive parameters are positively or negatively correlated to dose, respectively.

The criterion for sensitivity used to identify "risk-sensitive" parameters was a PRCC value with an absolute value equal to or greater than 0.1. To address the uncertainties associated with the input parameters identified as "risk-sensitive," the 25th percentile value of the parameter's distribution was selected for risk-sensitive parameters that had a negative PRCC value, and the 75th percentile value of the parameter's distribution was selected for risk-sensitive parameters that had a positive PRCC value.

The following RESRAD-Build parameters were identified as risk-sensitive for one or more of the ROCs by probabilistic analyses:

- building air exchange rate (LAMBDAT)

- deposition velocity (UD)
- resuspension rate (DKSUS)
- ingestion rate (INGE)
- air release fraction for source number (AIRFR(#))
- time of source removal for source number (RFO(#))

Table 6-3 Input Values for the Probabilistic Analyses for RESRAD-Build Parameters

RESRAD-BUILD Input Parameter Values for Probabilistic Analysis: Building Occupancy Scenario									
Parameter	**Type[a]**	**Priority**	**Treatment[b]**	**Value or Distribution**	**Value/Distribution Reference Source**	**Distribution's Statistical Parameters[c]**			
						1	**2**	**3**	**4**
Exposure Duration (d)	B	3	D	365.25	NUREG/CR-5512, NUREG/CR-7267				
Indoor Fraction	B	2	D	0.267	NUREG/CR-5512, NUREG/CR-7267				
Evaluation Time (y)	P	3	D	1 or multiple (e.g., 1, 5, 10, 50)	T=1 corresponds to dose over the 1st year				
Number of Rooms	P	3	D	1	NUREG/CR-5512 building occupancy scenario assumes one contaminated room				
Deposition Velocity (m/s)	P	2	S	Loguniform	NUREG/CR-6755, NUREG/CR-7267	2.70E-06	2.70E-03	-	-
Resuspension Rate (s^{-1})	P	1	S	Loguniform	NUREG/CR-6755, NUREG/CR-7267	2.50E-11	1.30E-05	-	-
Air Exchange Rate for Room (h^{-1})	B	2	S	Truncated Lognormal	NUREG/CR-6755	0.4187	0.88	0.001	0.999
Room Area (m^2)	P	2	S	64	NUREG/CR-6755				
Room Height (m)	P	2	D	3	NUREG/CR-6755				
Time Fraction	B	3	D	1	Defined as most conservative value in NUREG/CR-7267				
Inhalation Rate (m^3/d)	M	2	D	33.6	NUREG/CR-5512				
Indirect Ingestion Rate (m^2/h)	B	2	S	Loguniform	NUREG/CR-6755, NUREG/CR-7267	2.80E-05	2.90E-04	-	-
Receptor Location x, y, z (m)	B	3	D	4, 4,1	Center of room based on scenario room dimensions defined in NUREG/CR-5512 and NUREG/CR-7267				
Shielding Thickness (cm)	P	2	D	0	No shielding assumed				
Shielding Density (g/cm^3)	P	1	D	1	Input value required by code execution – input has no impact due to shielding thickness input				
Shielding Material	P	3	D	water	Input value required by code execution – input has no impact due to shielding thickness input				
Number of Sources	P	3	D	6	Includes floor, ceiling and 4 walls consistent to scenario assumptions in NUREG/CR-7267				

RESRAD-BUILD Input Parameter Values for Probabilistic Analysis: Building Occupancy Scenario									
Parameter	**Type[a]**	**Priority**	**Treatment[b]**	**Value or Distribution**	**Value/Distribution Reference Source**	**Distribution's Statistical Parameters[c]**			
						1	**2**	**3**	**4**
External Dose Conversion Factor, (mrem/y per pCi/cm^2)	M	3	D	RESRAD-Build Dose Conversion Factor Library	Federal Guidance Report No.12 (FGR-12) (Reference 6-14).				
Air Submersion Dose Conversion Factor, (mrem/y per pCi/m^3)	M	3	D	RESRAD-Build Dose Conversion Factor Library	FGR-12				
Inhalation Dose Conversion Factor, (mrem/pCi)	M	3	D	RESRAD-Build Dose Conversion Factor Library	Federal Guidance Report No.11 (FGR-11) (Reference 6-15).				
Ingestion Dose Conversion Factor, (mrem/pCi)	M	3	D	RESRAD-Build Dose Conversion Factor Library	FGR-11				
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	4, 4, 0	Center of floor based on dimensions for scenario-defined room				
Source length X-axis (m)	P	2	D	8	Based on area dimensions (64 m^2) for scenario-defined room				
Source length Y-axis (m)	P	2	D	8	Based on area dimensions (64 m^2) for scenario-defined room				
Area (m^2)	P	2	D	64	Floor area for scenario-defined room				
Air Release Fraction for H-3	B	2	D	1	NUREG/CR-7267				
Air Release Fraction (all nuclides other than H-3)	B	2	S	Triangular	NUREG/CR-6755, NUREG/CR-7267	1.00E-06	1	0.07	
Direct Ingestion (h^{-1})	B	2	D	4.91E-07	NUREG/CR-6755				
Removable Fraction	P	1	D	0.1	NUREG/CR-6755, NUREG/CR-5512				
Time for Source Removal (d)	P	2	S	Triangular	NUREG/CR-6755, NUREG/CR-7267	1,000	100,000	10,000	-
Radionuclide Concentration (pCi/m^2)	P	2	D	1	ROCs identified for OCNGS site.	-	-	-	-
Source 2: Wall 1									
Type	P	3	D	Area	NUREG/CR-5512				
Direction	P	3	D	Y	NUREG/CR-5512				

RESRAD-BUILD Input Parameter Values for Probabilistic Analysis: Building Occupancy Scenario									
Parameter	**Type[a]**	**Priority**	**Treatment[b]**	**Value or Distribution**	**Value/Distribution Reference Source**	**Distribution's Statistical Parameters[c]**			
						1	**2**	**3**	**4**
Location of Center of Source: x,y,z (m)	P	3	D	4, 0, 1.5	Center of wall based on dimensions for scenario-defined room.				
Source length X-axis (m)	P	2	D	8	Based on area dimensions (64 m^2) for scenario-defined room.				
Source length Z-axis (m)	P	2	D	3	Based on height (3 m) for scenario-defined room.				
Area (m^2)	P	2	D	24	Wall area for scenario defined room.				
Air Release Fraction for H-3	B	2	D	1	NUREG/CR-7267				
Air Release Fraction (all nuclides other than H-3)	B	2	S	Triangular	NUREG/CR-6755, NUREG/CR-7267	1.00E-06	1	0.07	
Direct Ingestion (h^{-1})	B	2	D	4.91E-07	NUREG/CR-6755				
Removable Fraction	P	1	D	0.1	NUREG/CR-6755				
Time for Source Removal (d)	P	2	S	Triangular	NUREG/CR-6755, NUREG/CR-7267	1,000	100,000	10,000	-
Radionuclide Concentration (pCi/m^2)	P	2	D	1	ROCs identified for OCNGS site.	-	-	-	-
Source 3: Wall 2									
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, 4, 1.5	Center of wall based on dimensions for scenario-defined room.				
Source length Y-axis (m)	P	2	D	8	Based on area dimensions (64 m^2) for scenario-defined room.				
Source length Z-axis (m)	P	2	D	3	Based on height (3 m) for scenario-defined room.				
Area (m^2)	P	2	D	24	Wall area for scenario defined room.				
Air Release Fraction for H-3	B	2	D	1	NUREG/CR-7267				
Air Release Fraction (all nuclides other than H-3)	B	2	S	Triangular	NUREG/CR-6755, NUREG/CR-7267	1.00E-06	1	0.07	
Direct Ingestion (h^{-1})	B	2	D	4.91E-07	NUREG/CR-6755				
Removable Fraction	P	1	D	0.1	NUREG/CR-6755				
Time for Source Removal (d)	P	2	S	Triangular	NUREG/CR-6755, NUREG/CR-7267	1,000	100,000	10,000	-

RESRAD-BUILD Input Parameter Values for Probabilistic Analysis: Building Occupancy Scenario									
Parameter	**Type[a]**	**Priority**	**Treatment[b]**	**Value or Distribution**	**Value/Distribution Reference Source**	**Distribution's Statistical Parameters[c]**			
						1	**2**	**3**	**4**
Radionuclide Concentration (pCi/m^2)	P	2	D	1	ROCs identified for OCNGS site.	-	-	-	-
Source 4: Wall 3									
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	4, 8, 1.5	Center of wall based on dimensions for scenario-defined room.				
Source length X-axis (m)	P	2	D	8	Based on area dimensions (64 m^2) for scenario-defined room.				
Source length Z-axis (m)	P	2	D	3	Based on height (3 m) for scenario-defined room.				
Area (m^2)	P	2	D	24	Wall area for scenario defined room.				
Air Release Fraction for H-3	B	2	D	1	NUREG/CR-7267				
Air Release Fraction (all nuclides other than H-3)	B	2	S	Triangular	NUREG/CR-6755, NUREG/CR-7267	1.00E-06	1	0.07	
Direct Ingestion (h^{-1})	B	2	D	4.91E-07	NUREG/CR-6755				
Removable Fraction	P	1	D	0.1	NUREG/CR-6755				
Time for Source Removal (d)	P	2	S	Triangular	NUREG/CR-6755, NUREG/CR-7267	1,000	100,000	10,000	-
Radionuclide Concentration (pCi/m^2)	P	2	D	1	ROCs identified for OCNGS site.	-	-	-	-
Source 5: Wall 4									
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	8, 4, 1.5	Center of wall based on dimensions for scenario-defined room.				
Source length Y-axis (m)	P	2	D	8	Based on area dimensions (64 m^2) for scenario-defined room.				
Source length Z-axis (m)	P	2	D	3	Based on height (3 m) for scenario-defined room.				
Area (m^2)	P	2	D	24	Wall area for scenario defined room.				
Air Release Fraction for H-3	B	2	D	1	NUREG/CR-7267				

RESRAD-BUILD Input Parameter Values for Probabilistic Analysis: Building Occupancy Scenario									
Parameter	**Type[a]**	**Priority**	**Treatment[b]**	**Value or Distribution**	**Value/Distribution Reference Source**	**Distribution's Statistical Parameters[c]**			
						1	**2**	**3**	**4**
Air Release Fraction (all nuclides other than H-3)	B	2	S	Triangular	NUREG/CR-6755, NUREG/CR-7267	1.00E-06	1	0.07	
Direct Ingestion (h^{-1})	B	2	D	4.91E-07	NUREG/CR-6755				
Removable Fraction	P	1	D	0.1	NUREG/CR-6755				
Time for Source Removal (d)	P	2	S	Triangular	NUREG/CR-6755, NUREG/CR-7267	1,000	100,000	10,000	-
Radionuclide Concentration (pCi/m^2)	P	2	D	1	ROCs identified for OCNGS site.	-	-	-	-
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	4, 4, 3	Center of ceiling based on dimensions for scenario-defined room.				
Source length X-axis (m)	P	2	D	8	Based on area dimensions (64 m^2) for scenario-defined room.				
Source length Y-axis (m)	P	2	D	8	Based on area dimensions (64 m^2) for scenario-defined room.				
Area (m^2)	P	2	D	64	Ceiling area for scenario-defined room.				
Air Release Fraction for H-3	B	2	D	1	NUREG/CR-7267				
Air Release Fraction (all nuclides other than H-3)	B	2	S	Triangular	NUREG/CR-6755, NUREG/CR-7267	1.00E-06	1	0.07	
Direct Ingestion (h^{-1})	B	2	D	4.91E-07	NUREG/CR-6755				
Removable Fraction	P	1	D	0.1	NUREG/CR-5512, NUREG/CR-6755				
Time for Source Removal (d)	P	2	S	Triangular	NUREG/CR-6755, NUREG/CR-7267	1,000	100,000	10,000	-
Radionuclide Concentration (pCi/m^2)	P	2	D	1	ROCs identified for OCNGS site.	-	-	-	-

Notes:

[a] P = physical, B = behavioral, M = metabolic

[b] D = deterministic (non-stochastic), S= Stochastic.

[c] Distribution Statistical Parameters:

Loguniform: 1= minimum, 2 = maximum

Truncated lognormal-n: 1= mean, 2 = standard deviation, 3 = lower quantile, 4 = upper quantile

Triangular: 1 = minimum, 2 = maximum, 3 = most likely

Table 6-4 lists the 25th, 50th, and 75th percentile values for the identified risk-sensitive parameters as determined from the probabilistic results. These values were assigned as input in the development of DCGL values.

Table 6-4 Summary of 25th, 50th, and 75th Percentile Values for Risk-Sensitive Parameters

Risk-Sensitive Parameter	Percentile Value		
	25th	50th	75th
LAMBDAT	8.4E-01	1.5E+00	2.7E+00
UD	1.5E-05	8.5E-05	4.8E-04
DKSUS	6.6E-10	1.8E-08	4.7E-07
INGE	5.0E-05	9.0E-05	1.6E-04
AIRFR(1)	1.6E-01	3.2E-01	5.2E-01
AIRFR(2)	1.6E-01	3.2E-01	5.2E-01
AIRFR(3)	1.6E-01	3.2E-01	5.2E-01
AIRFR(4)	1.6E-01	3.2E-01	5.2E-01
AIRFR(5)	1.6E-01	3.2E-01	5.2E-01
AIRFR(6)	1.6E-01	3.2E-01	5.2E-01
RFO(1)	1.8E+04	3.3E+04	5.3E+04
RFO(2)	1.8E+04	3.3E+04	5.3E+04
RFO(3)	1.8E+04	3.3E+04	5.3E+04
RFO(4)	1.8E+04	3.3E+04	5.3E+04
RFO(5)	1.8E+04	3.3E+04	5.3E+04
RFO(6)	1.8E+04	3.3E+04	5.3E+04

6.6.3 Building Surface DCGL Values

RESRAD-Build version 3.5 code runs were performed for each ROC for the OCNGS site. Table 6-5 Provides the input values used in the RESRAD-Build executions to develop Building Surface DCGL values.

The RESRAD-Build results (i.e., mrem/y per 1.0 pCi/m^2) were used as conversion factors (CF) to develop DCGL values that corresponded to 25 mrem/y (the dose criterion for unrestricted release established in 10 CFR §20.1402). This was accomplished as follows:

$$\frac{25\ mrem/y}{RESRAD\text{-}Build\ CF(mrem/y\ per\ pCi/m^2)} = DCGL_{25}(pCi/m^2) \qquad \textbf{Equation 6-1}$$

Unit conversion of DCGL values from pCi/m^2 to dpm/100 cm^2:

$$DCGL_{25}(pCi/m^2)(2.22\ dpm/pCi)(1\ m^2/10000\ cm^2)(100) = DCGL_{25}(dpm/100\ cm^2)$$

Equation 6-2

Except for the 25th/50th/75th percentile values listed in Table 6-4, all input for building surface DCGL values were the same as those used in the probabilistic analyses. The development of building surface DCGL values is documented in Engineering Calculation ENG-OCS-004 (Reference 6-16). The RESRAD-Build dose results used as CFs, building surface $DCGL_{25}$ values using Equation 6-2, and the final conversion to DCGL values with units of dpm/100cm^2 are provided by ROC in Table 6-6.

Table 6-5 RESRAD-Build Input Values for Building Surface DCGL Values

RESRAD-Build Input Parameter Values for Oyster Creek Building Surface DCGL Values					
Parameter	**Type[a]**	**Nuclide**	**Treatment[b]**	**Value / Distribution**	**Value Reference Source**
Exposure Duration (d)	B	All ROCs	D	365.25	NUREG/CR-5512; NUREG/CR-7267
Indoor Fraction	B	All ROCs	D	0.267	NUREG/CR-5512; NUREG/CR-7267
Evaluation Time (y)	P	All ROCs	D	1 (1, 5, 10, 25, 50 for Pu-241)	T=1 corresponds to dose over the 1st year; multiple input applied to Pu-241 verify time of peak dose
Number of Rooms	P	All ROCs	D	1	NUREG/CR-5512 building occupancy scenario assumption
Deposition Velocity (m/s)	P	Am-241, Cm-243, Cm-244, Np-237, Pu-238, Pu-239, Pu-240, Pu-241	D	8.50E-05	50th percentile value
		C-14, Co-60, Cs-137, Eu-152, Eu-154, Fe-55, H-3, Mn-54, Nb-94, Ni-63, Sb-125, Sr-90, Tc-99	D	4.80E-04	75th percentile value
Resuspension Rate (s^{-1})	P	C-14, Co-60, Cs-137, Eu-152, Eu-154, Fe-55, H-3, Mn-54, Nb-94, Ni-63, Sb-125, Sr-90, Tc-99	D	6.60E-10	25th percentile value
		Am-241, Cm-243, Cm-244, Np-237, Pu-238, Pu-239, Pu-240, Pu-241	D	1.80E-08	50th percentile value
Air Exchange Rate for Room (h^{-1})	P	All ROCs	D	8.40E-01	25th percentile value
Room Area (m^2)	P	All ROCs	D	64	NURGEG/CR-6755
Room Height (m)	P	All ROCs	D	3	NURGEG/CR-6755
Time Fraction	B	All ROCs	D	1	NUREG/CR-7267
Inhalation Rate (m^3/d)	M	All ROCs	D	33.6	NUREG/CR-5512, vol. 3 (Reference 6-17)
Indirect Ingestion Rate (m^2/h)	B	Cm-243, Cm-244, Eu-152, Eu-154, Pu-238, Pu-241	D	5.00E-05	25th percentile value
		Am-241, Fe-55, Co-60, Mn-54, Pu-240, Sb-125	D	9.00E-05	50th percentile value
		C-14, Cs-137, H-3, Nb-94, Ni-63, Np-237, Pu-239, Sr-90, Tc-99	D	1.60E-04	75th percentile value
Receptor Location	B	All ROCs	D	4, 4,1	NUREG/CR-5512; center of room based on scenario room dimensions from NUREG/CR-5512 and NUREG/CR-7267
Shielding Thickness (cm)	P	All ROCs	D	0	No shielding assumed

RESRAD-Build Input Parameter Values for Oyster Creek Building Surface DCGL Values					
Parameter	**Type[a]**	**Nuclide**	**Treatment[b]**	**Value / Distribution**	**Value Reference Source**
Shielding Density (g/cm^3)	P	All ROCs	D	1	Input value required for code execution – input has no impact due to shield thickness input
Shielding Material	P	All ROCs	D	water	Input value required for code execution – input has no impact due to shield thickness input
Number of Sources	P	All ROCs		6	Includes floor, ceiling and 4 walls consistent to scenario assumptions in NUREG/CR-6755 and NUREG/CR-7267
External Dose Conversion Factor, (mrem/y per pCi/cm^2)	M	All ROCs	D	RESRAD-Build library	FGR-12 Values
Air Submersion Dose Conversion Factor, (mrem/y per pCi/m^3)	M	All ROCs	D	RESRAD-Build library	FGR-12 Values
Inhalation Dose Conversion Factor, (mrem/pCi)	M	All ROCs	D	RESRAD-Build library	FGR-11 Values
Ingestion Dose Conversion Factor, (mrem/pCi)	M	All ROCs	D	RESRAD-Build library	FGR-11 Values
Source 1: Floor					
Type	P	All ROCs		area	NUREG/CR-5512
Direction	P	All ROCs		Z	NUREG/CR-5512
Location of Center of Source: x,y,z (m)	P	All ROCs	D	4, 4, 0	Center of floor based on dimensions for defined room
Source length X-axis (m)	P	All ROCs	D	8	Based on area dimensions (64 m^2) for defined room
Source length Y-axis (m)	P	All ROCs	D	8	Based on area dimensions (64 m^2) for defined room
Area (m^2)	P	All ROCs	D	---	Source length input used
Air Release Fraction	B	H-3	D	1	NUREG/CR-7267
		All others	D	5.20E-01	75th percentile value
Direct Ingestion (h^{-1})	B	All ROCs	D	4.91E-07	NUREG/CR6755
Removable Fraction	P	All ROCs	D	0.1	NUREG/CR-5512 and NUREG/CR-6755

RESRAD-Build Input Parameter Values for Oyster Creek Building Surface DCGL Values					
Parameter	**Type[a]**	**Nuclide**	**Treatment[b]**	**Value / Distribution**	**Value Reference Source**
Time for Source Removal (d)	P	Am-241, Cm-243, Cm-244, H-3, Ni-63, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, Tc-99	D	1.80E+04	25th percentile value
		C-14, Co-60, Cs-137, Eu-152, Eu-154, Fe-55, Mn-54, Nb-94, Sb-125	D	5.30E+04	75Th percentile value
Radionuclide Concentration (pCi/m^2)	P	All ROCs	D	1	-
Source 2: Wall 1					
Type	P	All ROCs		Area	NUREG/CR-5512
Direction	P	All ROCs		Y	NUREG/CR-5512
Location of Center of Source: x,y,z (m)	P	All ROCs	D	4, 0, 1.5	Center of wall based on dimensions for defined room
Source length X-axis (m)	P	All ROCs	D	8	Based on area dimensions (64 m^2) for defined room
Source length Z-axis (m)	P	All ROCs	D	3	Based on height (3 m) for defined room
Area (m^2)	P	All ROCs	D	---	Source dimension used
Air Release Fraction	B	H-3	D	1	NUREG/CR-7267
		All others	D	5.20E-01	75th percentile value
Direct Ingestion (h^{-1})	B	All ROCs	D	4.91E-07	NUREG/CR6755
Removable Fraction	P	All ROCs	D	0.1	NUREG/CR-6755
Time for Source Removal (d)	P	Am-241, Cm-243, Cm-244, H-3, Nb-94, Ni-63, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, Tc-99	D	1.80E+04	25th percentile value
		Eu-152, Eu-154	D	3.30E+04	50th percentile value
		C-14, Co-60, Cs-137, Fe-55, Mn-54, Sb-125	D	5.30E+04	75Th percentile value
Radionuclide Concentration (pCi/m^2)	P	All ROCs	D	1	-
Source 3: Wall 2					
Type	P	All ROCs		Area	NUREG/CR-5512
Direction	P	All ROCs		X	NUREG/CR-5512
Location of Center of Source: x,y,z (m)	P	All ROCs	D	0.0, 4, 1.5	center of wall based on dimensions for defined room

RESRAD-Build Input Parameter Values for Oyster Creek Building Surface DCGL Values					
Parameter	**Type[a]**	**Nuclide**	**Treatment[b]**	**Value / Distribution**	**Value Reference Source**
Source length Y-axis (m)	P	All ROCs	D	8	Based on area dimensions (64 m^2) for defined room
Source length Z-axis (m)	P	All ROCs	D	3	Based on height (3 m) for defined room
Area (m^2)	P	All ROCs	D	---	Source dimension used
Air Release Fraction	B	H-3	D	1	NUREG/CR-7267
		All others	D	5.20E-01	75th percentile value
Direct Ingestion (h^{-1})	B	All ROCs	D	4.91E-07	NUREG/CR6755
Removable Fraction	P	All ROCs	D	0.1	NUREG/CR-6755
Time for Source Removal (d)	P	Am-241, Cm-243, Cm-244, Eu-154, H-3, Nb-94, Ni-63, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, Tc-99	D	1.80E+04	25th percentile value
		Eu-152, Fe-55	D	3.30E+04	50th percentile value
		C-14, Co-60, Cs-137, Mn-54, Sb-125	D	5.30E+04	75Th percentile value
Radionuclide Concentration (pCi/m^2)	P	All ROCs	D	1	-
Source 4: Wall 3					
Type	P	All ROCs		area	NUREG/CR-5512
Direction	P	All ROCs		Y	NUREG/CR-5512
Location of Center of Source: x,y,z (m)	P	All ROCs	D	4, 8, 1.5	Center of wall based on dimensions for defined room
Source length X-axis (m)	P	All ROCs	D	8	Based on area dimensions (64 m^2) for defined room
Source length Z-axis (m)	P	All ROCs	D	3	Based on height (3 m) for defined room
Area (m^2)	P	All ROCs	D	---	Source dimension used
Air Release Fraction	B	H-3	D	1	NUREG/CR-7267
		All others	D	5.20E-01	75th percentile value
Direct Ingestion (h^{-1})	B	All ROCs	D	4.91E-07	NUREG/CR6755
Removable Fraction	P	All ROCs	D	0.1	NUREG/CR-6755

RESRAD-Build Input Parameter Values for Oyster Creek Building Surface DCGL Values					
Parameter	**Type[a]**	**Nuclide**	**Treatment[b]**	**Value / Distribution**	**Value Reference Source**
Time for Source Removal (d)	P	Am-241, Cm-243, Cm-244, Eu-154, H-3, Nb-94, Ni-63, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, Tc-99	D	1.80E+04	25th percentile value
		Eu-152, Fe-55	D	3.30E+04	50th percentile value
		C-14, Co-60, Cs-137, Mn-54, Sb-125	D	5.30E+04	75Th percentile value
Radionuclide Concentration (pCi/m^2)	P	All ROCs	D	1	-
Source 5: Wall 4					
Type	P	All ROCs		area	NUREG/CR-5512
Direction	P	All ROCs		x	NUREG/CR-5512
Location of Center of Source: x,y,z (m)	P	All ROCs	D	8, 4, 1.5	Center of wall based on dimensions for defined room
Source length Y-axis (m)	P	All ROCs	D	8	Based on area dimensions (64 m^2) for defined room
Source length Z-axis (m)	P	All ROCs	D	3	Based on height (3 m) for defined room
Area (m^2)	P	All ROCs	D	---	Source length inputs used
Air Release Fraction	B	H-3	D	1	NUREG/CR-7267
		All others	D	5.20E-01	75th percentile value
Direct Ingestion (h^{-1})	B	All ROCs	D	4.91E-07	NUREG/CR6755
Removable Fraction	P	All ROCs	D	0.1	NUREG/CR-6755
Time for Source Removal (d)	P	Am-241, Cm-243, Cm-244, H-3, Nb-94, Ni-63, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, Tc-99	D	1.80E+04	25th percentile value
		Eu-154	D	3.30E+04	50th percentile value
		C-14, Co-60, Cs-137, Eu-152, Fe-55, Mn-54, Sb-125	D	5.30E+04	75Th percentile value
Radionuclide Concentration (pCi/m^2)	P	All ROCs	D	1	-
Source 6: Ceiling					
Type	P	All ROCs		area	NUREG/CR-5512
Direction	P	All ROCs		Z	NUREG/CR-5512

RESRAD-Build Input Parameter Values for Oyster Creek Building Surface DCGL Values					
Parameter	**Type[a]**	**Nuclide**	**Treatment[b]**	**Value / Distribution**	**Value Reference Source**
Location of Center of Source: x,y,z (m)	P	All ROCs	D	4, 4, 3	Center of ceiling based on dimensions for defined room
Source length X-axis (m)	P	All ROCs	D	8	Based on area dimensions (64 m^2) for defined room
Source length Y-axis (m)	P	All ROCs	D	8	Based on area dimensions (64 m^2) for defined room
Area (m^2)	P	All ROCs	D	---	Source length inputs used
Air Release Fraction	B	H-3	D	1	NUREG/CR-7267
		All other ROCs	D	5.20E-01	75th percentile value
Direct Ingestion (h^{-1})	B	All ROCs	D	4.91E-07	NUREG/CR6755
Removable Fraction	P	All ROCs	D	0.1	NUREG/CR-6755
Time for Source Removal (d)	P	Am-241, Cm-243, Cm-244, H-3, Ni-63, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, Tc-99	D	1.80E+04	25th percentile value
		Fe-55	D	3.30E+04	50th percentile value
		C-14, Co-60, Cs-137, Eu-152, Eu-154, Mn-54, Nb-94, Sb-125	D	5.30E+04	75Th percentile value
Radionuclide Concentration (pCi/m^2)	P	All ROCs	D	1	-

Notes:
[a] P = physical, B = behavioral, M = metabolic
[b] D = deterministic (non-stochastic), S= Stochastic.

Table 6-6 Radionuclide-Specific DCGL Values

Nuclide	DCGL Value Development		
	CF (mrem/y per 1pCi/m^2)	DCGL$_{25}$ (pCi/m^2)	DCGL (dpm/100cm^2)
Am-241	3.37E-04	7.42E+04	1.65E+03
C-14	8.64E-08	2.89E+08	6.42E+06
Cm-243	2.31E-04	1.08E+05	2.40E+03
Cm-244	1.83E-04	1.37E+05	3.03E+03
Co-60	4.11E-05	6.08E+05	1.35E+04
Cs-137	1.18E-05	2.12E+06	4.70E+04
Eu-152	2.05E-05	1.22E+06	2.71E+04
Eu-154	2.17E-05	1.15E+06	2.56E+04
Fe-55	1.44E-08	1.74E+09	3.85E+07
H-3	2.64E-09	9.47E+09	2.10E+08
Mn-54	1.04E-05	2.40E+06	5.34E+04
Nb-94	3.00E-05	8.33E+05	1.85E+04
Ni-63	3.41E-08	7.33E+08	1.63E+07
Np-237	4.15E-04	6.02E+04	1.34E+03
Pu-238	2.95E-04	8.47E+04	1.88E+03
Pu-239	3.26E-04	7.67E+04	1.70E+03
Pu-240	3.26E-04	7.67E+04	1.70E+03
Pu-241	8.22E-06	3.04E+06	6.75E+04
Sb-125	7.38E-06	3.39E+06	7.52E+04
Sr-90	6.82E-06	3.67E+06	8.14E+04
Tc-99	1.10E-07	2.27E+08	5.05E+06

6.6.4 Area Factors for Building Surface DCGL Values

RESRAD-Build 3.5 was used to develop area factors (AFs) to maintain consistency with the approach used in the building surface sensitivity analysis and DCGL calculations.

Except for the number of sources and source size, all input is the same as that used in the building structure DCGL calculations. Only one source is modeled instead of the six sources considered in calculating the building structure DCGL values. The base case for AF values is a single area source (i.e., a 64 m^2 floor). Five smaller area sources were assumed with the receptor located 1 meter away from the source midpoint: 50 m^2, 10 m^2, 5 m^2, 2.5 m^2, and 1 m^2.

AF values for the buildings/structures were calculated in a 2-step process. First, the total doses from all pathways for each ROC for a base case and the assumed reduced sizes of contaminated areas were calculated using RESRAD-Build 3.5. Then, the AF values are determined from the ratio of the dose for the base case to the dose for each assumed smaller contaminated area. The area sizes assumed are 64 m^2 (base case), 50 m^2, 10 m^2, 5 m^2, 2.5 m^2, and 1 m^2. The source dimensions for the X- and Y-axes for the base case and smaller areas are assumed equal to the square root of the size of the area source. Table 6-7 summarizes the RESRAD-Build dose results for the various area sizes by ROC.

The AF values were calculated from the RESRAD-Build doses as follows:

$$AF = dose_{64}/dose_i \qquad \textbf{Equation 6-3}$$

Where:

- $dose_{64}$ = base case dose
- $dose_i$ = dose for area size i = 50 m^2, 10 m^2, 5 m^2, 2.5 m^2, and 1 m^2

The calculations and derivations of the input values used in the development of AF values are provided in Engineering Calculation ENG-OCS-006 (Reference 6-18). Table 6-8 shows the AF values for each area size by ROC.

Table 6-7 RESRAD-Build 3.5 Dose Results

Area (m^2)	Annual Dose (mrem) from 1 pCi/m^2:										
	Am-241	**C-14**	**Cm-243**	**Cm-244**	**Co-60**	**Cs-137**	**Eu-152**	**Eu-154**	**Fe-55**	**H-3**	**Mn-54**
64	9.64E-05	2.48E-08	6.65E-05	5.23E-05	1.98E-05	5.40E-06	9.88E-06	1.05E-05	4.06E-09	7.54E-10	5.05E-06
50	7.54E-05	1.94E-08	5.21E-05	4.08E-05	1.82E-05	4.90E-06	9.07E-06	9.60E-06	3.17E-09	5.89E-10	4.64E-06
10	1.52E-05	3.92E-09	1.07E-05	8.16E-06	9.19E-06	2.38E-06	4.58E-06	4.85E-06	6.34E-10	1.18E-10	2.35E-06
5	7.65E-06	1.99E-09	5.48E-06	4.10E-06	6.13E-06	1.58E-06	3.06E-06	3.23E-06	3.19E-10	5.91E-11	1.57E-06
2.5	3.82E-06	9.95E-10	2.77E-06	2.04E-06	3.76E-06	9.64E-07	1.87E-06	1.98E-06	1.58E-10	2.94E-11	9.63E-07
1	1.54E-06	4.01E-10	1.12E-06	8.18E-07	1.78E-06	4.55E-07	8.88E-07	9.40E-07	6.35E-11	1.18E-11	4.56E-07
Area (m^2)	**Annual Dose (mrem) from 1 pCi/m^2:**										
	Nb-94	**Ni-63**	**Np-237**	**Pu-238**	**Pu-239**	**Pu-240**	**Pu-241**	**Sb-125**	**Sr-90**	**Tc-99**	
64	1.41E-05	9.74E-09	1.19E-04	8.43E-05	9.32E-05	9.31E-05	1.81E-06	3.57E-06	1.97E-06	3.16E-08	
50	1.29E-05	7.61E-09	9.35E-05	6.58E-05	7.28E-05	7.27E-05	1.42E-06	3.28E-06	1.54E-06	2.48E-08	
10	6.54E-06	1.52E-09	1.93E-05	1.32E-05	1.46E-05	1.45E-05	2.83E-07	1.66E-06	3.23E-07	5.15E-09	
5	4.37E-06	7.64E-10	9.86E-06	6.61E-06	7.31E-06	7.30E-06	1.42E-07	1.11E-06	1.66E-07	2.64E-09	
2.5	2.68E-06	3.80E-10	4.99E-06	3.29E-06	3.64E-06	3.63E-06	7.08E-08	6.78E-07	8.45E-08	1.34E-09	
1	1.27E-06	1.52E-10	2.03E-06	1.32E-06	1.46E-06	1.46E-06	2.84E-08	3.21E-07	3.46E-08	5.47E-10	

Table 6-8 Building Surface Area Factors by Radionuclide and Area Size

Area (m^2)	Area Factor Values: Am-241	C-14	Cm-243	Cm-244	Co-60	Cs-137	Eu-152	Eu-154	Fe-55	H-3	Mn-54
64	1	1	1	1	1	1	1	1	1	1	1
50	1	1	1	1	1	1	1	1	1	1	1
10	6	6	6	6	2	2	2	2	6	6	2
5	13	12	12	13	3	3	3	3	13	13	3
2.5	25	25	24	26	5	6	5	5	26	26	5
1	63	62	59	64	11	12	11	11	64	64	11

Area (m^2)	Area Factor Values: Nb-94	Ni-63	Np-237	Pu-238	Pu-239	Pu-240	Pu-241	Sb-125	Sr-90	Tc-99
64	1	1	1	1	1	1	1	1	1	1
50	1	1	1	1	1	1	1	1	1	1
10	2	6	6	6	6	6	6	2	6	6
5	3	13	12	13	13	13	13	3	12	12
2.5	5	26	24	26	26	26	26	5	23	24
1	11	64	59	64	64	64	64	11	57	58

6.7 Development of DCGLs for Site Surface Soil

The IU scenario selected as the OCNGS site compliance scenario was the basis for developing ROC-specific DCGL values for assessing the radiological status of site surface soil. The IU scenario provides a conservative estimate of radiation exposure from residual radioactive contamination in site surface soils to individuals working at an industrial site. Residual concentrations of plant-related radioactive contamination in soil within the OCNGS site boundary meeting the soil DCGL values demonstrate compliance to NRC radiological criteria as applied to an industrial setting.

6.7.1 Conceptual Site Model for Surface Soil

In the OCNGS IU Scenario, the average member of the critical group is a hypothetical full-time industrial site worker assigned outdoor tasks and who also catches and consumes fish from the intake/discharge canal during off-hours. The critical receptor is assumed to work outdoors 7 hours each workday for 50 work weeks regardless of weather and seasonal conditions. This assumption increases the conservatism in the outdoor inhalation exposure time and ignores (i) seasonal conditions (e.g., cold temperatures and icing during winter months) that would prohibit outdoor work and (ii) weather conditions, such as rain and snow, that would suppress the potential for airborne radioactive material while the critical receptor is outdoors. In addition, when this assumption is combined with a conservative input for the inhalation rate (i.e., the 75th percentile value from the inhalation rate distribution), there is high confidence that the contribution from the inhalation pathway to the total dose is conservatively assessed.

Lacey Township's industrial zones allow for a wide variety of uses, including manufacturing, construction, and other forms of power generation. Crop production or raising meat/milk animals for human consumption are not likely events for these types of industrial settings, which eliminate the use of site groundwater or existing groundwater wells as a source for irrigation of crops or drinking water for animals. Therefore, ingestion exposure pathways for plant, meat, and milk are assumed absent in the IU scenario.

Additionally, in the IU scenario, it is assumed that there is no potable groundwater source on the industrial site because all drinking water and water for other uses is provided by a municipal water supply. Lacey Township has installed the infrastructure all connections to a municipal water supply are in place to meet all future potable water needs at the site. The OC IU scenario assumes that the industrial occupier of the site takes advantage of the Lacey Township water connection already in place at license termination rather than use site groundwater to meet site water needs. This assumption is supported by Lacey Ordinance #93-31, which establishes requirements to disconnect water service from water wells and seal the wells (§ 329-2, Subsections E (1), (2), and (3)). OCNGS site is located in Block 1001, Lot 4.02, which is listed in § 329-2, Subsection E (4) making the site subject to the provisions in § 329-2, Subsections E (1), (2), and (3). Additionally, the Township of Lacey, through its Board of Health or the Ocean County Board of Health, will conduct inspections to ensure compliance with the requirement that any water well be disconnected and sealed.

The estimated annual dose from residual radioactive contamination in the soil to the critical receptor is due to the following exposure pathways:

- Direct external radiation exposure (on-site time-dependent)

- Inhalation exposure (on-site time-dependent)
- Inadvertent ingestion of contaminated soil (on-site time-dependent)
- Exposure via ingestion of aquatic food from the intake/discharge canal (on-site time-independent)

The conceptual hydrological model for this IU scenario has three geological strata: (1) a contaminated zone (CZ), (2) an unsaturated zone (UZ), and (3) a saturated zone (SZ). The CZ is assumed to be uncovered, equivalent in size to the OCNGS Protected Area (PA). The UZ, SZ, and groundwater are assumed initially uncontaminated.

6.7.2 Probabilistic Analyses of RESRAD-Onsite Input Parameters

Probabilistic analyses were performed to identify "risk-sensitive" RESRAD-Onsite parameters in the modeling of the IU scenario. A "risk-sensitive" parameter is one that produces a significant change in the calculated dose with a change in the input value. The uncertainty associated with risk-sensitive parameters is addressed in subsequent DCGL calculations by determining and assigning reasonably conservative input values from the results of RESRAD-Onsite probabilistic analyses. Thus, the results of probabilistic analyses supported the development of surface soil DCGL values for the OCNGS site.

The RESRAD-Onsite Probabilistic Output Report provides regression and correlation coefficients for the time the peak of the mean (POM) dose occurs. The PRCC was used to identify risk-sensitive parameters. PRCC values greater than zero (positive value) or less than zero (negative value) identify whether risk-sensitive parameters are positively or negatively correlated to dose, respectively.

The criterion for identifying risk-sensitive parameters was a PRCC value with an absolute value equal to or greater than 0.25. To address the uncertainties associated with the input parameters identified as risk-sensitive, the 75th percentile value of the parameter's distribution was selected as a reasonably conservative input value for a parameter that had a positive PRCC value equal to or greater than 0.25, and the 25th percentile value of the parameter's distribution was selected as reasonably conservative input a for a risk-sensitive parameter that had a negative PRCC value equal to or greater than 0.25.

6.7.2.1 Selection of Input

Input parameters were treated as either deterministic (a single value is assigned) or stochastic (a parameter distribution is assigned). Treatment depended on parameter type, availability of site-specific data, and the relevance of the parameter in the dose calculations. Behavioral and metabolic parameters were treated as deterministic and were assigned values from NUREG/CR-5512, NUREG/CR-7267, or the RESRAD User Manual.

Physical parameters describe the site and would not change if the receptor changed. Using site data as input values for RESRAD-Onsite parameters that describe the OCNGS site enables site-specific analyses and the development of site-specific DCGL values. Site-specific parameters are those that describe the following attributes:

- area and thickness of the CZ
- site soil type
- site vertical strata

- site soil hydrogeologic characteristics
- site topography
- nearby watershed
- site meteorology

Physical parameters for which site-specific data are unavailable were assigned parameter distributions from NUREG/CR-7267 or ANL/EVS/TM-14/4. ANL/EVS/TM-14/4 does not list K_d distributions for some elements (e.g., C, Eu, tritium, and Nb); therefore, the K_d distributions for these elements and assigned to the OCNGS ROCs were obtained from NUREG/CR-7267.

Input values for the fractions of time that the critical receptor spends outdoors and indoors while on-site are based on the assumption that the worker spends 7 hours per day on outdoor tasks and 1 hour per day for indoor work breaks. While on-site, the critical receptor receives radiation dose via the on-site time-dependent exposure pathways (listed in Section 6.7.1). The critical receptor also catches and ingests aquatic food from the intake/discharge canal. Input for aquatic food parameters included distributions for the fraction of contaminated aquatic food in the receptor's diet and bioaccumulation (transfer) factors for fish (obtained from NUREG/CR-7267).

In the OC IU scenario, the critical receptor is assumed to receive an unshielded external dose of 7h during every 8h workday (87.5% of the time on site) and a shielded external dose of 1h during an 8h workday (12.5% of the time on site). In lieu of a site-building material-specific shielding study and due to the short shielded exposure time, the distribution from NUREG/CR-7267 was used as input, and the 75th percentile value was selected as reasonably conservative input for external shielding.

The area of the CZ is assumed to be equal to the OCNGS yard area within the perimeter fence, 124,400 m2 (based on the CAD drawing of the OCNGS PA). The thickness of the CZ was determined from OCNGS radiological data from recent and historical site soil samples collected at various depths. The use of available site soil data to determine the thickness of the CZ is consistent with NRC expectations. Plant-related contamination in soil samples collected at a depth of 13 ft has been documented in OCNGS documents. The use of 13 feet as the maximum depth for contamination and 6 inches as the minimum thickness of the CZ supported the development of a site-specific uniform distribution. The modeling of the OCNGS CZ allows the application of DCGL values in the assessment of results from surface and subsurface soil samples. And soil exposed during excavations.

A site-specific distribution for the thickness of the UZ was determined from the minimum CZ thickness and groundwater depth range provided in the OCNGS HIR. The minimum UZ thickness represented the distance between the minimum CZ thickness and the minimum depth to groundwater, and the maximum UZ thickness was determined from the minimum CZ thickness and the maximum depth to groundwater. This resulted in a site-specific uniform distribution as RESRAD input for the thickness of the UZ.

The parameter "length parallel to the aquifer flow" is defined as the maximum horizontal distance measured in the CZ, 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 CZ was approximated by a circle with an area of 124,400 m^2 (the area of the OCNGS PA). The diameter of the circle with an area equal to 124,400 m^2 was used as input for the length parallel to the aquifer parameter.

Input for the thickness of the UZ was based on site-specific information for groundwater depths provided in the OCNGS HIR. A site-specific uniform distribution was developed from the minimum and maximum depth to groundwater at the OCNGS site (5 ft to 20 ft) and the minimum and maximum thickness of the CZ (0.5 ft to 13 ft).

Sand was selected as the soil type for the CZ and UZ based on information provided in the OCNGS Hydrogeologic Investigation Report.

Site-specific input values for the RESRAD-Onsite hydrogeologic parameters, such as hydraulic gradient, hydraulic conductivity, and the effective porosity of site soil in the UZ and SZ, as well as the selection of sand as the soil type for the OCNGS site, were obtained from the OCNGS Hydrogeologic Investigation Report.

The calculations and derivations of the input values used in the probabilistic analyses for the surface soil and the IU scenario are provided in Engineering Calculation ENG-OCS-007 (Reference 6-19). Table 6-9 and Table 6-10 are scenario-specific input tables; that is, they summarize the input values and source of information for all RESRAD-Onsite parameters specifically used in the probabilistic analyses for the modeled IU scenario. Similar input tables will be developed for probabilistic analysis for other scenarios that may be modeled using the RESRAD-Onsite code.

Table 6-9 IU Scenario Exposure Pathways

IU Scenario RESRAD Exposure Pathways	
External Gamma	Open
Inhalation	Open
Plant Ingestion	Close
Meat Ingestion	Close
Milk Ingestion	Close
Aquatic Foods	Open
Drinking Water	Close
Soil Ingestion	Open
Radon	Close

Table 6-10 Input Values and Basis for RESRAD-Onsite Parameters: Probabilistic Analyses for the IU Scenario

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Soil Concentrations										
Basic radiation dose limit (mrem/y)	P	3	D	25	10 CFR §20.1402	NR	NR	NR	NR	
Initial principal radionuclide (pCi/g)	P	2	D	1	Unit Value	NR	NR	NR	NR	
Distribution coefficients (values for sand soil type, cm^3/g)										
Ac-227	P	1	S	Truncated lognormal-n	NUREG/CR-7267	7.44	1.1	0.001	0.999	1700
Am-241	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.91	1.95	0.001	0.999	1000
Am-243	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.91	1.95	0.001	0.999	1000
C-14	P	1	S	Truncated lognormal-n	NUREG/CR-7267	3.04	1.82	0.001	0.999	21
Cm-243	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.13	2.64	0.001	0.999	3400
Cm-244	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.13	2.64	0.001	0.999	3400
Co-60	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.56	2.89	0.001	0.999	260
Cs-137	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.27	1.79	0.001	0.999	530
Eu-152	P	1	S	Truncated lognormal-n	NUREG/CR-7267	6.86	4.01	0.001	0.999	955
Eu-154	P	1	S	Truncated lognormal-n	NUREG/CR-7267	6.86	4.01	0.001	0.999	955
Fe-55	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.77	0	0.001	0.999	320
Gd-152	P	1	S	Truncated lognormal-n	NUREG/CR-7267	1.61	3.22	0.001	0.999	5
H-3	P	1	S	Truncated lognormal-n	NUREG/CR-7267	-2.81	0.5	0.001	0.999	0.06
Mn-54	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.89	2.64	0.001	0.999	980
Nb-94	P	1	S	Truncated lognormal-n	NUREG/CR-7267	7.31	1.39	0.001	0.999	1500
Ni-63	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.87	2.3	0.001	0.999	130
Np-237	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	2.64	1.39	0.001	0.999	14
Pa-231	P	1	S	Truncated lognormal-n	NUREG/CR-7267	7.6	1.1	0.001	0.999	2000
Pb-210	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.39	1.39	0.001	0.999	220
Po-210	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.61	1.79	0.001	0.999	100
Pu-238	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.99	1.39	0.001	0.999	400
Pu-239	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.99	1.39	0.001	0.999	400
Pu-240	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.99	1.39	0.001	0.999	400
Pu-241	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.99	1.39	0.001	0.999	400
Ra-226	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.04	2.08	0.001	0.999	3100
Ra-228	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.04	2.08	0.001	0.999	3100
Sb-125	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	2.83	1.79	0.001	0.999	17
Sr-90	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	3.09	1.79	0.001	0.999	22
Tc-99	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	-3.22	1.1	0.001	0.999	0.04

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Te-125m	P	1	S	Truncated lognormal-n	NUREG/CR-7267	6.31	3.22	0.001	0.999	550
Th-228	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
Th-229	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
Th-230	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
Th-232	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
U-233	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
U-234	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
U-235	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
U-236	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
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	1, 3, 10, 30, 100, 300, 1000	RESRAD Default	NR	NR	NR	NR	
Contaminated Zone										
Area of contaminated zone (m^2)	P	2	D	124,400	OCNGS PA	NR	NR	NR	NR	
Thickness of contaminated zone (m)	P	2	S	Uniform	Minimum thickness to maximum thickness based on subsurface soil data in OCGS HSA (section 7.2.1.2.7.)	0.1524	3.96			2.06
Length parallel to aquifer flow (m)	P	2	D	398	Site-specific – assumed diameter of a circle with an area OCNGS PA	NR	NR	NR	NR	
Cover and Contaminated Zone Hydrological Data										
Cover depth (m)	P	2	D	0	No cover	NR	NR	NR	NR	
Density of contaminated zone (g/cm^3)	P	1	S	Bounded Normal	NUREG/CR-7267 distribution for site soil type - sand.	1.5105	0.159	1.019	2.002	1.5105
Contaminated zone erosion rate (m/y)	P	2	D	6.0E-04	NUREG/CR-7267; assumed erosion rate for site with shallow slope	NR	NR	NR	NR	
Contaminated zone total porosity	P	2	S	Bounded Normal	NUREG/CR-7267 distribution for site soil type - sand	0.43	0.06	0.2446	0.6154	0.43
Contaminated zone field capacity	P	3	D	0.18	Calculated using equation in NUREG/CR-7267	NR	NR	NR	NR	
Contaminated zone hydraulic conductivity (m/y)	P	2	D	2741	OCNGS *Hydrogeologic Investigation Report*	NR	NR	NR	NR	

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Contaminated zone b parameter	P	2	S	Bounded Log Normal n	NUREG/CR-7267 distribution for site soil type - sand	- 0.0253	0.216	0.501	1.90	0.975
Humidity in air (g/m^3)	P	3	D	6.6	Figure 1 in *Regional and Site-Specific Absolute Humidity Data for Use in Tritium Dose Calculations* (Reference 6-20)	NR	NR	NR	NR	
Evapotranspiration coefficient	P	2	S	Uniform	NUREG/CR-7267	0.5	0.75	NR	NR	0.625
Average annual wind speed (m/s)	P	2	D	3.13	Internet search: https://www.windfinder.com/windstatistics/oyster_creek_barnegat_bay	NR	NR	NR	NR	
Precipitation (m/y)	P	2	D	1.4	Annual Report on the Meteorological Program at Oyster Creek Generating Station – average annual precipitation for 2015 through 2020 (Reference 6-21 through 6-26)	NR	NR	NR	NR	
Irrigation (m/y)	B	3	D	0.2	RESRAD default	NR	NR	NR	NR	
Irrigation mode	B	3	D	Overhead	Overhead irrigation is common practice for crops in U.S.	NR	NR	NR	NR	
Runoff coefficient	P	2	D	0.2	Value determined using methodology described in *Data Collection Handbook* and NUREG/CR-7267	NR	NR	NR	NR	
Watershed area for nearby stream or pond (m^2)	P	3	D	1.01E+08	NJ-GeoWeb (NJDEP BGIS) (Reference 6-27)	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/CR-7267 distribution for site soil type - sand	1.5105	0.159	1.019	2.002	1.5105
Saturated zone total porosity	P	1	S	Bounded Normal	NUREG/CR-7267 distribution for site soil type - sand	0.43	0.06	0.2446	0.6154	0.43
Saturated zone effective porosity	P	1	D	0.25	OCNGS *Hydrogeologic Investigation Report*	NR	NR	NR	NR	
Saturated zone field capacity	P	3	D	0.18	Value based on site-specific soil type (sand); calculated using equation in NUREG/CR-7267	NR	NR	NR	NR	
Saturated zone hydraulic conductivity (m/y)	P	1	D	2741	OCNGS *Hydrogeologic Investigation Report*	NR	NR	NR	NR	
Saturated zone hydraulic gradient	P	2	S	Uniform	OCNGS *Hydrogeologic Investigation Report* (section 5.1.4)	0.01	0.04			0.025
Saturated zone b parameter	P	2	S	Bounded Log Normal n	NUREG/CR-7267 distribution for site soil type – sand	- 0.0253	0.216	0.501	1.90	0.975
Water table drop rate (m/y)	P	3	D	1.00E-03	RESRAD Default	NR	NR	NR	NR	

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Well pump intake depth (m below water table)	P	2	D	10	RESRAD Default	NR	NR	NR	NR	
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		N/A	Input not required – drinking water pathway inactive					
Unsaturated Zone Hydrological Data										
Number of unsaturated zone strata	P	3	D	1	*OCNGS Hydrogeologic Investigation Report*	NR	NR	NR	NR	
Unsat. zone 1, thickness (m)	P	1	S	uniform	Distribution developed from depth range for site groundwater (2017 *Hydrogeologic Investigation Report* and minimum thickness of CZ	1.37	5.94			3.65
Unsat. zone 1, soil density (g/cm^3)	P	2	S	Bounded Normal	NUREG/CR-7267 distribution for site soil type – sand	1.5105	0.159	1.019	2.002	1.5105
Unsat. zone 1, total porosity	P	2	S	Bounded Normal	NUREG/CR-7267 distribution for site soil type – sand	0.43	0.06	0.2446	0.6154	0.43
Unsat. zone 1, effective porosity	P	2	D	0.25	OCNGS *Hydrogeologic Investigation Report*	NR	NR	NR	NR	
Unsat. zone 1, field capacity	P	3	D	0.18	Value based on site-specific soil type (sand); calculated using equation in NUREG/CR-7267	NR	NR	NR	NR	
Unsat. zone 1, hydraulic conductivity (m/y)	P	2	D	2741	OCNGS *Hydrogeologic Investigation Report*	NR	NR	NR	NR	
Unsat. zone 1, soil-specific b parameter	P	2	S	Bounded Log Normal n	NUREG/CR-7267 distribution for site soil type – sand	- 0.0253	0.216	0.501	1.90	0.975
Occupancy										
Inhalation rate (m^3/y)	B	3	S	Triangular	NUREG/CR-7267	4380	8400	13000		8593
Mass loading for inhalation (g/m^3)	P	2	S	Continuous linear	NUREG/CR-7267					2.3E-05
Exposure duration	B	3	D	30	RESRAD Default	NR	NR	NR	NR	
Indoor dust filtration factor	P	2	S	Uniform	NUREG/CR-7267	0.15	0.95			0.55
Shielding factor, external gamma	P	2	S	Bounded lognormal-n	NUREG/CR-7267	-1.3	0.59	0.044	1	0.2725
Fraction of time spent indoors	B	3	D	0.03	Fraction of calendar year assuming 1h/work day for daily work breaks during an occupational year	NR	NR	NR	NR	
Fraction of time spent outdoors	B	3	D	0.2	Fraction of calendar year assuming 7h/work day for outside tasks during an occupational year	NR	NR	NR	NR	
Shape factor flag, external gamma	P	3	D	Circular	RESRAD Default - Circular contaminated zone assumed	NR	NR	NR	NR	

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Ingestion, Dietary										
Fruits, vegetables, grain consumption (kg/y)	B	2	D	N/A	Input not required - plant ingestion pathway inactive	NR	NR	NR	NR	
Leafy vegetable consumption (kg/y)	B	3	D	N/A	Input not required - plant ingestion pathway inactive	NR	NR	NR	NR	
Milk consumption (L/y)	B	2	D	N/A	Input not required - milk ingestion pathway inactive	NR	NR	NR	NR	
Meat and poultry consumption (kg/y)	B	3	D	N/A	Input not required - meat ingestion pathway inactive	NR	NR	NR	NR	
Fish consumption (kg/y)	B	3	D	20.6	NUREG/CR-5512	NR	NR	NR	NR	
Other seafood consumption (kg/y)	B	3	D	0.9	RESRAD Default	NR	NR	NR	NR	
Soil & dust ingestion rate (g/y)	B	2	S	Triangular	NUREG/CR-7267	0	18.3	36.5		18.3
Drinking water intake (L/y)	B	2		N/A	Input not required – drinking water pathway inactive					
Contamination fraction of drinking water	P	3		N/A	Input not required – drinking water pathway inactive					
Contamination fraction of household water	P	3		N/A	Input not required – water pathway inactive					
Contamination fraction of livestock water	P	3		N/A	Input not required – drinking water/ingestion pathways inactive					
Contamination fraction of irrigation water	P	3		N/A	Input not required – plant ingestion pathway inactive					
Contamination fraction of aquatic food	P	2	S	Triangular	NUREG/CR-7267	0	0.39	1		0.45
Contamination fraction of plant food	P	3		N/A	Input not required – plant ingestion pathway inactive					
Contamination fraction of meat	P	3		N/A	Input not required – meat ingestion pathway inactive					
Contamination fraction of milk	P	3		N/A	Input not required – milk ingestion pathway inactive					
Ingestion, Non-Dietary										
Livestock fodder intake for meat (kg/d)	M	3		N/A	Input not required – meat ingestion pathway inactive					
Livestock fodder intake for milk (kg/d)	M	3		N/A	Input not required – milk ingestion pathway inactive					
Livestock water intake for meat (L/d)	M	3		N/A	Input not required – water ingestion pathway inactive					
Livestock water intake for milk (L/d)	M	3		N/A	Input not required – milk ingestion pathway inactive					
Livestock soil intake (kg/d)	M	3		N/A	Input not required – meat ingestion pathway inactive					

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Mass loading for foliar deposition (g/m^3)	P	3		N/A	Input not required – plant ingestion pathway inactive					
Depth of soil mixing layer (m)	P	2	D	0.15	RESRAD Default	NR	NR	NR	NR	
Depth of roots (m)	P	1		N/A	Input not required – plant ingestion pathway inactive					
Drinking water fraction from ground water	P	3		N/A	Input not required – drinking water ingestion pathway inactive					
Household water fraction from ground water (if used)	P	3		N/A	Input not required – drinking water pathway inactive					
Livestock water fraction from ground water	P	3		N/A	Input not required – drinking water/meat ingestion pathways inactive					
Irrigation fraction from ground water	P	3		N/A	Input not required – drinking water pathway inactive					
Wet weight crop yield for Non-Leafy (kg/m^2)	P	2		N/A	Input not required – plant ingestion pathway inactive					
Wet weight crop yield for Leafy (kg/m^2)	P	3		N/A	Input not required – plant ingestion pathway inactive					
Wet weight crop yield for Fodder (kg/m^2)	P	3		N/A	Input not required – meat ingestion pathway inactive					
Growing Season for Non-Leafy (y)	P	3		N/A	Input not required – plant ingestion pathway inactive					
Growing Season for Leafy (y)	P	3		N/A	Input not required – plant ingestion pathway inactive					
Growing Season for Fodder (y)	P	3		N/A	Input not required – meat ingestion pathway inactive					
Translocation Factor for Non-Leafy	P	3		N/A	Input not required – plant ingestion pathway inactive					
Translocation Factor for Leafy	P	3		N/A	Input not required – plant ingestion pathway inactive					
Translocation Factor for Fodder	P	3		N/A	Input not required – meat ingestion pathway inactive					
Weathering Removal Constant for Vegetation (1/y)	P	2		N/A	Input not required – plant ingestion pathway inactive					
Wet Foliar Interception Fraction for Non-Leafy	P	3		N/A	Input not required – plant ingestion pathway inactive					
Wet Foliar Interception Fraction for Leafy	P	2		N/A	Input not required – plant ingestion pathway inactive					
Wet Foliar Interception Fraction for Fodder	P	3		N/A	Input not required – meat ingestion pathway inactive					
Dry Foliar Interception Fraction for Non-Leafy	P	3		N/A	Input not required – plant ingestion pathway inactive					
Dry Foliar Interception Fraction for Leafy	P	3		N/A	Input not required – plant ingestion pathway inactive					

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Dry Foliar Interception Fraction for Fodder	P	3		N/A	Input not required – meat ingestion pathway inactive					
Storage times of contaminated foodstuffs (days)										
Fruits, non-leafy vegetables, and grain	B	3		N/A	Input not required – plant ingestion pathway inactive					
Leafy vegetables	B	3		N/A	Input not required – plant ingestion pathway inactive					
Milk	B	3		N/A	Input not required – milk ingestion pathway inactive					
Meat and poultry	B	3		N/A	Input not required – meat ingestion pathway inactive					
Fish	B	3	D	7	RESRAD Default	NR	NR	NR	NR	
Crustacea and mollusks	B	3	D	7	RESRAD Default	NR	NR	NR	NR	
Well water	B	3		N/A	Input not required – drinking water pathway inactive					
Surface water	B	3		N/A	Input not required drinking water pathway inactive					
Livestock fodder	B	3		N/A	Input not required – meat ingestion pathway inactive					
Special Radionuclides (C-14)										
C-12 concentration in water (g/cm^3)	P	3	D	2.00E-05	RESRAD Default	NR	NR	NR	NR	
C-12 concentration in contaminated soil (g/g)	P	3	D	3.00E-02	RESRAD Default	NR	NR	NR	NR	
Fraction of vegetation carbon from soil	P	3	D	2.00E-02	RESRAD Default	NR	NR	NR	NR	
Fraction of vegetation carbon from air	P	3	D	9.80E-01	RESRAD Default	NR	NR	NR	NR	
C-14 evasion layer thickness in soil (m)	P	2	D	0.3	RESRAD Default	NR	NR	NR	NR	
C-14 evasion flux rate from soil (1/s)	P	3	D	7.00E-07	RESRAD Default	NR	NR	NR	NR	
C-12 evasion flux rate from soil (1/s)	P	3	D	1.00E-10	RESRAD Default	NR	NR	NR	NR	
Fraction of grain in beef cattle feed	B	3	D	0.8	RESRAD Default	NR	NR	NR	NR	
Fraction of grain in milk cow feed	B	3	D	0.2	RESRAD Default	NR	NR	NR	NR	
Inhalation Dose Conversion Factors (mrem/pCi inhaled) from FGR11 (contained in RESRAD Dose Conversion Library)										
Ingestion Dose Conversion Factors (mrem/pCi ingested) from FGR11 (contained in RESRAD Dose Conversion Library)										
Plant Transfer Factors (pCi/g plant)/(pCi/g soil) Note: Plant ingestion pathway closed – input for plant transfer factors not required for IU dose calculations.										
Meat Transfer Factors (pCi/kg)/(pCi/d) Note: Meat ingestion pathway closed – input for meat transfer factors not required for IU dose calculations.										

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Milk Transfer Factors (pCi/L)/(pCi/d) Note: Milk ingestion pathway closed – input for milk transfer factors not required for IU dose calculations.										
Bioaccumulation Factors for Fish ((pCi/kg)/(pCi/L))										
Ac-227	P	2	S	Lognormal-n	NUREG/CR-7267	3.2	1.1			
Am-241	P	2	S	Lognormal-n	NUREG/CR-7267	5.5	1.1			
Am-243	P	2	S	Lognormal-n	NUREG/CR-7267	5.5	1.1			
C-14	P	2	S	Lognormal-n	NUREG/CR-7267	13.0	1.1			
Cm-243	P	2	S	Lognormal-n	NUREG/CR-7267	3.4	1.1			
Cm-244	P	2	S	Lognormal-n	NUREG/CR-7267	3.4	1.1			
Co-60	P	2	S	Lognormal-n	NUREG/CR-7267	4.3	0.9			7.4E+01
Cs-137	P	2	S	Lognormal-n	NUREG/CR-7267	7.8	0.9			2.4E+03
Eu-152	P	2	S	Lognormal-n	NUREG/CR-7267	4.9	1.6			1.3E+02
Eu-154	P	2	S	Lognormal-n	NUREG/CR-7267	4.9	1.6			1.3E+02
Fe-55	P	2	S	Lognormal-n	NUREG/CR-7267	5.1	1.9			1.6E+02
Gd-152	P	2	S	Lognormal-n	NUREG/CR-7267	3.4	1.1			3.0E+01
H-3	P	2	S	Lognormal-n	NUREG/CR-7267	0	0.1			1.0E+00
Mn-54	P	2	S	Lognormal-n	NUREG/CR-7267	5.5	1.9			2.4E+02
Nb-94	P	2	S	Lognormal-n	NUREG/CR-7267	5.7	1.1			3.0E+02
Ni-63	P	2	S	Lognormal-n	NUREG/CR-7267	3.0	0.6			2.0E+01
Np-237	P	2	S	Lognormal-n	NUREG/CR-7267	3.0	1.1			2.0E+01
Pa-231	P	2	S	Lognormal-n	NUREG/CR-7267	2.3	1.1			1.0E+01
Pb-210	P	2	S	Lognormal-n	NUREG/CR-7267	3.2	1.1			2.5E+02
Po-210	P	2	S	Lognormal-n	NUREG/CR-7267	3.6	1.5			3.7E+01
Pu-238	P	2	S	Lognormal-n	NUREG/CR-7267	10.0	1.0			2.2E+04
Pu-239	P	2	S	Lognormal-n	NUREG/CR-7267	10.0	1.0			2.2E+04
Pu-240	P	2	S	Lognormal-n	NUREG/CR-7267	10.0	1.0			2.2E+04
Pu-241	P	2	S	Lognormal-n	NUREG/CR-7267	10.0	1.0			2.2E+04
Ra-226	P	2	S	Lognormal-n	NUREG/CR-7267	1.4	1.9			4.1E+00
Ra-228	P	2	S	Lognormal-n	NUREG/CR-7267	1.4	1.9			4.1E+00
Sb-125	P	2	S	Lognormal-n	NUREG/CR-7267	3.6	1.5			3.7E+01
Sr-90	P	2	S	Lognormal-n	NUREG/CR-7267	1.1	1.4			3.0E+00
Tc-99	P	2	S	Lognormal-n	NUREG/CR-7267	3.0	1.1			2.0E+01
Te-125m	P	2	S	Lognormal-n	NUREG/CR-7267	5.0	0.4			1.5E+02
Th-228	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.9E+01
Th-229	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.9E+01
Th-230	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.9E+01
Th-232	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.9E+01
U-233	P	2	S	Lognormal-n	NUREG/CR-7267	0.0	2.5			1.0E+00

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
U-234	P	2	S	Lognormal-n	NUREG/CR-7267	0.0	2.5			1.0E+00
U-235	P	2	S	Lognormal-n	NUREG/CR-7267	0.0	2.5			1.0E+00
U-236	P	2	S	Lognormal-n	NUREG/CR-7267	0.0	2.5			1.0E+00
Bioaccumulation Factors for Crustacea/ Mollusks ((pCi/kg)/(pCi/L)) RESRAD default value for each radionuclide applied										
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	

Notes:

[a] P = physical, B = behavioral, M = metabolic

[b] 1 = high-priority parameter, 2 = medium-priority parameter, 3 = low-priority parameter

[c] D = deterministic, S = stochastic

N/A = not applicable

[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 = mode, 3 = maximum

Uniform: 1 = minimum, 2 = maximum

6.7.2.2 RESRAD-Onsite Probabilistic Analyses Results for Surface Soils and IU Scenario

Risk-sensitive RESRAD-Onsite parameters were identified using the criterion of a PRCC with an absolute value equal to or greater than 0.25. The risk-sensitive input parameters varied among the ROCs, but included parameters such as:

- Inhalation rate
- Mass loading for inhalation
- Soil ingestion
- Thickness of CZ
- K_d in the CZ
- K_d in the UZ
- K_d in the SZ
- External shielding factor
- Evapotranspiration coefficient
- Bioaccumulation for fish
- Contaminated fraction of aquatic food

After identifying the risk-sensitive parameters, reasonably conservative input values were determined from the sensitivity results to capture a large portion of uncertainty in the input value used in the subsequent DCGL calculations. The 75th percentile value of the risk-sensitive parameter's distribution was selected when the absolute value of the PRCC was ≥0.25 and the PRCC had a positive value. The 25th percentile value was selected when the absolute value of the PRCC value was ≥0.25 but had a negative value. Table 6-11 summarizes the 75th and 25th percentile values for each identified risk-sensitive input parameter for each ROC.

Table 6-11 RESRAD-Generated Percentile Values for Risk-Sensitive Input Parameters

Risk-Sensitive Parameter	Affected Nuclide	Percentile Value	
		25th	75th
Inhalation Rate (m^3/y)	Am-241		9.9E+03
	Cm-243		9.9E+03
	Cm-244		9.9E+03
	Fe-55		9.9E+03
	H-3		9.9E+03
	Pu-238		9.9E+03
Mass Loading for Inhalation (g/m^3)	Am-241		2.9E-05
	Cm-243		2.9E-05
	Cm-244		2.9E-05
	Fe-55		2.9E-05
	Np-237		2.9E-05
	Pu-238		2.9E-05
	Pu-241		2.9E-05
Soil Ingestion (g/y)	Am-241		2.4E+01
	Cm-243		2.4E+01
	Cm-244		2.4E+01

Risk-Sensitive Parameter	Affected Nuclide	Percentile Value	
		25th	75th
	Fe-55		2.4E+01
	Ni-63		2.4E+01
	Np-237		2.4E+01
	Pu-238		2.4E+01
	Pu-239		2.4E+01
	Pu-240		2.4E+01
	Pu-241		2.4E+01
	Sr-90		2.4E+01
Thickness of CZ (m)	C-14		3.0E+00
	H-3		3.0E+00
K_d in CZ (cm^3/g)	Am-241		3.7E+03
	Co-60		1.8E+03
	Eu-152		1.4E+04
	Eu-154		1.4E+04
	H-3	4.3E-02	
	Mn-54		5.8E+03
	Ni-63		6.1E+02
	Np-237		3.6E+01
	Pu-239		1.0E+03
	Pu-240		1.0E+03
	Pu-241		1.0E+03
	Sb-125		5.6E+01
	Sr-90		7.3E+01
K_d in UZ (cm^3/g)	C-14	6.2E+00	
	Pu-239	1.6E+02	
	Pu-240	1.6E+02	
	Tc-99	1.9E-02	
External Shielding Factor	Cm-243		4.0E-01
	Co-60		4.0E-01
	Cs-137		4.0E-01
	Eu-152		4.0E-01
	Eu-154		4.0E-01
	Mn-54		4.0E-01
	Nb-94		4.0E-01
	Np-237		4.0E-01
	Sb-125		4.0E-01
	Sr-90		4.0E-01
Evapotranspiration Coefficient	H-3		6.9E-01
Bioaccumulation Factor for Fish (pCi/kg)/(pCi/L)	Tc-99		4.2E+01
Contamination Fraction for Aquatic Food	Tc-99		6.1E-01

6.7.3 Surface Soil DCGL Values

The IU scenario modeled for probabilistic analysis was also modeled in the DCGL calculations. With the exceptions for the 75th and 25th percentile input values for risk-sensitive parameters, all input values were the same as those used in the probabilistic analyses. RESRAD-Onsite was executed in the probabilistic mode to allow evaluation of the distributions retained for "non-risk-sensitive" parameters with the deterministic input for risk-sensitive parameters (i.e., 75th and 25th percentile values) and to obtain a POM dose.

The calculated POM dose and the surface soil DCGL values for each ROC are provided in Table 6-12. The surface soil DCGL values for OCNGS ROCs corresponded to an annual dose equal to the NRC radiological criteria for unrestricted release (i.e., 25 mrem/y) and were calculated using the POM doses according to the following relationship:

$$DCGL_i = 25/POM_i \qquad \textbf{Equation 6-4}$$

Where:

- $DCGL_i$ = the DCGL value for the i^{th} ROC in units of pCi/g
- 25 = The NRC radiological criteria for unrestricted release, 25 mrem/y
- POM_i = the RESRAD-Onsite generated POM for the i^{th} ROC in units of mrem/y per pCi/g

Details regarding calculations and derivations of the input values used in the development of surface soil DCGL values are provided in Engineering Calculation ENG-OCS-008 (Reference 6-28).

Table 6-12 RESRAD-Onsite Generated POM Doses and DCGL Values by ROC

ROC	POM Dose (mrem/y per pCi/g)	DCGL (pCi/g)
Am-241	3.42E-02	7.31E+02
C-14	1.21E-02	2.07E+03
Cm-243	1.38E-01	1.81E+02
Cm-244	1.37E-02	1.82E+03
Co-60	3.15E+00	7.94E+00
Cs-137	6.99E-01	3.58E+01
Eu-152	1.42E+00	1.76E+01
Eu-154	1.53E+00	1.63E+01
Fe-55	2.98E-06	8.39E+06
H-3	4.98E-04	5.02E+04
Mn-54	7.34E-01	3.41E+01
Nb-94	2.01E+00	1.24E+01
Ni-63	3.23E-06	7.74E+06
Np-237	4.35E-01	5.75E+01
Pu-238	2.20E-02	1.14E+03
Pu-239	8.17E-02	3.06E+02
Pu-240	8.57E-02	2.92E+02
Pu-241	1.00E-03	2.50E+04

ROC	POM Dose (mrem/y per pCi/g)	DCGL (pCi/g)
Sb-125	4.50E-01	5.56E+01
Sr-90	5.89E-03	4.24E+03
Tc-99	1.82E-03	1.37E+04

6.7.4 Area Factors for Soil DCGL Values

RESRAD-Onsite was used to calculate POM doses associated with 8 sizes for the area of the CZ. Except for 2 RESRAD-Onsite parameters (the CZ area and the length parallel to aquifer flow), all input values were the same as those used in the DCGL calculations.

The base case for AFs was an assumed CZ area equal to 2,000 m^2 because that is the maximum size for a MARSSIM Class 1 land survey unit. Eight sizes for the CZ were assumed for AFs: 2000 m^2 (base case), 1000 m^2, 500 m^2, 100 m^2, 50 m^2, 10 m^2, 5 m^2, and 1 m^2. As the area of the CZ area decreases, the value for the length parallel to aquifer flow (LCZPAQ) also decreases. The CZ is assumed to be circular, so the value for LCZPAQ is equal to the circle's diameter. Table 6-13 shows the input values for LCZPAQ for each CZ area size.

Table 6-13 Value of LCZPAQ for Assumed CZ Areas

RESRAD-Onsite Parameter	Input Value							
CZ (m^2)	2,000	1,000	500	100	50	10	5	1
LCZPAQ (m)	50	36	25	11	8.0	3.6	2.5	1.1

The POM doses resulting from the various areas of the CZ are presented in Table 6-14.

Table 6-14 RESRAD-Onsite Dose Results by CZ Size

ROC	POM Dose (mrem/y) for CZ Size (m^2):							
	2000	1000	500	100	50	10	5	1
Am-241	3.19E-02	3.16E-02	2.12E-02	1.20E-02	1.02E-02	6.79E-03	5.02E-03	2.62E-03
C-14	3.64E-04	2.13E-04	1.30E-04	2.96E-05	1.42E-05	3.48E-06	2.01E-06	6.22E-07
Cm-243	1.29E-01	1.27E-01	1.19E-01	1.03E-01	9.39E-02	6.13E-02	4.13E-02	1.45E-02
Cm-244	1.28E-02	1.26E-02	7.05E-03	2.43E-03	1.79E-03	1.15E-03	1.01E-03	8.10E-04
Co-60	2.91E+00	2.88E+00	2.82E+00	2.53E+00	2.30E+00	1.47E+00	9.74E-01	3.16E-01
Cs-137	6.42E-01	6.34E-01	6.22E-01	5.61E-01	5.12E-01	3.30E-01	2.19E-01	7.23E-02
Eu-152	1.31E+00	1.30E+00	1.27E+00	1.14E+00	1.04E+00	6.66E-01	4.43E-01	1.44E-01
Eu-154	1.42E+00	1.40E+00	1.37E+00	1.23E+00	1.12E+00	7.16E-01	4.75E-01	1.55E-01
Fe-55	2.97E-06	2.97E-06	1.49E-06	3.08E-07	1.60E-07	3.95E-08	2.40E-08	1.07E-08
H-3	6.33E-05	4.48E-05	3.17E-05	1.41E-05	1.00E-05	4.47E-06	3.16E-06	1.41E-06
Mn-54	6.77E-01	6.69E-01	6.55E-01	5.88E-01	5.37E-01	3.44E-01	2.29E-01	7.50E-02
Nb-94	1.85E+00	1.83E+00	1.79E+00	1.61E+00	1.47E+00	9.44E-01	6.28E-01	2.06E-01
Ni63	3.21E-06	3.21E-06	1.62E-06	3.42E-07	1.82E-07	5.11E-08	3.38E-08	1.82E-08
Np-237	4.05E-01	4.01E-01	3.67E-01	3.11E-01	2.83E-01	1.84E-01	1.23E-01	4.31E-02

ROC	POM Dose (mrem/y) for CZ Size (m^2):							
	2000	1000	500	100	50	10	5	1
Pu-238	2.05E-02	2.03E-02	1.13E-02	3.89E-03	2.86E-03	1.84E-03	1.62E-03	1.30E-03
Pu-239	2.19E-02	2.18E-02	1.18E-02	3.70E-03	2.60E-03	1.55E-03	1.35E-03	1.06E-03
Pu-240	2.19E-02	2.17E-02	1.18E-02	3.68E-03	2.58E-03	1.54E-03	1.34E-03	1.05E-03
Pu241	9.39E-04	6.87E-04	6.18E-04	1.20E-04	8.85E-05	5.49E-05	4.83E-05	3.86E-05
Sb-125	4.13E-01	4.08E-01	4.01E-01	3.62E-01	3.30E-01	2.13E-01	1.42E-01	4.70E-02
Sr-90	5.50E-03	5.44E-03	4.93E-03	4.14E-03	3.75E-03	2.38E-03	1.59E-03	5.21E-04
Tc-99	4.86E-05	2.83E-05	1.90E-05	1.40E-05	1.24E-05	7.93E-06	5.30E-06	1.81E-06

AF values are calculated from the POM doses generated by RESRAD-Onsite using the following equation:

$$AF_{i,a} = POM_{2000,i}/POM_{i,a} \qquad \textbf{Equation 6-5}$$

Where:

- $AF_{i,a}$ = the area factor (unitless) for the i^{th} ROC and CZ area size "a"
- $POM_{2000,i}$ = POM dose for the i^{th} ROC in the base case (mrem/y)
- $POM_{i,a}$ = POM dose for the i^{th} ROC and CZ area size "a"

Details regarding calculations and derivations of the input values used in the development of surface soil DCGL values are provided in Engineering Calculation ENG-OCS-009 (Reference 6-29). Table 6-15 presents the AF values for soil by ROC.

Table 6-15 Area Factors for Surface Soil DCGLs

ROC	Area Factor for Area CZ (m^2):							
	2000	1000	500	100	50	10	5	1
Am-241	1	1	2	3	3	5	6	12
C-14	1	2	3	12	26	104	181	585
Cm-243	1	1	1	1	1	2	3	9
Cm-244	1	1	2	5	7	11	13	16
Co-60	1	1	1	1	1	2	3	9
Cs-137	1	1	1	1	1	2	3	9
Eu-152	1	1	1	1	1	2	3	9
Eu-154	1	1	1	1	1	2	3	9
Fe-55	1	1	2	10	19	75	124	278
H-3	1	1	2	4	6	14	20	45
Mn-54	1	1	1	1	1	2	3	9
Nb-94	1	1	1	1	1	2	3	9
Ni63	1	1	2	9	18	63	95	176
Np-237	1	1	1	1	1	2	3	9
Pu-238	1	1	2	5	7	11	13	16
Pu-239	1	1	2	6	8	14	16	21

ROC	Area Factor for Area CZ (m^2):							
	2000	**1000**	**500**	**100**	**50**	**10**	**5**	**1**
Pu-240	1	1	2	6	8	14	16	21
Pu241	1	1	2	8	11	17	19	24
Sb-125	1	1	1	1	1	2	3	9
Sr-90	1	1	1	1	1	2	3	11
Tc-99	1	2	3	3	4	6	9	27

6.8 Development of DCGLs for Below-Grade Concrete Structures

The model for calculating dose and DCGLs from residual radioactivity in the backfilled below-grade building foundations is called the Basement Fill Model (BFM). The RB, TB, and ORB are the building foundations to remain in place at license termination. In addition, the below-grade portion of the stack area will remain in place. There are two media in backfilled basements: walls/floors and embedded pipe. Each is modeled separately. Detailed descriptions of the source term abstractions, conceptual models, and DCGL calculations for each media are provided in the Sections that follow. A brief overview is provided here.

The decommissioning of the RB, TB, ORB, and stack area involves demolishing these structures to a depth of 3 feet below grade. The concrete portions below this depth will remain in place, be released by FSS, and then backfilled. The land area will be restored to its original grade and contoured. The remaining foundations are assumed to include only exterior walls and floors (walls/floors) as a media or source term. Internal walls, platforms, and pedestals are assumed to be removed in the BFM for the OCNGS site.

The BFM wall/floor model incorporates the dose contributions from 3 source release scenarios:

- Instant release of contamination from concrete walls and floors to the fill material within 1 m of the concrete.
- Capture of concrete with drilling spoils generated during the failed installation of a well.
- Excavation of the portion of the concrete walls above the groundwater table.

The details for each source release are provided in the following sections. The doses from the three scenarios are summed to determine the final wall/floor DCGL. The exposure pathways assumed in the IU scenario for soil (open land areas) are assumed active in the BFM.

- Direct external radiation exposure pathway
- Inhalation exposure pathway
- Inadvertent ingestion of contaminated soil
- Ingestion exposure via aquatic food from the intake/discharge canal

6.8.1 Assumptions for the BFM for Walls and Floors

The BFM DCGL values incorporate the dose contributions via the 3 source release scenarios listed above and are based on several assumptions. The contaminated volume (CV) calculations consider the most likely contaminated below-grade structures (i.e., the RB, TB, ORB, and stack

area). Below-grade tunnels, such as the intake and discharged tunnels, are not expected to contain a significant amount of contamination but will be assessed using the BFM DCGL values for walls and floors. Surface areas assumed for the walls and floors of below-grade concrete foundations reflect the interior surface areas of the foundation's outer walls and floors; all interior rooms and platforms in below-grade foundations are assumed to be removed.

Contamination of walls and floors is assumed to be uniformly distributed and is instantaneously released into 1m fill material adjacent to the concrete surfaces, thereby creating the CV for modeling. The fill material is assumed to be site soil. The CV area is restored to its original grade and contour. For modeling purposes, the groundwater table is assumed to be at the average depth near the RB, TB, and ORB, placing most of the CV in the SZ. The concrete structures do not impede groundwater flow.

6.8.2 Conceptual Site Model for BFM Instantaneous Release Scenario

The Instantaneous Release (IR) scenario is one of 3 scenarios that support the development of BFM DCGL values for walls and floors ($DCGL_{w/f}$) for assessing radioactive contamination on below-grade concrete structures. The scenario assumes an instantaneous release of radioactive contamination on the surfaces of the walls and floors of below-grade concrete basements of the RB, TB, ORB, and stack area to the fill material within 1m of the concrete surfaces, creating a CV. The resultant CV remains below site grade, covered by a 3-ft of clean soil, and assumed to extend to a depth of 43ft, which is the depth of the RB foundation walls. Based on site geological features, this assumed depth places portions of the CV above and below the groundwater table. The partitioning of the CV above and below the groundwater table is based on the site average groundwater table depth determined from OCNGS site groundwater information for wells in the vicinity of the RB, TB, and ORB. Additionally, the below-grade physical concrete structures are assumed not to impede groundwater flow.

A SA/V ratio of 1 is used to calculate the concentration in fill after the IR from walls/floors. It is noted that there are penetrations through the walls of the below-grade building foundations with SA/V ratios greater than 1 (e.g., the SA/V ratio for the RB is 6.8, 8.4 for the TB, and 6.6 for the ORB). The impact of the penetrations on the total wall/floor source term is limited because the total internal surface areas of the penetrations are small relative to the surface area of the wall/floor. For example, the penetration surface areas are 0.3%, 0.3%, and 2% for the RB, TB, and ORB, respectively. Therefore, the wall/floor BFM IR DCGL values are applied directly to penetrations to simplify the conceptual model.

The CV is assessed using the site compliance scenario, the IU scenario, which assumes the average member of the critical group is a hypothetical full-time site worker assigned to outdoor tasks and who also catches and consumes fish from the intake/discharge canal. The pathways used to estimate the critical receptor's radiation exposure resulting from residual radioactivity in the soil for this scenario are:

- Direct external radiation exposure pathway
- Inhalation exposure pathway
- Ingestion exposure via aquatic food from the intake/discharge canal
- Inadvertent ingestion of contaminated soil

6.8.3 Probabilistic Analyses of RESRAD-Onsite Input Parameters – IR Scenario

Probabilistic analyses were performed using the RESRAD-Onsite code to identify risk-sensitive parameters in the modeled IR scenario. The CV for the IR scenario was calculated using the surface areas of below-grade concrete surfaces for the RB, TB, ORB, and stack areas. The surface areas (m^2) are multiplied by 1 m to obtain the total volume of fill material immediately adjacent at 1m to the concrete surfaces. Table 6-16 shows the development of the CV.

Table 6-16 Development of the CV for the IR Scenario

Structure	Below-Grade Surface Area		"Instant Release" CV
	ft^2	m^2	m^3
Reactor Building	78,655	7,307	7,307
Turbine Building	96,535	8,968	8,968
Old RW Building	14,224	1,321	1,321
Stack Area	27,862	2,588	2,588
Total Volume	**217,276**	**20,184**	**20,184**

The CZ in the IR scenario was modeled as a zone with an assumed thickness equal to the height of the RB wall. The area of the CZ was determined from the total CV value listed in Table 6-18 and the assumed thickness of the CZ, 43 ft. Another RESRAD-Onsite parameter, the length parallel to aquifer flow, was set to the diameter of the CZ.

Sand is assumed as soil type for cover and fill material (consistent with soil type assumed in calculations for surface soil DCGL values and supported by information provided in the OCNGS Hydrogeologic Investigation Report, the OCS HSA, and well installation logs). To remain consistent with the modeling for surface soil DCGL values, the distributions for K_d values, density, porosity, field capacity, and RESRAD "b" parameter for sand from NURREG/CR-7267 were used in the probabilistic analyses.

The calculations and derivations of the input values used in the probabilistic analyses for the BFM IR Scenario are provided in a Technical Support Document, TSD 24-055 (Reference 6-30). Table 6-17 and Table 6-18 summarize the input values and source of information used in the probabilistic analyses for the IR scenario.

PRCC values with an absolute value equal to or greater than 0.25 were used to identify risk-sensitive RESRAD-Onsite parameters. The risk-sensitive parameters identified in the modeling of the IR scenario varied among the ROCs but included parameters such as:

- Distribution coefficients (K_d values) in the CZ
- K_d values in the SZ
- Density of cover material
- Hydraulic gradient in SZ
- Fish transfer (bioaccumulation) factor
- Aquatic food fraction
- Evapotranspiration coefficient

After identifying the risk-sensitive parameters, reasonably conservative values were determined from the RESRAD-Onsite results to capture a large portion of uncertainty associated with input used in the subsequent development of BFM $DCGL_{IR}$ values. The 75th percentile value of a risk-sensitive parameter's distribution was selected when the absolute value of the PRCC was ≥0.25 and the PRCC had a positive value. The 25th percentile value was selected when the absolute value of the PRCC value was ≥0.25 but had a negative value. Table 6-19 summarizes the 75th and 25th percentile values for the identified risk-sensitive parameters by ROC.

Table 6-17 IU BFM IR Scenario Exposure Pathways

IU BFM IR Scenario Exposure Pathways	
External Gamma	Open
Inhalation	Open
Plant Ingestion	Close
Meat Ingestion	Close
Milk Ingestion	Close
Aquatic Foods	Open
Drinking Water	Close
Soil Ingestion	Open
Radon	Close

Table 6-18 Values and Basis for RESRAD-Onsite Parameters for the Probabilistic Analysis for the IU BFM IR Scenario

Values and Basis for Probabilistic Analysis: BFM IR Scenario to Support the Development of the BFM $DCGL_{w/f}$ and the IU Compliance Scenario										
Parameter (unit)	**Type[a]**	**Priority[b]**	**Treatment[c]**	**Value / Distribution**	**Basis**	**Distribution's Statistical Parameters[d]**				**Median / Mean**
						1	**2**	**3**	**4**	
Soil Concentrations										
Basic radiation dose limit (mrem/y)	P	3	D	25	10 CFR 20.1402	NR	NR	NR	NR	
Initial principal radionuclide (pCi/g)	P	2	D	1	Unit Value	NR	NR	NR	NR	
Distribution coefficients (values for **sand** soil type, cm^3/g)										
Ac-227	P	1	S	Truncated lognormal-n	NUREG/CR-7267	7.44	1.1	0.001	0.999	1700
Am-241	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.91	1.95	0.001	0.999	1000
Am-243	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.91	1.95	0.001	0.999	1000
C-14	P	1	S	Truncated lognormal-n	NUREG/CR-7267	3.04	1.82	0.001	0.999	21
Cm-243	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.13	2.64	0.001	0.999	3400
Cm-244	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.13	2.64	0.001	0.999	3400
Co-60	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.56	2.89	0.001	0.999	260
Cs-137	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.27	1.79	0.001	0.999	530
Eu-152	P	1	S	Truncated lognormal-n	NUREG/CR-7267	6.86	4.01	0.001	0.999	955
Eu-154	P	1	S	Truncated lognormal-n	NUREG/CR-7267	6.86	4.01	0.001	0.999	955
Fe-55	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.77	0	0.001	0.999	320
Gd-152	P	1	S	Truncated lognormal-n	NUREG/CR-7267	1.61	3.22	0.001	0.999	5
H-3	P	1	S	Truncated lognormal-n	NUREG/CR-7267	-2.81	0.5	0.001	0.999	0.06
Mn-54	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.89	2.64	0.001	0.999	980
Nb-94	P	1	S	Truncated lognormal-n	NUREG/CR-7267	7.31	1.39	0.001	0.999	1500
Ni-63	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.87	2.3	0.001	0.999	130
Np-237	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	2.64	1.39	0.001	0.999	14
Pa-231	P	1	S	Truncated lognormal-n	NUREG/CR-7267	7.6	1.1	0.001	0.999	2000
Pb-210	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.39	1.39	0.001	0.999	220
Po-210	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.61	1.79	0.001	0.999	100

Values and Basis for Probabilistic Analysis: BFM IR Scenario to Support the Development of the BFM $DCGL_{w/f}$ and the IU Compliance Scenario										
Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Pu-238	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.99	1.39	0.001	0.999	400
Pu-239	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.99	1.39	0.001	0.999	400
Pu-240	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.99	1.39	0.001	0.999	400
Pu-241	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.99	1.39	0.001	0.999	400
Ra-226	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.04	2.08	0.001	0.999	3100
Ra-228	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.04	2.08	0.001	0.999	3100
Sb-125	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	2.83	1.79	0.001	0.999	17
Sr-90	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	3.09	1.79	0.001	0.999	22
Tc-99	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	-3.22	1.1	0.001	0.999	0.04
Te-125m	P	1	S	Truncated lognormal-n	NUREG/CR-7267	6.31	3.22	0.001	0.999	550
Th-228	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
Th-229	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
Th-230	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
Th-232	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
U-233	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
U-234	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
U-235	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
U-236	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
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 Default	NR	NR	NR	NR	
Contaminated Zone										
Area of contaminated zone (m^2)	P	2	D	1539.6	Based on CV and height of RB wall.	NR	NR	NR	NR	

Values and Basis for Probabilistic Analysis: BFM IR Scenario to Support the Development of the BFM $DCGL_{w/f}$ and the IU Compliance Scenario										
Parameter (unit)	**Type[a]**	**Priority[b]**	**Treatment[c]**	**Value / Distribution**	**Basis**	**Distribution's Statistical Parameters[d]**				**Median / Mean**
						1	**2**	**3**	**4**	
Thickness of contaminated zone (m)	P	2	D	13.1	CZ thickness set to RB wall height.	NR	NR	NR	NR	
Length parallel to aquifer flow (m)	P	2	D	44.3	Set to diameter of CZ.	NR	NR	NR	NR	
Does the initial contamination penetrate the water table?				Yes	Based on site features and RB dimensions.					
Contaminated fraction below water table			D	0.7326	Based on average groundwater depths recorded for wells around the RB, TB, and ORB.	NR	NR	NR	NR	
Cover and Contaminated Zone Hydrological Data										
Cover depth (m)	P	2	D	0.91	3ft site cap.	NR	NR	NR	NR	
Cover density (g/cm^3)	P	2	S	Truncated Normal	NUREG/CR-7267 density distribution for site soil type - sand.	1.5105	0.159	0.001	0.999	1.5105
Cover erosion rate (m/y)	P	2	D	6.00E-04	Assumed final site grade is level. Input for erosion rate = NUREG/CR-7267 erosion rate for relatively level site	NR	NR	NR	NR	
Density of contaminated zone (g/cm^3)	P	1	S	Truncated Normal	NUREG/CR-7267 density distribution for site soil type - sand.	1.5105	0.159	0.001	0.999	1.5105
Contaminated zone erosion rate (m/y)	P	2	D	6.00E-04	Assumed same as cover.	NR	NR	NR	NR	
Contaminated zone total porosity	P	2	S	Bounded Normal	NUREG/CR-7267 distribution for site soil type -sand	0.43	0.06	0.2446	0.6154	0.43
Contaminated zone field capacity	P	3	D	0.18	Value based on site-specific soil type (sand); calculated using equation in NUREG/CR-7267	NR	NR	NR	NR	
Contaminated zone hydraulic conductivity (m/y)	P	2	D	2741	OCNGS Hydrogeologic Investigation Report	NR	NR	NR	NR	
Contaminated zone b parameter	P	2	S	Bounded Log Normal n	NUREG/CR-7267 distribution for site soil type - sand	-0.0253	0.216	0.501	1.9	0.975
Humidity in air (g/m^3)	P	3	D	6.6	From *Regional and Site-Specific Absolute Humidity Data for Use in Tritium Dose Calculations*.	NR	NR	NR	NR	
Evapotranspiration coefficient	P	2	S	Uniform	NUREG/CR-7267 distribution	0.5	0.75	NR	NR	0.625
Average annual wind speed (m/s)	P	2	D	3.13	Internet search: https://www.windfinder.com/windstatistics/oyster_creek_barnegat_bay	NR	NR	NR	NR	
Precipitation (m/y)	P	2	D	1.4	Annual Report on the Meteorological Program at Oyster Creek Generating Station – average annual precipitation for 2015 through 2020	NR	NR	NR	NR	

Values and Basis for Probabilistic Analysis: BFM IR Scenario to Support the Development of the BFM $DCGL_{w/f}$ and the IU Compliance Scenario										
Parameter (unit)	**Type[a]**	**Priority[b]**	**Treatment[c]**	**Value / Distribution**	**Basis**	**Distribution's Statistical Parameters[d]**				**Median / Mean**
						1	**2**	**3**	**4**	
Irrigation (m/y)	B	3	S	Uniform	Distribution determined using methodology described in Data Collection Handbook and NUREG/CR-6697	0	0.08			0.04
Irrigation mode	B	3	D	Overhead	Overhead irrigation is common practice for crops in U.S.	NR	NR	NR	NR	
Runoff coefficient	P	2	D	0.2	Value determined using methodology described in Data Collection Handbook and NUREG/CR-7267	NR	NR	NR	NR	
Watershed area for nearby stream or pond (m^2)	P	3	D	1.01E+08	NJ-GeoWeb (NJDEP BGIS)	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	Truncated Normal	NUREG/CR-7267 distribution for site soil type -sand	1.5105	0.159	0.001	0.999	1.5105
Saturated zone total porosity	P	1	S	Truncated Normal	NUREG/CR-7267 distribution for site soil type -sand	0.43	0.06	0.001	0.999	0.43
Saturated zone effective porosity	P	1	D	0.25	OCNGS Hydrogeologic Investigation Report	NR	NR	NR	NR	
Saturated zone field capacity	P	3	D	0.18	Value based on site-specific soil type (sand); calculated using equation in NUREG/CR-7267	NR	NR	NR	NR	
Saturated zone hydraulic conductivity (m/y)	P	1	D	2741	OCNGS Hydrogeologic Investigation Report	NR	NR	NR	NR	
Saturated zone hydraulic gradient	P	2	S	Uniform	*OCNGS* Hydrogeologic Investigation Report	0.01	0.04			0.025
Saturated zone b parameter	P	2	S	N/A	Input not required when CZ is in SZ	NR	NR	NR	NR	
Water table drop rate (m/y)	P	3	D	0	CZ in SZ	NR	NR	NR	NR	
Well pump intake depth (m below water table)	P	2	D	9.6	Set to the distance from the water table to the lower boundary of contamination in the aquifer at the downgradient edge of the contaminated zone.	NR	NR	NR	NR	
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	N/A	Input not required.	NR	NR	NR	NR	
Unsaturated Zone Hydrological Data										
Unsaturated zones	P	3	D	0	CZ directly below cover.	NR	NR	NR	NR	

Values and Basis for Probabilistic Analysis: BFM IR Scenario to Support the Development of the BFM $DCGL_{w/f}$ and the IU Compliance Scenario										
Parameter (unit)	**Type[a]**	**Priority[b]**	**Treatment[c]**	**Value / Distribution**	**Basis**	**Distribution's Statistical Parameters[d]**				**Median / Mean**
						1	**2**	**3**	**4**	
Unsat. zone 1, thickness (m)	P	1	D	N/A	UZ set to 0 zones; input for UZ parameters not used.	NR	NR	NR	NR	
Unsat. zone 1, soil density (g/cm^3)	P	2	S	N/A	UZ set to 0 zones; input for UZ parameters not used.–	NR	NR	NR	NR	
Unsat. zone 1, total porosity	P	2	S	N/A	UZ set to 0 zones; input for UZ parameters not used.–	NR	NR	NR	NR	
Unsat. zone 1, effective porosity	P	2	D	N/A	UZ set to 0 zones; input for UZ parameters not used.	NR	NR	NR	NR	
Unsat. zone 1, field capacity	P	3	D	N/A	UZ set to 0 zones; input for UZ parameters not used.	NR	NR	NR	NR	
Unsat. zone 1, hydraulic conductivity (m/y)	P	2	D	N/A	UZ strata set to 0; input for UZ parameters not used.	NR	NR	NR	NR	
Unsat. zone 1, soil-specific b parameter	P	2	S	N/A	UZ set to 0 zones; input for UZ parameters not used.–	NR	NR	NR	NR	
Occupancy										
Inhalation rate (m^3/y)	B	3	D	8400	NUREG/CR-7267	NR	NR	NR	NR	
Mass loading for inhalation (g/m^3)	P	2	S	Continuous linear	NUREG/CR-7267					2.30E-05
Exposure duration	B	3	D	30	RESRAD Default	NR	NR	NR	NR	
Indoor dust filtration factor	P	2	S	Uniform	NUREG/CR-7267	0.15	0.95			0.55
Shielding factor, external gamma	P	2	S	Bounded lognormal-n	NUREG/CR-7267	-1.3	0.59	0.044	1	0.2725
Fraction of time spent indoors	B	3	D	0.03	Fraction of calendar year assuming 1h/work day for daily work breaks	NR	NR	NR	NR	
Fraction of time spent outdoors	B	3	D	0.2	Fraction of calendar year assuming 7h/work day for outside tasks	NR	NR	NR	NR	
Shape factor flag, external gamma	P	3	D	Circular	Circular contaminated zone assumed	NR	NR	NR	NR	
Ingestion, Dietary										
Fruits, vegetables, grain consumption (kg/y)	B	2	D	N/A	Input not required - plant ingestion pathway inactive	NR	NR	NR	NR	
Leafy vegetable consumption (kg/y)	B	3	D	N/A	Input not required - plant ingestion pathway inactive	NR	NR	NR	NR	
Milk consumption (L/y)	B	2	D	N/A	Input not required - milk ingestion pathway inactive	NR	NR	NR	NR	

Values and Basis for Probabilistic Analysis: BFM IR Scenario to Support the Development of the BFM $DCGL_{w/f}$ and the IU Compliance Scenario										
Parameter (unit)	**Type[a]**	**Priority[b]**	**Treatment[c]**	**Value / Distribution**	**Basis**	**Distribution's Statistical Parameters[d]**				**Median / Mean**
						1	**2**	**3**	**4**	
Meat and poultry consumption (kg/y)	B	3	D	N/A	Input not required - meat ingestion pathway inactive	NR	NR	NR	NR	
Fish consumption (kg/y)	B	3	D	20.6	NUREG/CR-5512	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	Triangular	NUREG/CR-7267	0	18.3	36.5		18.3
Drinking water intake (L/y)	B	2	D	N/A	Input not required – drinking water pathway inactive	NR	NR	NR	NR	
Contamination fraction of drinking water	P	3	D	N/A	Input not required – drinking water pathway inactive	NR	NR	NR	NR	
Contamination fraction of household water	P	3		N/A	Input not required – water pathway inactive					
Contamination fraction of livestock water	P	3	D	N/A	Input not required – drinking water/ingestion pathways inactive	NR	NR	NR	NR	
Contamination fraction of irrigation water	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Contamination fraction of aquatic food	P	2	D	Triangular	NUREG/CR-7267	0	0.39	1		0.39
Contamination fraction of plant food	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Contamination fraction of meat	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Contamination fraction of milk	P	3	D	N/A	Input not required – milk ingestion pathway inactive	NR	NR	NR	NR	
Ingestion, Non-Dietary										
Livestock fodder intake for meat (kg/d)	M	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Livestock fodder intake for milk (kg/d)	M	3	D	N/A	Input not required – milk ingestion pathway inactive	NR	NR	NR	NR	
Livestock water intake for meat (L/d)	M	3	D	N/A	Input not required – water ingestion pathway inactive	NR	NR	NR	NR	
Livestock water intake for milk (L/d)	M	3	D	N/A	Input not required – milk ingestion pathway inactive	NR	NR	NR	NR	
Livestock soil intake (kg/d)	M	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Mass loading for foliar deposition (g/m^3)	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	

Values and Basis for Probabilistic Analysis: BFM IR Scenario to Support the Development of the BFM $DCGL_{w/f}$ and the IU Compliance Scenario										
Parameter (unit)	**Type[a]**	**Priority[b]**	**Treatment[c]**	**Value / Distribution**	**Basis**	**Distribution's Statistical Parameters[d]**				**Median / Mean**
						1	**2**	**3**	**4**	
Depth of soil mixing layer (m)	P	2	S	Triangular	NUREG/CR-7267	0	0.15	0.6		0.23
Depth of roots (m)	P	1	S	N/A	Input not required – plant ingestion pathway inactive	0.3	4			1.85
Drinking water fraction from ground water	P	3	D	N/A	Input not required – drinking water ingestion pathway inactive	NR	NR	NR	NR	
Household water fraction from ground water	P	3		N/A	Input not required – drinking water pathway inactive					
Livestock water fraction from ground water	P	3	D	N/A	Input not required – drinking water/meat ingestion pathways inactive	NR	NR	NR	NR	
Irrigation fraction from ground water	P	3	D	N/A	Input not required – drinking water pathway inactive	NR	NR	NR	NR	
Wet weight crop yield for Non-Leafy (kg/m^2)	P	2	S	N/A	Input not required – plant ingestion pathway inactive	0.56	0.48	0.001	0.999	1.75
Wet weight crop yield for Leafy (kg/m^2)	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Wet weight crop yield for Fodder (kg/m^2)	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Growing Season for Non-Leafy (y)	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Growing Season for Leafy (y)	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Growing Season for Fodder (y)	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Translocation Factor for Non-Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Translocation Factor for Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Translocation Factor for Fodder	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Weathering Removal Constant for Vegetation (1/y)	P	2	S	N/A	Input not required – plant ingestion pathway inactive	5.1	18	84		33
Wet Foliar Interception Fraction for Non-Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Wet Foliar Interception Fraction for Leafy	P	2	S	N/A	Input not required – plant ingestion pathway inactive	0.06	0.67	0.95		0.58
Wet Foliar Interception Fraction for Fodder	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Non-Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	

Values and Basis for Probabilistic Analysis: BFM IR Scenario to Support the Development of the BFM $DCGL_{w/f}$ and the IU Compliance Scenario										
Parameter (unit)	**Type[a]**	**Priority[b]**	**Treatment[c]**	**Value / Distribution**	**Basis**	**Distribution's Statistical Parameters[d]**				**Median / Mean**
						1	**2**	**3**	**4**	
Dry Foliar Interception Fraction for Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Fodder	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Storage times of contaminated foodstuffs (days):										
Fruits, non-leafy vegetables, and grain	B	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Leafy vegetables	B	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Milk	B	3	D	N/A	Input not required – milk ingestion pathway inactive	NR	NR	NR	NR	
Meat and poultry	B	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Fish	B	3	D	7	RESRAD Default	NR	NR	NR	NR	
Crustacea and mollusks	B	3	D	7	RESRAD Default	NR	NR	NR	NR	
Well water	B	3	D	N/A	Input not required – drinking water pathway inactive	NR	NR	NR	NR	
Surface water	B	3	D	N/A	Input not required drinking water pathway inactive	NR	NR	NR	NR	
Livestock fodder	B	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Special Radionuclides (C-14)										
C-12 concentration in water (g/cm^3)	P	3	D	2.00E-05	RESRAD Default	NR	NR	NR	NR	
C-12 concentration in contaminated soil (g/g)	P	3	D	3.00E-02	RESRAD Default	NR	NR	NR	NR	
Fraction of vegetation carbon from soil	P	3	D	2.00E-02	RESRAD Default	NR	NR	NR	NR	
Fraction of vegetation carbon from air	P	3	D	9.80E-01	RESRAD Default	NR	NR	NR	NR	
C-14 evasion layer thickness in soil (m)	P	2	S	Triangular	NUREG/CR-7267	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	NR	NR	NR	NR	
C-12 evasion flux rate from soil (1/s)	P	3	D	1.00E-10	RESRAD Default	NR	NR	NR	NR	
Fraction of grain in beef cattle feed	B	3	D	0.25	NUREG/CR-7267	NR	NR	NR	NR	

Values and Basis for Probabilistic Analysis: BFM IR Scenario to Support the Development of the BFM $DCGL_{w/f}$ and the IU Compliance Scenario										
Parameter (unit)	**Type[a]**	**Priority[b]**	**Treatment[c]**	**Value / Distribution**	**Basis**	**Distribution's Statistical Parameters[d]**				**Median / Mean**
						1	**2**	**3**	**4**	
Fraction of grain in milk cow feed	B	3	D	0.1	NUREG/CR-7267	NR	NR	NR	NR	
Inhalation Dose Conversion Factors (mrem/pCi inhaled) from FGR11 (contained in RESRAD Dose Conversion Library)										
Ingestion Dose Conversion Factors (mrem/pCi ingested) from FGR11 (contained in RESRAD Dose Conversion Library)										
Plant Transfer Factors (pCi/g plant)/(pCi/g soil) Note: Plant ingestion pathway closed – input for plant transfer factors not required for Industrial Use dose calculations.										
Meat Transfer Factors (pCi/kg)/(pCi/d) Note: Meat ingestion pathway closed – input for meat transfer factors not required for Industrial Use dose calculations.										
Milk Transfer Factors (pCi/L)/(pCi/d) Note: Milk ingestion pathway closed – input for milk transfer factors not required for Industrial Use dose calculations.										
Bioaccumulation Factors for Fish ((pCi/kg)/(pCi/L))										
Ac-227	P	2	S	Lognormal-n	NUREG/CR-7267	3.2	1.1			2.50E+01
Am-241	P	2	S	Lognormal-n	NUREG/CR-7267	5.5	1.1			2.40E+02
Am-243	P	2	S	Lognormal-n	NUREG/CR-7267	5.5	1.1			2.40E+02
C-14	P	2	S	Lognormal-n	NUREG/CR-7267	13	1.1			4.40E+05
Cm-243	P	2	S	Lognormal-n	NUREG/CR-7267	3.4	1.1			3.00E+01
Cm-244	P	2	S	Lognormal-n	NUREG/CR-7267	3.4	1.1			3.00E+01
Co-60	P	2	S	Lognormal-n	NUREG/CR-7267	4.3	0.9			7.40E+01
Cs-137	P	2	S	Lognormal-n	NUREG/CR-7267	7.8	0.9			2.40E+03
Eu-152	P	2	S	Lognormal-n	NUREG/CR-7267	4.9	1.6			1.30E+02
Eu-154	P	2	S	Lognormal-n	NUREG/CR-7267	4.9	1.6			1.30E+02
Fe-55	P	2	S	Lognormal-n	NUREG/CR-7267	5.1	1.9			1.60E+02
Gd-152	P	2	S	Lognormal-n	NUREG/CR-7267	3.4	1.1			3.00E+01
H-3	P	2	S	Lognormal-n	NUREG/CR-7267	0	0.1			1.00E+00
Mn-54	P	2	S	Lognormal-n	NUREG/CR-7267	5.5	1.9			2.40E+02
Nb-94	P	2	S	Lognormal-n	NUREG/CR-7267	5.7	1.1			3.00E+02
Ni-63	P	2	S	Lognormal-n	NUREG/CR-7267	3	0.6			2.00E+01
Np-237	P	2	S	Lognormal-n	NUREG/CR-7267	3	1.1			2.00E+01
Pa-231	P	2	S	Lognormal-n	NUREG/CR-7267	2.3	1.1			1.00E+01
Pb-210	P	2	S	Lognormal-n	NUREG/CR-7267	3.2	1.1			2.50E+02
Po-210	P	2	S	Lognormal-n	NUREG/CR-7267	3.6	1.5			3.70E+01
Pu-238	P	2	S	Lognormal-n	NUREG/CR-7267	10	1			2.20E+04
Pu-239	P	2	S	Lognormal-n	NUREG/CR-7267	10	1			2.20E+04
Pu-240	P	2	S	Lognormal-n	NUREG/CR-7267	10	1			2.20E+04
Pu-241	P	2	S	Lognormal-n	NUREG/CR-7267	10	1			2.20E+04

Values and Basis for Probabilistic Analysis: BFM IR Scenario to Support the Development of the BFM $DCGL_{w/f}$ and the IU Compliance Scenario										
Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Ra-226	P	2	S	Lognormal-n	NUREG/CR-7267	1.4	1.9			4.10E+00
Ra-228	P	2	S	Lognormal-n	NUREG/CR-7267	1.4	1.9			4.10E+00
Sb-125	P	2	S	Lognormal-n	NUREG/CR-7267	3.6	1.5			3.70E+01
Sr-90	P	2	S	Lognormal-n	NUREG/CR-7267	1.1	1.4			3.00E+00
Tc-99	P	2	S	Lognormal-n	NUREG/CR-7267	3	1.1			2.00E+01
Te-12m	P	2	S	Lognormal-n	NUREG/CR-7267	5	0.4			1.50E+02
Th-228	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.90E+01
Th-229	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.90E+01
Th-230	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.90E+01
U-233	P	2	S	Lognormal-n	NUREG/CR-7267	0	2.5			1.00E+00
U-234	P	2	S	Lognormal-n	NUREG/CR-7267	0	2.5			1.00E+00
U-235	P	2	S	Lognormal-n	NUREG/CR-7267	0	2.5			1.00E+00
U-236	P	2	S	Lognormal-n	NUREG/CR-7267	0	2.5			1.00E+00
Bioaccumulation Factors for Crustacea/ Mollusks ((pCi/kg)/(pCi/L)) RESRAD default value for each radionuclide applied										
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	

Notes:

[a] P = physical, B = behavioral, M = metabolic

[b] 1 = high-priority parameter, 2 = medium-priority parameter, 3 = low-priority parameter

[c] D = deterministic, S = stochastic

N/A = not applicable

[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 = mode, 3 = maximum

Uniform: 1 = minimum, 2 = maximum

Table 6-19 Input Values for Risk-Sensitive Parameters

Risk-Sensitive Parameter	ROC	Percentile Value 25th	75th
K_d in CZ	Am-241	2.69E+02	
	C-14	6.13E+00	
	Cm-243	5.74E+02	
	Cm-244	5.74E+02	
	Co-60	3.71E+01	
	Cs-137	1.58E+02	
	Eu-152	6.40E+01	
	Eu-154	6.40E+01	
	Mn-54	1.66E+02	
	Nb-94		3.81E+03
	Ni63	2.77E+01	
	Np-237	5.49E+00	
	Pu-238	1.56E+02	
	Pu-239	1.56E+02	
	Pu-240	1.56E+02	
	Pu-241	1.57E+02	
	Sb-125	5.07E+00	
	Sr-90	6.58E+00	
Kd in SZ	Am-241	2.69E+02	
	C-14	6.13E+00	
	Co-60	3.71E+01	
	Cs-137	1.58E+02	
	Eu-152	6.40E+01	
	Eu-154	6.40E+01	
	Mn-54	1.66E+02	
	Ni63	2.77E+01	
	Np-237	5.49E+00	
	Pu-238	1.56E+02	
	Pu-239	1.56E+02	
	Pu-240	1.56E+02	
	Pu-241	1.57E+02	
	Sr-90	6.58E+00	
Density of cover material	Co-60	1.40E+00	
	Cs-137	1.40E+00	
	Eu-152	1.40E+00	
	Eu-154	1.40E+00	
	Mn-54	1.40E+00	
	Nb-94	1.40E+00	
	Sb-125	1.40E+00	
SZ hydraulic gradient	H-3	1.75E-02	
	Nb-94	1.75E-02	
	Tc-99	1.75E-02	

Risk-Sensitive Parameter	ROC	Percentile Value 25th	75th
Fish transfer factor	Am-241		5.14E+02
	C-14		9.28E+05
	Cs-137		4.47E+03
	Fe-55		5.90E+02
	H-3		1.07E+00
	Ni-63		3.01E+01
	Np-237		4.21E+01
	Pu-238		4.32E+04
	Pu-239		4.32E+04
	Pu-240		4.32E+04
	Pu-241		4.32E+04
	Sb-125		1.00E+02
	Sr-90		7.71E+00
	Tc-99		4.21E+01
Aquatic food fraction	Am-241		6.10E-01
	C-14		6.10E-01
	Cm-243		6.10E-01
	Cm-244		6.10E-01
	Cs-137		6.10E-01
	Fe-55		6.10E-01
	H-3		6.10E-01
	Ni-63		6.10E-01
	Np-237		6.10E-01
	Pu-238		6.10E-01
	Pu-239		6.10E-01
	Pu-240		6.10E-01
	Pu-241		6.10E-01
	Sb-125		6.10E-01
	Sr-90		6.10E-01
	Tc-99		6.10E-01
Evapotranspiration coefficient	Fe-55	5.62E-01	

6.8.4 DCGL Values for BFM Instantaneous Release Scenario

RESRAD-Onsite code executions were performed for each ROC in the development of DCGL values for the BFM IR scenario (BFM $DCGL_{IR}$). The probabilistic module of RESRAD-Onsite software was used to compute a POM dose, which was used to determine the DCGL values corresponding to the NRC dose criteria established in 10 CFR §20.1403 (i.e., 25 mrem/y). Except for the reasonably conservative input values for the risk-sensitive RESRAD-Onsite parameters listed in Table 6-20, input values were the same as those used in the IR probabilistic analyses.

In addition to the RESRAD-Onsite code executions, ROC-specific $DCGL_{IR}$ values relied on two other calculations.

The first is the calculation of the activity concentrations in fill (sand) material (pCi/g) that corresponded to the assumed initial surface activity concentration (i.e., 1 pCi/m^2). This calculation used the following equation:

$$C_{fill} = \frac{A_s}{(V_{fill})(1E+06)(D_{fill})} \quad \textbf{Equation 6-6}$$

Where:

- C_{fill} = activity concentration in the fill material resulting from the assumed initial surface area activity concentration, pCi/g per 1 pCi/m^2
- A_s = initial unit surface area activity assumed over 1 m^2 of concrete surface, 1 pCi
- V_{fill} = unit volume of fill material, 1m^3
- $1E+06$ = unit conversion factor, cm^3 per m^3
- D_{fill} = density of fill material, 1.5105 g/cm^3 (the mean value of the density distribution for sand from NUREG/CR-7267)

The value of C_{fill} was 6.62E-07 pCi/g per 1 pCi/m^2 for all ROCs, which was used along with the RESRAD-Onsite POM doses and the 10 CFR §20.1402 dose criterion to calculate the ROC-specific values for DCGL$_{IR}$. This step was accomplished using the equation below.

$$DCGL_{IR,i} = \frac{25}{(POM_i)(C_{fill})} \quad \textbf{Equation 6-7}$$

Where:

- $DCGL_{IR,i}$ = DCGL$_{IR}$ value for the i^{th} ROC, pCi/m^2
- 25 = 10 CFR §20.1402 unrestricted release criterion, mrem/y
- POM_i = POM dose for the i^{th} ROC, mrem/y per 1 pCi/g
- C_{fill} = 6.62E-07 pCi/g per 1 pCi/m^2 for all ROCs

The development of the BFM DCGL$_{IR}$ is documented in Section 3.1 in TSD 24-063 (Reference 6-31). The RESRAD-Onsite results and the BFM DCGL$_{IR}$ values are presented in Table 6-20 for each ROC.

Table 6-20 RESRAD Onsite Generated POM Doses and DCGL$_{IR}$ Values by ROC

ROC	POM dose (mrem/y)	DCGL$_{IR}$ (pCi/m^2)
Am-241	1.42E-03	2.65E+10
C-14	5.20E-02	7.26E+08
Cm-243	1.58E-04	2.40E+11
Cm-244	3.89E-04	9.70E+10
Co-60	1.51E-04	2.50E+11
Cs-137	1.99E-04	1.90E+11
Eu-152	3.50E-05	1.08E+12
Eu-154	4.42E-05	8.55E+11
Fe-55	1.54E-07	2.46E+14
H-3	1.94E-08	1.95E+15
Mn-54	1.32E-05	2.87E+12
Nb-94	3.04E-02	1.24E+09
Ni-63	1.29E-07	2.92E+14
Np-237	7.84E-03	4.82E+09

ROC	POM dose (mrem/y)	$DCGL_{IR}$ (pCi/m^2)
Pu-238	1.65E-01	2.29E+08
Pu-239	1.86E-01	2.03E+08
Pu-240	1.86E-01	2.03E+08
Pu-241	3.27E-03	1.15E+10
Sb-125	9.21E-06	4.10E+12
Sr-90	4.58E-05	8.24E+11
Tc-99	1.72E-05	2.19E+12

6.8.5 Conceptual Site Model and Assumptions for BFM Drilling Spoils Scenario

Like the IR scenario, the BFM drilling spoils (DS) scenario is one of 3 scenarios that support the development of BFM $DCGL_{w/f}$. The DS scenario assumes that contaminated concrete in a building foundation is captured and mixed with a site soil column extracted during the failed installation of a hypothetical onsite well. The concrete-soil mixture constitutes the "drilling spoils." Under this scenario, the source term resides with the concrete, not the soil column.

Assuming the minimum distance to a basement floor maximizes the radionuclide concentration in the DS. Of the concrete structures to remain in place at the OCS site, the ORB has the shallowest floor, 14.4 ft. The drill is assumed to travel 1 inch into the ORB floor before drilling is stopped due to meeting refusal from the concrete. Therefore, the total well drilling depth is assumed to be the sum of the ORB wall, 3-ft cover, and 1 inch into the concrete before refusal. The source term in the concrete volume is assumed dispersed in the total concrete/soil volume when the spoils are at the ground surface. The DS are treated as soil and are assumed to be spread on the ground at a thickness of 6 inches. The IU critical receptor and exposure pathways (listed in Section 6.3) are in the DS.

6.8.6 BFM DCGL Values for Drilling Spoils Scenario

The development of DCGL values for the DS scenario included several calculations. The volume of the DS was calculated to be 0.1728 m^3 based on the assumed depth and a 4-inch bore diameter. The area of the DS at the ground surface was calculated to be 1.134 m^2, based on the assumed 6-inch thickness of the spoils after spreading.

The surface concentration activity of contamination on the concrete required to produce a concentration in the DS equal to 1 pCi/g was determined to be 8.05E+06 pCi/m^2 per 1 pCi/g. This concentration was calculated using the following equation:

$$C_c = \frac{(V_{ds})(1E{+}06)(D_f)(C_{ds})}{\pi r^2} \qquad \textbf{Equation 6-8}$$

Where:

- C_c = surface concentration activity of contamination on the concrete required to produce a concentration in the DS equal to 1 pCi/g
- V_{ds} = the volume of DS, m^3
- $1E{+}06$ = conversion for cm^3/m^3
- D_f = density of soil assumed for the DS, g/cm^3

- C_{ds} = unit concentration in DS, 1 pCi/g
- π = pi constant
- r = radius of borehole, m

It was not necessary to perform DS-specific RESRAD-Onsite code executions. When spread over the ground surface, the DS represents a small area of contaminated surface soil (1.134 m2) with an assumed 6-inch thickness, and that small area would be modeled with the same input, except for the CV-related input as that used for the IU surface soil DCGL values. In addition, the adjustments to input values based on the area of the DS would be the same as the input adjustments made in the development of AF values for surface soil DCGLs. Accordingly, in lieu of RESRAD-Onsite code executions, the RESRAD-Onsite ROC-specific POM doses from the RESRAD-Onsite results for surface soil DCGL values (which were developed for a CZ thickness ranging from 0.1524 m to 3.96 m) and the surface soil AFs were applied in the development of $DCGL_{ds}$ values. AFs for a contaminated area equal to 1m^2 were selected based on the calculated area of the DS. The ROC-specific DCGL values DS ($DCGL_{ds,i}$) were calculated using Equation 6-9.

$$\boldsymbol{DCGL_{ds,i} = \frac{(25)(C_c)\left(AF_{1m^2,i}\right)}{POM_i}} \qquad \textbf{Equation 6-9}$$

Where:

- $DCGL_{ds,i}$ = the $DCGL_{ds}$ for the i^{th} ROC, pCi/m^2
- 25 = 10 CFR §20.1402 radiological criterion for unrestricted release, mrem/y
- C_c = 8.05E+06 pCi/m^2 per 1 pCi/g
- $AF_{1m^2,i}$ = the 1m^2 AFs, unitless (from Engineering Calculation ENG-OCS-009)
- POM_i = the POM dose for the i^{th} ROC, mrem/y per pCi/g (from Engineering Calculation ENG-OCS-008)

The development of the BFM $DCGL_{ds}$ is documented in Section 3.2 in TSD 24-063. Table 6-21 lists the $DCGL_{ds}$ values by ROC.

Table 6-21 POM Doses and Area Factors Supporting DCGL$_{ds}$ Values

ROC	POM (mrem/y per pCi/g)	AF_{1m^2}	$DCGL_{ds}$ (pCi/m^2)
Am-241	3.42E-02	12	7.06E+10
C-14	1.21E-02	585	9.73E+12
Cm-243	1.38E-01	9	1.31E+10
Cm-244	1.37E-02	16	2.35E+11
Co-60	3.15E+00	9	5.75E+08
Cs-137	6.99E-01	9	2.59E+09
Eu-152	1.42E+00	9	1.28E+09
Eu-154	1.53E+00	9	1.18E+09
Fe-55	2.98E-06	278	1.88E+16
H-3	4.98E-04	45	1.82E+13

ROC	POM (mrem/y per pCi/g)	AF_{1m^2}	$DCGL_{ds}$ (pCi/m^2)
Mn-54	7.34E-01	9	2.47E+09
Nb-94	2.01E+00	9	9.01E+08
Ni-63	3.23E-06	176	1.10E+16
Np-237	4.35E-01	9	4.16E+09
Pu-238	2.20E-02	16	1.46E+11
Pu-239	8.17E-02	21	5.17E+10
Pu-240	8.57E-02	21	4.93E+10
Pu-241	1.00E-03	24	4.83E+12
Sb-125	4.50E-01	9	4.03E+09
Sr-90	5.89E-03	11	3.76E+11
Tc-99	1.82E-03	27	2.99E+12

6.8.7 Conceptual Site Model for BFM Concrete Excavation Scenario

The concrete excavation is the third scenario that contributes to the development of BFM $DCGL_{w/f}$. Under this scenario, portions of the concrete walls of a below-grade foundation are excavated, rubblized, and spread over the ground surface to a thickness of 1m. Concrete excavation is assumed terminated when the groundwater table has been reached. The depth to groundwater assumed in this scenario is the average depth to groundwater for wells located in the vicinity of the RB, TB, and ORB (the general location of below-grade building foundations and where excavation is assumed to occur). Once at the ground surface, the excavated concrete (EC) is treated as surface soil. The critical receptor and exposure pathways in the site compliance scenario (the IU scenario) are applied in the modeling of the EC scenario.

6.8.8 BFM DCGL Values for Concrete Excavation Release Scenario

The volume of EC in this scenario was assumed to be from the building foundation providing the largest excavatable concrete volume above the groundwater table. The above-groundwater concrete volumes were calculated for the RB, TB, and ORB using documented building wall length and width dimensions and a wall height value representing the distance from minus 3 ft to the average depth to groundwater. The calculated volumes of EC were 675 m^3 for the RB, 872 m^3 for the TB, and 195 m^3 for the ORB. The largest volume, 872 m^3 for the TB, was selected as the CV for the EC scenario.

The assumption that the 872 m^3 of EC is spread to a thickness of 1m produces a CZ area equal to 872 m^2. Additionally, the assumption that the concrete is treated as soil when spread at the ground surface permits the use of the IU surface soil DCGL values, which are applicable to CZ thickness ranging from 0.1524 m to 3.96 m, and the corresponding AF values. However, this approach also made it necessary to determine the activity concentration in the EC (C_{ec}) that was produced by an assumed initial concrete surface area contamination equal to 1 pCi/m^2. The value of C_{ec} was calculated to be 4.75E-07 pCi/g per 1 pCi/m^2 using the following equation:

$$C_{ec} = \frac{A_c}{(t_w)(30.48)(W_{UA})(1E{+}04)(D_f)} \qquad \textbf{Equation 6-10}$$

Where:

- C_{ec} = unit concentration in the EC (pCi/g per 1 pCi/m^2)
- A_c = initial unit activity assumed over 1 m^2 of concrete surface (1 pCi)
- t_w = wall thickness (ft)
- 30.48 = conversion for cm/ft
- W_{UA} = unit area of concrete wall (1 m^2)
- $1E{+}04$ = conversion for cm^2/m^2
- D_f = assumed density of concrete, 2.3 g/cm^2, which is the mid-point of the density range in Health Physics and Radiological Health (Reference 6-32).

The value of C_{ec} was used along with the IU surface soil DCGL values and the corresponding AF values for a contaminated area equal to 872 m^2 to calculate the $DCGL_{ec}$ values using the following equation:

$$\boldsymbol{DCGL_{ec,i} = \frac{(DCGL_{soil,i})(AF_{cz,i})}{C_{ec}}} \qquad \textbf{Equation 6-11}$$

Where:

- $DCGL_{ec,i} = DCGL_{ec}$ value for the i^{th} ROC, pCi/m^2
- $DCGL_{soil,i} = DCGL_{soil}$ value for the i^{th} ROC, pCi/g (from Engineering Calculation ENG-OCS-008)
- $AF_{cz,i}$ = the applicable AF_{cz} for the i^{th} ROC, unitless (from Engineering Calculation ENG-OCS-009)
- C_{ec} = unit concentration in the EC, pCi/g per 1 pCi/m^2

An AF value of 1 is applicable for an area of 872 m^2 for all ROCs. The development of the BFM $DCGL_{ec}$ is documented in Section 3.3 in TSD 24-063. Table 6-22 presents the calculated values for $DCGL_{ec}$.

Table 6-22 DCGL$_{ec}$ Values by ROC

ROC	$DCGL_{soil}$ (pCi/g)	$DCGL_{ec}$ (pCi/m^2)
Am-241	7.31E+02	1.54E+09
C-14	2.07E+03	4.35E+09
Cm-243	1.81E+02	3.81E+08
Cm-244	1.82E+03	3.83E+09
Co-60	7.94E+00	1.67E+07
Cs-137	3.58E+01	7.53E+07
Eu-152	1.76E+01	3.70E+07
Eu-154	1.63E+01	3.43E+07
Fe-55	8.39E+06	1.76E+13
H-3	5.02E+04	1.06E+11
Mn-54	3.41E+01	7.17E+07
Nb-94	1.25E+01	2.61E+07
Ni-63	7.75E+06	1.63E+13
Np-237	5.75E+01	1.21E+08
Pu-238	1.14E+03	2.40E+09

ROC	$DCGL_{soil}$ (pCi/g)	$DCGL_{ec}$ (pCi/m^2)
Pu-239	2.37E+02	6.44E+08
Pu-240	3.06E+02	6.14E+08
Pu-241	2.92E+02	5.26E+10
Sb-125	5.56E+01	1.17E+08
Sr-90	4.24E+03	8.92E+09
Tc-99	1.37E+04	2.88E+10

6.8.9 BFM DCGL Values for Concrete Foundations and Structures

The BFM wall/floor DCGL ($DCGL_{w/f}$) incorporates the dose contributions from the IR, DS, and EC scenarios. The BFM $DCGL_{w/f}$ values apply to all below-grade concrete foundations and structures left in place at license termination. The values of BFM $DCGL_{w/f}$, listed in

Table 6-23, were calculated using Equation 6-12.

$$DCGL_{w/f} = \frac{1}{(1/DCGL_{IR})+(1/DCGL_{ds})+(1/DCGL_{ec})} \quad \textbf{Equation 6-12}$$

The development of the BFM $DCGL_{IR}$ is documented in Section 3.4 in TSD 24-063.

Table 6-23 BFM $DCGL_{w/f}$ Values by ROC

ROC	$DCGL_{IR}$ (pCi/m^2)	$DCGL_{DS}$ (pCi/m^2)	$DCGL_{EC}$ (pCi/m^2)	$DCGL_{W/F}$ (pCi/m^2)
Am-241	2.65E+10	7.06E+10	1.54E+09	1.42E+09
C-14	7.26E+08	9.73E+12	4.35E+09	6.22E+08
Cm-243	2.40E+11	1.31E+10	3.81E+08	3.69E+08
Cm-244	9.70E+10	2.35E+11	3.83E+09	3.63E+09
Co-60	2.50E+11	5.75E+08	1.67E+07	1.62E+07
Cs-137	1.90E+11	2.59E+09	7.53E+07	7.31E+07
Eu-152	1.08E+12	1.28E+09	3.70E+07	3.60E+07
Eu-154	8.55E+11	1.18E+09	3.43E+07	3.33E+07
Fe-55	2.46E+14	1.88E+16	1.76E+13	1.64E+13
H-3	1.95E+15	1.82E+13	1.06E+11	1.05E+11
Mn-54	2.87E+12	2.47E+09	7.17E+07	6.97E+07
Nb-94	1.24E+09	9.01E+08	2.61E+07	2.48E+07
Ni-63	2.92E+14	1.10E+16	1.63E+13	1.54E+13
Np-237	4.82E+09	4.16E+09	1.21E+08	1.15E+08
Pu-238	2.29E+08	1.46E+11	2.40E+09	2.09E+08
Pu-239	2.03E+08	5.17E+10	6.44E+08	1.54E+08
Pu-240	2.03E+08	4.93E+10	6.14E+08	1.52E+08
Pu-241	1.15E+10	4.83E+12	5.26E+10	9.45E+09
Sb-125	4.10E+12	4.03E+09	1.17E+08	1.14E+08
Sr-90	8.24E+11	3.76E+11	8.92E+09	8.62E+09

ROC	$DCGL_{IR}$ (pCi/m^2)	$DCGL_{DS}$ (pCi/m^2)	$DCGL_{EC}$ (pCi/m^2)	$DCGL_{W/F}$ (pCi/m^2)
Tc-99	2.19E+12	2.99E+12	2.88E+10	2.82E+10

6.9 BFM for Embedded Pipes

The RB, TB, and ORB basement floors contain drains embedded in the concrete. Embedded Pipe (EP) is defined as a pipe that runs vertically through a concrete wall or horizontally through a concrete floor. The conceptual and mathematical models for the EP dose assessment are fundamentally the same as the BFM wall/floor IR model. However, rather than relying on the results of probabilistic analyses in the development of BFM $DCGL_{w/f}$, the development of DCGL values for EPs included separate probabilistic analysis because the CV is in a different configuration, and it was important to identify risk-sensitive parameters specific to the modeling of EP.

6.9.1 Conceptual Site Model for BFM Embedded Pipe Scenario

The BFM $DCGL_{ep}$ values are based on a scenario that assumes an IR of residual internal surface radioactivity in EPs to 1m of fill (soil) directly above the concrete floors of the RB, TB, and ORB. The CVs resulting from the 3 foundation floors are summed, and the total CV is modeled as the CZ. The CZ is assumed covered by site soil and located entirely in the SZ. The physical concrete walls and floors of the below-grade structures are assumed not to impede groundwater flow or migration of residual contamination.

The critical receptor and active exposure pathways for the IU scenario are assumed for EP. The pathways used to estimate radiation exposure resulting from residual radioactivity associated with EP are those assumed for the compliance IU scenario:

- Direct external radiation exposure pathway
- Inhalation exposure pathway
- Ingestion exposure via aquatic food from the intake/discharge canal
- Inadvertent ingestion of contaminated soil

6.9.2 Probabilistic Analyses of RESRAD-Onsite Input Parameters

Probabilistic analyses performed for EPs followed the approach described in the previous sections. Sand is assumed as soil type for cover and fill material (consistent with soil type assumed in calculations for surface soil DCGL values and supported by information provided in the 2017 Hydrogeologic Investigation Report, the OCS HSA, and well installation logs). Distributions for K_d values, density, porosity, field capacity, and RESRAD "b" parameter for sand are taken from NUREG/CR-7267.

The CV was calculated using documented RB, TB, and ORB floor dimensions. The total floor area for the RB, TB, and ORB is 6,355.3 m^2, which results in a CV equal to 6,355.3 m^3. The CZ area and length parallel to aquifer flow were determined from the CV and an assumed 1-m thickness: 6355.3 m^2 and 90 m, respectively.

The probabilistic analysis for EP is documented in Calculation ENG-OCS-014 (Reference 6-33). Table 6-24 and Table 6-25 summarizes the input values and the reference source for each input parameter.

Table 6-24 IU BFM EP Scenario Exposure Pathways

IU BFM EP Scenario Exposure Pathways	
External Gamma	Open
Inhalation	Open
Plant Ingestion	Close
Meat Ingestion	Close
Milk Ingestion	Close
Aquatic Foods	Open
Drinking Water	Close
Soil Ingestion	Open
Radon	Close

Table 6-25 Values and Basis for RESRAD-Onsite Parameters for the IU BFM EP Scenario

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Soil Concentrations										
Basic radiation dose limit (mrem/y)	P	3	D	25	10 CFR §20.1402	NR	NR	NR	NR	
Initial principal radionuclide (pCi/g)	P	2	D	1	Unit Value	NR	NR	NR	NR	
Distribution coefficients (K_d) (values for **sand** soil type, cm^3/g)										
Ac-227	P	1	S	Truncated lognormal-n	NUREG/CR-7267	7.44	1.1	0.001	0.999	1700
Am-241	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.91	1.95	0.001	0.999	1000
Am-243	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.91	1.95	0.001	0.999	1000
C-14	P	1	S	Truncated lognormal-n	NUREG/CR-7267	3.04	1.82	0.001	0.999	21
Cm-243	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.13	2.64	0.001	0.999	3400
Cm-244	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.13	2.64	0.001	0.999	3400
Co-60	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.56	2.89	0.001	0.999	260
Cs-137	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.27	1.79	0.001	0.999	530
Eu-152	P	1	S	Truncated lognormal-n	NUREG/CR-7267	6.86	4.01	0.001	0.999	955
Eu-154	P	1	S	Truncated lognormal-n	NUREG/CR-7267	6.86	4.01	0.001	0.999	955
Fe-55	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.77	0	0.001	0.999	320
Gd-152	P	1	S	Truncated lognormal-n	NUREG/CR-7267	1.61	3.22	0.001	0.999	5
H-3	P	1	S	Truncated lognormal-n	NUREG/CR-7267	-2.81	0.5	0.001	0.999	0.06
Mn-54	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.89	2.64	0.001	0.999	980
Nb-94	P	1	S	Truncated lognormal-n	NUREG/CR-7267	7.31	1.39	0.001	0.999	1500
Ni-63	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.87	2.3	0.001	0.999	130
Np-237	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	2.64	1.39	0.001	0.999	14
Pa-231	P	1	S	Truncated lognormal-n	NUREG/CR-7267	7.6	1.1	0.001	0.999	2000
Pb-210	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.39	1.39	0.001	0.999	220
Po-210	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.61	1.79	0.001	0.999	100
Pu-238	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.99	1.39	0.001	0.999	400
Pu-239	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.99	1.39	0.001	0.999	400
Pu-240	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.99	1.39	0.001	0.999	400

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Pu-241	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.99	1.39	0.001	0.999	400
Ra-226	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.04	2.08	0.001	0.999	3100
Ra-228	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.04	2.08	0.001	0.999	3100
Sb-125	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	2.83	1.79	0.001	0.999	17
Sr-90	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	3.09	1.79	0.001	0.999	22
Tc-99	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	-3.22	1.1	0.001	0.999	0.04
Te-125m	P	1	S	Truncated lognormal-n	NUREG/CR-7267	6.31	3.22	0.001	0.999	550
Th-228	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
Th-229	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
Th-230	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
Th-232	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
U-233	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
U-234	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
U-235	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
U-236	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
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 Default	NR	NR	NR	NR	
Contaminated Zone										
Area of contaminated zone (m^2)	P	2	D	6355.3	Combined CV from RB, TB, and ORB.	NR	NR	NR	NR	
Thickness of contaminated zone (m)	P	2	D	1.0	Scenario assumption.	NR	NR	NR	NR	
Length parallel to aquifer flow (m)	P	2	D	90	Set to diameter of CZ.	NR	NR	NR	NR	
Does the initial contamination penetrate the water table?				Yes	Based on site features and RB dimensions.					
Contaminated fraction below water table			D	1.0	Entire CV assumed in SZ	NR	NR	NR	NR	

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Cover and Contaminated Zone Hydrological Data										
Cover depth (m)	P	2	D	7.81	Area-weighted value for bldg. wall heights.	NR	NR	NR	NR	
Cover density (g/cm^3)	P	2	S	Truncated Normal	Site soil type = sand (OCNGS *Hydrogeologic Investigation Report*). Input for density of fill material = NUREG/CR-7267 density distribution for site soil type - sand.	1.5105	0.159	0.001	0.999	1.5105
Cover erosion rate (m/y)	P	2	D	6.0E-04	Assumed final site grade is level. Input for erosion rate = NUREG/CR-7267 erosion rate for site with shallow slope (i.e., level)	NR	NR	NR	NR	
Density of contaminated zone (g/cm^3)	P	1	S	Truncated Normal	Site soil type = sand (OCNGS *Hydrogeologic Investigation Report*). Input for density of fill material = NUREG/CR-7267 density distribution for site soil type - sand.	1.5105	0.159	0.001	0.999	1.5105
Contaminated zone erosion rate (m/y)	P	2	D	6.0E-04	Assumed same as cover.	NR	NR	NR	NR	
Contaminated zone total porosity	P	2	S	Bounded Normal	NUREG/CR-7267 distribution for site soil type - sand	0.43	0.06	0.2446	0.6154	0.43
Contaminated zone field capacity	P	3	D	0.18	Value based on site-specific soil type (sand); calculated using equation in NUREG/CR-7267	NR	NR	NR	NR	
Contaminated zone hydraulic conductivity (m/y)	P	2	D	2741	OCNGS *Hydrogeologic Investigation Report*	NR	NR	NR	NR	
Contaminated zone b parameter	P	2	S	Bounded Log Normal n	NUREG/CR-7267 distribution for site soil type - sand	- 0.0253	0.216	0.501	1.90	0.975
Humidity in air (g/m^3)	P	3	D	6.6	From *Regional and Site-Specific Absolute Humidity Data for Use in Tritium Dose Calculations*.	NR	NR	NR	NR	
Evapotranspiration coefficient	P	2	S	Uniform	NUREG/CR-7267 distribution	0.5	0.75	NR	NR	0.625
Average annual wind speed (m/s)	P	2	D	3.13	Internet search: https://www.windfinder.com/windstatistics/oyster_creek_barnegat_bay	NR	NR	NR	NR	
Precipitation (m/y)	P	2	D	1.4	*Annual Report on the Meteorological Program at Oyster Creek Generating Station* – average annual precipitation for 2015 through 2020	NR	NR	NR	NR	
Irrigation (m/y)	B	3	S	Uniform	Distribution determined using methodology described in *Data Collection Handbook* and NUREG/CR-6697	0	0.08			0.04
Irrigation mode	B	3	D	Overhead	Overhead irrigation is common practice for crops in U.S.	NR	NR	NR	NR	

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Runoff coefficient	P	2	D	0.2	Value determined using methodology described in *Data Collection Handbook* and NUREG/CR-7267	NR	NR	NR	NR	
Watershed area for nearby stream or pond (m^2)	P	3	D	1.01E+08	NJ-GeoWeb (NJDEP BGIS)	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	Truncated Normal	NUREG/CR-7267 distribution for site soil type – sand	1.5105	0.159	0.001	0.999	1.5105
Saturated zone total porosity	P	1	S	Truncated Normal	NUREG/CR-7267 distribution for site soil type – sand	0.43	0.06	0.001	0.999	0.43
Saturated zone effective porosity	P	1	D	0.25	OCNGS *Hydrogeologic Investigation Report*	NR	NR	NR	NR	
Saturated zone field capacity	P	3	D	0.18	Value based on site-specific soil type **(**sand); calculated using equation in NUREG/CR-7267	NR	NR	NR	NR	
Saturated zone hydraulic conductivity (m/y)	P	1	D	2741	OCNGS *Hydrogeologic Investigation Report*	NR	NR	NR	NR	
Saturated zone hydraulic gradient	P	2	S	Uniform	OCNGS *Hydrogeologic Investigation Report*	0.01	0.04			0.025
Saturated zone b parameter	P	2	S	Bounded Log Normal n	NUREG/CR-7267 distribution for site soil type – sand	- 0.0253	0.216	0.501	1.90	0.975
Water table drop rate (m/y)	P	3	D	0	CZ in SZ	NR	NR	NR	NR	
Well pump intake depth (m below water table)	P	2	D	4.42	NOTE: input has no impact for IU scenario.	NR	NR	NR	NR	
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	Min, and max value based on site irrigation and general case parameter values presented in NUREG/CR-7267.	407	567			487
Unsaturated Zone Hydrological Data										
Number of unsaturated zone strata	P	3	D	0	UZ above CZ and is assumed part of cover.	NR	NR	NR	NR	
Unsat. zone 1, thickness (m)	P	1	D	N/A	Input not required when number of UZ = 0.					
Unsat. zone 1, soil density (g/cm^3)	P	2	S	N/A	Input not required when number of UZ = 0.					
Unsat. zone 1, total porosity	P	2	S	N/A	Input not required when number of UZ = 0.					

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Unsat. zone 1, effective porosity	P	2	D	N/A	Input not required when number of UZ = 0.					
Unsat. zone 1, field capacity	P	3	D	N/A	Input not required when number of UZ = 0.					
Unsat. zone 1, hydraulic conductivity (m/y)	P	2	D	N/A	Input not required when number of UZ = 0.					
Unsat. zone 1, soil-specific b parameter	P	2	S	N/A	Input not required when number of UZ = 0.					
Occupancy										
Inhalation rate (m^3/y)	B	3	D	8400	NUREG/CR-7267	NR	NR	NR	NR	
Mass loading for inhalation (g/m^3)	P	2	S	Continuous linear	NUREG/CR-7267					2.3E-05
Exposure duration	B	3	D	30	RESRAD Default	NR	NR	NR	NR	
Indoor dust filtration factor	P	2	S	Uniform	NUREG/CR-7267	0.15	0.95			0.55
Shielding factor, external gamma	P	2	S	Bounded lognormal-n	NUREG/CR-7267	-1.3	0.59	0.044	1	0.2725
Fraction of time spent indoors	B	3	D	0.03	Fraction of calendar year assuming 1h/workday for daily work breaks	NR	NR	NR	NR	
Fraction of time spent outdoors	B	3	D	0.2	Fraction of calendar year assuming 7h/workday for outside tasks	NR	NR	NR	NR	
Shape factor flag, external gamma	P	3	D	Circular	Circular contaminated zone assumed	NR	NR	NR	NR	
Ingestion, Dietary										
Fruits, vegetables, grain consumption (kg/y)	B	2	D	N/A	Input not required - plant ingestion pathway inactive	NR	NR	NR	NR	
Leafy vegetable consumption (kg/y)	B	3	D	N/A	Input not required - plant ingestion pathway inactive	NR	NR	NR	NR	
Milk consumption (L/y)	B	2	D	N/A	Input not required - milk ingestion pathway inactive	NR	NR	NR	NR	
Meat and poultry consumption (kg/y)	B	3	D	N/A	Input not required - meat ingestion pathway inactive	NR	NR	NR	NR	
Fish consumption (kg/y)	B	3	D	20.6	NUREG/CR-5512, Vol. 3	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	Triangular	NUREG/CR-7267	NR	NR	NR	NR	
Drinking water intake (L/y)	B	2	D	N/A	Input not required – drinking water pathway inactive	NR	NR	NR	NR	
Contamination fraction of drinking water	P	3	D	N/A	Input not required – drinking water pathway inactive	NR	NR	NR	NR	

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Contamination fraction of household water	P	3		N/A	Input not required – water pathway inactive					
Contamination fraction of livestock water	P	3	D	N/A	Input not required – drinking water/ingestion pathways inactive	NR	NR	NR	NR	
Contamination fraction of irrigation water	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Contamination fraction of aquatic food	P	2	D	Triangular	NUREG/CR-7267	NR	NR	NR	NR	
Contamination fraction of plant food	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Contamination fraction of meat	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Contamination fraction of milk	P	3	D	N/A	Input not required – milk ingestion pathway inactive	NR	NR	NR	NR	
Ingestion, Non-Dietary										
Livestock fodder intake for meat (kg/d)	M	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Livestock fodder intake for milk (kg/d)	M	3	D	N/A	Input not required – milk ingestion pathway inactive	NR	NR	NR	NR	
Livestock water intake for meat (L/d)	M	3	D	N/A	Input not required – water ingestion pathway inactive	NR	NR	NR	NR	
Livestock water intake for milk (L/d)	M	3	D	N/A	Input not required – milk ingestion pathway inactive	NR	NR	NR	NR	
Livestock soil intake (kg/d)	M	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Mass loading for foliar deposition (g/m^3)	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Depth of soil mixing layer (m)	P	2	S	Triangular	NUREG/CR-7267	0	0.15	0.6		0.23
Depth of roots (m)	P	1	S	N/A	Input not required – plant ingestion pathway inactive	0.3	4			1.85
Drinking water fraction from ground water	P	3	D	N/A	Input not required – drinking water ingestion pathway inactive	NR	NR	NR	NR	
Household water fraction from ground water	P	3		N/A	Input not required – drinking water pathway inactive					
Livestock water fraction from ground water	P	3	D	N/A	Input not required – drinking water/meat ingestion pathways inactive	NR	NR	NR	NR	
Irrigation fraction from ground water	P	3	D	N/A	Input not required – drinking water pathway inactive	NR	NR	NR	NR	
Wet weight crop yield for Non-Leafy (kg/m^2)	P	2	S	N/A	Input not required – plant ingestion pathway inactive	0.56	0.48	0.001	0.999	1.75

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Wet weight crop yield for Leafy (kg/m^2)	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Wet weight crop yield for Fodder (kg/m^2)	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Growing Season for Non-Leafy (y)	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Growing Season for Leafy (y)	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Growing Season for Fodder (y)	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Translocation Factor for Non-Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Translocation Factor for Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Translocation Factor for Fodder	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Weathering Removal Constant for Vegetation (1/y)	P	2	S	N/A	Input not required – plant ingestion pathway inactive	5.1	18	84		33
Wet Foliar Interception Fraction for Non-Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Wet Foliar Interception Fraction for Leafy	P	2	S	N/A	Input not required – plant ingestion pathway inactive	0.06	0.67	0.95		0.58
Wet Foliar Interception Fraction for Fodder	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Non-Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Fodder	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Storage times of contaminated foodstuffs (days):										
Fruits, non-leafy vegetables, and grain	B	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Leafy vegetables	B	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Milk	B	3	D	N/A	Input not required – milk ingestion pathway inactive	NR	NR	NR	NR	
Meat and poultry	B	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Fish	B	3	D	7	RESRAD Default	NR	NR	NR	NR	
Crustacea and mollusks	B	3	D	7	RESRAD Default	NR	NR	NR	NR	
Well water	B	3	D	N/A	Input not required – drinking water pathway inactive	NR	NR	NR	NR	

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Surface water	B	3	D	N/A	Input not required drinking water pathway inactive	NR	NR	NR	NR	
Livestock fodder	B	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Special Radionuclides (C-14)										
C-12 concentration in water (g/cm^3)	P	3	D	2.00E-05	RESRAD Default	NR	NR	NR	NR	
C-12 concentration in contaminated soil (g/g)	P	3	D	3.00E-02	RESRAD Default	NR	NR	NR	NR	
Fraction of vegetation carbon from soil	P	3	D	2.00E-02	RESRAD Default	NR	NR	NR	NR	
Fraction of vegetation carbon from air	P	3	D	9.80E-01	RESRAD Default	NR	NR	NR	NR	
C-14 evasion layer thickness in soil (m)	P	2	S	Triangular	NUREG/CR-7267	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	NR	NR	NR	NR	
C-12 evasion flux rate from soil (1/s)	P	3	D	1.00E-10	RESRAD Default	NR	NR	NR	NR	
Fraction of grain in beef cattle feed	B	3	D	0.2500	NUREG/CR-7267	NR	NR	NR	NR	
Fraction of grain in milk cow feed	B	3	D	0.1000	NUREG/CR-7267	NR	NR	NR	NR	
Inhalation Dose Conversion Factors (mrem/pCi inhaled) from FGR11 (contained in RESRAD Dose Conversion Library)										
Ingestion Dose Conversion Factors (mrem/pCi ingested) from FGR11 (contained in RESRAD Dose Conversion Library)										
Plant Transfer Factors (pCi/g plant)/(pCi/g soil) **Note: Plant ingestion pathway closed – input for plant transfer factors not required for IU dose calculations.**										
Meat Transfer Factors (pCi/kg)/(pCi/d) **Note: Meat ingestion pathway closed – input for meat transfer factors not required for IU dose calculations.**										
Milk Transfer Factors (pCi/L)/(pCi/d) **Note: Milk ingestion pathway closed – input for milk transfer factors not required for IU dose calculations.**										
Bioaccumulation Factors for Fish ((pCi/kg)/(pCi/L))										
Ac-227	P	2	S	Lognormal-n	NUREG/CR-7267	3.2	1.1			2.5E+01
Am-241	P	2	S	Lognormal-n	NUREG/CR-7267	5.5	1.1			2.4E+02
Am-243	P	2	S	Lognormal-n	NUREG/CR-7267	5.5	1.1			2.4E+02
C-14	P	2	S	Lognormal-n	NUREG/CR-7267	13.0	1.1			4.4E+05
Cm-243	P	2	S	Lognormal-n	NUREG/CR-7267	3.4	1.1			3.0E+01

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Cm-244	P	2	S	Lognormal-n	NUREG/CR-7267	3.4	1.1			3.0E+01
Co-60	P	2	S	Lognormal-n	NUREG/CR-7267	4.3	0.9			7.4E+01
Cs-137	P	2	S	Lognormal-n	NUREG/CR-7267	7.8	0.9			2.4E+03
Eu-152	P	2	S	Lognormal-n	NUREG/CR-7267	4.9	1.6			1.3E+02
Eu-154	P	2	S	Lognormal-n	NUREG/CR-7267	4.9	1.6			1.3E+02
Fe-55	P	2	S	Lognormal-n	NUREG/CR-7267	5.1	1.9			1.6E+02
Gd-152	P	2	S	Lognormal-n	NUREG/CR-7267	3.4	1.1			3.0E+01
H-3	P	2	S	Lognormal-n	NUREG/CR-7267	0	0.1			1.0E+00
Mn-54	P	2	S	Lognormal-n	NUREG/CR-7267	5.5	1.9			2.4E+02
Nb-94	P	2	S	Lognormal-n	NUREG/CR-7267	5.7	1.1			3.0E+02
Ni-63	P	2	S	Lognormal-n	NUREG/CR-7267	3.0	0.6			2.0E+01
Np-237	P	2	S	Lognormal-n	NUREG/CR-7267	3.0	1.1			2.0E+01
Pa-231	P	2	S	Lognormal-n	NUREG/CR-7267	2.3	1.1			1.0E+01
Pb-210	P	2	S	Lognormal-n	NUREG/CR-7267	3.2	1.1			2.5E+02
Po-210	P	2	S	Lognormal-n	NUREG/CR-7267	3.6	1.5			3.7E+01
Pu-238	P	2	S	Lognormal-n	NUREG/CR-7267	10.0	1.0			2.2E+04
Pu-239	P	2	S	Lognormal-n	NUREG/CR-7267	10.0	1.0			2.2E+04
Pu-240	P	2	S	Lognormal-n	NUREG/CR-7267	10.0	1.0			2.2E+04
Pu-241	P	2	S	Lognormal-n	NUREG/CR-7267	10.0	1.0			2.2E+04
Ra-226	P	2	S	Lognormal-n	NUREG/CR-7267	1.4	1.9			4.1E+00
Ra-228	P	2	S	Lognormal-n	NUREG/CR-7267	1.4	1.9			4.1E+00
Sb-125	P	2	S	Lognormal-n	NUREG/CR-7267	3.6	1.5			3.7E+01
Sr-90	P	2	S	Lognormal-n	NUREG/CR-7267	1.1	1.4			3.0E+00
Tc-99	P	2	S	Lognormal-n	NUREG/CR-7267	3.0	1.1			2.0E+01
Te-12m	P	2	S	Lognormal-n	NUREG/CR-7267	5.0	0.4			1.5E+02
Th-228	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.9E+01
Th-229	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.9E+01
Th-230	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.9E+01
U-233	P	2	S	Lognormal-n	NUREG/CR-7267	0.0	2.5			1.0E+00
U-234	P	2	S	Lognormal-n	NUREG/CR-7267	0.0	2.5			1.0E+00
U-235	P	2	S	Lognormal-n	NUREG/CR-7267	0.0	2.5			1.0E+00
U-236	P	2	S	Lognormal-n	NUREG/CR-7267	0.0	2.5			1.0E+00
Bioaccumulation Factors for Crustacea/ Mollusks ((pCi/kg)/(pCi/L)) RESRAD default value for each radionuclide applied										
Graphics Parameters										
Number of points				32	RESRAD Default	NR	NR	NR	NR	
Spacing				log	RESRAD Default	NR	NR	NR	NR	
Time integration parameters										

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Maximum number of points for dose				17	RESRAD Default	NR	NR	NR	NR	

Notes:

[a] P = physical, B = behavioral, M = metabolic

[b] 1 = high-priority parameter, 2 = medium-priority parameter, 3 = low-priority parameter

[c] D = deterministic, S = stochastic

N/A = not applicable

[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 = mode, 3 = maximum

Uniform: 1 = minimum, 2 = maximum

The probabilistic analyses for the EP scenario identified several RESRAD-Onsite parameters as risk-sensitive for some, but not all, ROCs. The identified risk-sensitive parameters are:

- Distribution coefficients (K_d values) in the CZ and SZ
- Hydraulic gradient in SZ
- Fish transfer factors
- Aquatic food fraction
- Evapotranspiration coefficient
- Density of CZ
- Evapotranspiration coefficient

Following the identification of risk-sensitive parameters, 25th and 75th percentile values were determined from the RESRAD-Onsite probabilistic results and are presented in Table 6-26. The values listed in Table 6-26 represent reasonably conservative values that address a large portion of the uncertainty associated with the risk-sensitive parameters and were used as input in the development of $DCGL_{ep}$ values.

Table 6-26 RESRAD-Generated Percentile Values for Risk-Sensitive Input Parameters

Risk-Sensitive Parameter	ROC	Percentile Value	
		25th	75th
K_d in CZ	Am-241	2.69E+02	
	C-14	6.13E+00	
	Cm-243	5.74E+02	
	Cm-244	5.74E+02	
	Co-60	3.71E+01	
	Cs-137	1.58E+02	
	Eu-152	6.40E+01	
	Eu-154	6.40E+01	
	H-3	4.30E-03	
	Mn-54	1.66E+02	
	Nb-94	5.86E+02	
	Ni-63	2.77E+01	
	Np-237	5.49E+00	
	Pu-238	1.56E+02	
	Pu-239	1.56E+02	
	Pu-240	1.56E+02	
	Pu-241	1.57E+02	
	Sb-125	5.07E+00	
	Sr-90	6.58E+00	

Risk-Sensitive Parameter	ROC	Percentile Value 25th	75th
K_d in SZ	Am-241	2.69E+02	
	C-14	6.13E+00	
	Co-60	3.71E+01	
	Cs-137	1.58E+02	
	Eu-152	6.40E+01	
	Eu-154	6.40E+01	
	Mn-54	1.66E+02	
	Nb-94	5.86E+02	
	Ni-63	2.77E+01	
	Np-237	5.49E+00	
	Pu-238	1.56E+02	
	Pu-239	1.56E+02	
	Pu-240	1.56E+02	
	Pu-241	1.57E+02	
	Sb-125	5.07E+00	
	Sr-90	6.58E+00	
	Te-125m		4.79E+03
SZ hydraulic gradient	All ROCs except Tc-99, and H-3	1.75E-02	3.25E-02
Aquatic food fraction	All ROCs		6.09E-01
Fish TF	Am-241		5.14E+02
	C-14		9.28E+05
	Co-60		1.35E+02
	Cs-137		4.48E+03
	Eu-152		3.95E+02
	Eu-154		3.95E+02
	Fe-55		5.90E+02
	H-3		1.07E+00
	Nb-94		6.27E+02
	Ni-63		3.01E+01
	Np-237		4.21E+01
	Pu-238		4.32E+04
	Pu-239		4.32E+04
	Pu-240		4.32E+04
	Pu-241		4.32E+04
	Sb-125		1.00E+02
	Sr-90		7.72E+00
	Tc-99		4.21E+01
Density of CZ	H-3		1.62E+00
Evapotranspiration coefficient	H-3		6.87E-01

6.9.3 BFM DCGL Values for Embedded Pipe Scenario

Except for the 75th and 25th percentile values, input for the EP DCGL values was the same as that used for the EP probabilistic analyses. Table 6-27 and Table 6-28 summarizes the input values for the RESRAD-Onsite executions.

The first step in developing EP DCGL values ($DCGL_{ep}$) was performing RESRAD-Onsite code executions using the input values listed in Table 6-28. The resulting POM doses are provided by ROC in Table 6-29.

A review of the RESRAD reports shows that the POM doses calculated for the EP scenario are delivered solely through the aquatic food ingestion pathway. The contributions to total dose via the direct, inhalation, and inadvertent soil ingestion pathways are shown as zeros in the RESRAD reports. The small doses via the aquatic food pathway are likely over-estimations for doses that may be received by a person who ingests fish from the canal because:

- the conservative input for the contaminated fraction of aquatic food in the receptor's diet (0.609 vs 0.39 distribution mode),
- conservative input for fish transfer factors (75th percentile values in risk-sensitive ROC's distribution) and
- RESRAD-Onsite modeling for the fish ingestion pathway (the OCNGS intake/discharge canal is modeled by RESRAD-Onsite as a pond/lake, not a flowing canal).

The next step was to determine the concentration in fill (C_f) in units of pCi/g that resulted from an assumed initial surface contamination equal to 1 pCi/m^2. The value for C_f was determined to be equal to 4.9E-08 pCi/g using Equation 6-13.

$$\boldsymbol{C_f = \frac{(Initial\ Pipe\ Contamination)(SA_{tp})}{(SA_{tf})(CV_t)(Soil\ Density)(CF)}} \qquad \textbf{Equation 6-13}$$

Where:

- C_f = concentration in fill, pCi/g per initial surface contamination
  Initial pipe contamination = 1 pCi/m^2
- SA_{tp} = sum internal surface area for EP in the RB, Tb, and ORB, 470.6 m^2
- SA_{tf} = sum surface area for the floor of the RB, TB, and ORB, 6,355.3 m^2
- CV_t = contaminated volume thickness, 1m
- Soil density = 1.5105 g/cm^3 (the median value for the sand density distribution from NUREG/CR-7267 is assumed as the value for soil density)
- CF = unit conversion factor, 1E+06 cm^3/m^3

The $DCGL_{ep}$ values corresponding to the NRC radiological criteria for unrestricted release, 25 mrem/y, were calculated as follows:

$$\boldsymbol{DCGL_{ep,i} = \frac{25}{(POM_i)(C_f)}} \qquad \textbf{Equation 6-14}$$

Where:

- $DCGL_{ep,i}$ = the $DCGL_{ep}$ for the i^{th} ROC, pCi/m^2
- 25 = NRC radiological criterion for unrestricted release, mrem/y
- POM_i = POM dose for the i^{th} ROC, mrem/y per 1 pCi/g
- C_f = 4.9E-08 pCi/g per 1 pCi/m^2

Table 6-27 IU BFM EP Scenario Exposure Pathways for DCGL Calculations

IU BFM EP Scenario Exposure Pathways	
External Gamma	Open
Inhalation	Open
Plant Ingestion	Close
Meat Ingestion	Close
Milk Ingestion	Close
Aquatic Foods	Open
Drinking Water	Close
Soil Ingestion	Open
Radon	Close

Table 6-28 Values and Basis for DCGL Calculations for the IU BFM EP Scenario

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Soil Concentrations										
Basic radiation dose limit (mrem/y)	P	3	D	25	10 CFR §20.1402	NR	NR	NR	NR	
Initial principal radionuclide (pCi/g)	P	2	D	1	Unit Value	NR	NR	NR	NR	
Distribution coefficient, k_d (values/distributions for sand soil type (cm^3/g))										
Ac-227	P	1	S	Truncated lognormal-n	NUREG/CR-7267	7.44	1.1	0.001	0.999	1700
Am-241	P	1	D	2.69E+02 (CZ, SZ)	25th percentile value					
Am-243	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.91	1.95	0.001	0.999	1000
C-14	P	1	D	6.13E+00 (CZ, SZ)	25th percentile value					
Cm-243	P	1	D	5.74E+02 (CZ)	25th percentile value	8.13	2.64	0.001	0.999	3400
			S	Truncated lognormal-n (SZ)	ANL/EVS/TM-14/4					
Cm-244	P	1	D	5.74E+02 (CZ)	25th percentile value	8.13	2.64	0.001	0.999	3400
			S	Truncated lognormal-n (SZ)	ANL/EVS/TM-14/4					
Co-60	P	1	D	3.71E+01 (CZ, SZ)	25th percentile value					
Cs-137	P	1	D	1.58E+02 (CZ, SZ)	25th percentile value					
Eu-152	P	1	D	6.40E+01 (CZ, SZ)	25th percentile value					
Eu-154	P	1	D	6.40E+01 (CZ, SZ)	25th percentile value					
Fe-55	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.77	0	0.001	0.999	320
Gd-152	P	1	S	Truncated lognormal-n	NUREG/CR-7267	1.61	3.22	0.001	0.999	5
H-3	P	1	D	4.30E-03 (CZ)	NUREG/CR-7267	-2.81	0.5	0.001	0.999	0.06
			S	Truncated lognormal-n (SZ)						
Mn-54	P	1	D	1.66E+02 (CZ, SZ)	25th percentile value					
Nb-94	P	1	D	5.86E+02 (CZ, SZ)	25th percentile value					
Ni-63	P	1	D	2.77E+01 (CZ, SZ)	25th percentile value					
Np-237	P	1	D	5.49E+00 (CZ, SZ)	25th percentile value					
Pa-231	P	1	S	Truncated lognormal-n	NUREG/CR-7267	7.6	1.1	0.001	0.999	2000
Pb-210	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	5.39	1.39	0.001	0.999	220
Po-210	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.61	1.79	0.001	0.999	100
Pu-238	P	1	D	1.56E+02 (CZ, SZ)	25th percentile value					
Pu-239	P	1	D	1.56E+02 (CZ, SZ)	25th percentile value					
Pu-240	P	1	D	1.56E+02 (CZ, SZ)	25th percentile value					
Pu-241	P	1	D	1.57E+02 (CZ, SZ)	25th percentile value					
Ra-226	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.04	2.08	0.001	0.999	3100

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Ra-228	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	8.04	2.08	0.001	0.999	3100
Sb-125	P	1	D	5.07E+00 (CZ, SZ)	25th percentile value					
Sr-90	P	1	D	6.58E+00 (CZ, SZ)	25th percentile value					
Tc-99	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	-3.22	1.1	0.001	0.999	0.04
Te-125m	P	1	S	Truncated lognormal-n (CZ)	NUREG/CR-7267	6.31	3.22	0.001	0.999	550
				4.79E+03 (SZ)	75th percentile value					
Th-228	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
Th-229	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
Th-230	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
Th-232	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	6.55	2.4	0.001	0.999	700
U-233	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
U-234	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
U-235	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
U-236	P	1	S	Truncated lognormal-n	ANL/EVS/TM-14/4	4.7	2.48	0.001	0.999	110
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 Default	NR	NR	NR	NR	
Contaminated Zone										
Area of contaminated zone (m^2)	P	2	D	6355.3	Combined CV from RB, TB, and ORB.	NR	NR	NR	NR	
Thickness of contaminated zone (m)	P	2	D	1.0	Scenario assumption.	NR	NR	NR	NR	
Length parallel to aquifer flow (m)	P	2	D	90	Set to diameter of CZ.	NR	NR	NR	NR	
Does the initial contamination penetrate the water table?				Yes	Based on site features and RB dimensions.					
Contaminated fraction below water table			D	1.0	Entire CV assumed in SZ	NR	NR	NR	NR	
Cover and Contaminated Zone Hydrological Data										
Cover depth (m)	P	2	D	7.81	Area-weighted value for bldg. wall heights.	NR	NR	NR	NR	
Cover density (g/cm^3)	P	2	S	Truncated Normal	Site soil type = sand (Hydrogeologic Investigation Report). Input for density of fill material = NUREG/CR-7267 density distribution for site soil type - sand.	1.5105	0.159	0.001	0.999	1.5105

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Cover erosion rate (m/y)	P	2	D	6.0E-04	Assumed final site grade is level. Input for erosion rate = NUREG/CR-7267 erosion rate for site with shallow slope (i.e., relatively level)	NR	NR	NR	NR	
Density of contaminated zone (g/cm^3)	P	1	S	Truncated Normal (all ROCs except H-3)	Site soil type = sand (Hydrogeologic Investigation Report). Input for density of fill material = NUREG/CR-7267 density distribution for site soil type - **s**and.	1.5105	0.159	0.001	0.999	1.5105
			D	1.62E+00 (H-3)	75th percentile value					
Contaminated zone erosion rate (m/y)	P	2	D	6.0E-04	Assumed same as cover.	NR	NR	NR	NR	
Contaminated zone total porosity	P	2	S	Bounded Normal	NUREG/CR-7267 distribution for site soil type - **s**and	0.43	0.06	0.2446	0.6154	0.43
Contaminated zone field capacity	P	3	D	0.18	Value based on site-specific soil type (**s**and); calculated using equation in NUREG/CR-7267	NR	NR	NR	NR	
Contaminated zone hydraulic conductivity (m/y)	P	2	D	2741	OCNGS Hydrogeologic Investigation Report	NR	NR	NR	NR	
Contaminated zone b parameter	P	2	S	Bounded Log Normal n	NUREG/CR-7267 distribution for site soil type - **s**and	- 0.0253	0.216	0.501	1.90	0.975
Humidity in air (g/m^3)	P	3	D	6.6	From Regional and Site-Specific Absolute Humidity Data for Use in Tritium Dose Calculations.	NR	NR	NR	NR	
Evapotranspiration coefficient	P	2	S	Uniform (all ROCs except H-3)	NUREG/CR-7267 distribution	0.5	0.75	NR	NR	0.625
			D	6.87E-01 (H-3)	75th percentile value					
Average annual wind speed (m/s)	P	2	D	3.13	Internet search: https://www.windfinder.com/windstatistics/oyster_creek_barnegat_bay	NR	NR	NR	NR	
Precipitation (m/y)	P	2	D	1.4	Annual Report on the Meteorological Program at Oyster Creek Generating Station – average annual precipitation for 2015 through 2020	NR	NR	NR	NR	
Irrigation (m/y)	B	3	S	Uniform	Distribution determined using methodology described in *Data Collection Handbook* and NUREG/CR-6697	0	0.08			0.04
Irrigation mode	B	3	D	Overhead	Overhead irrigation is common practice for crops in U.S.	NR	NR	NR	NR	
Runoff coefficient	P	2	D	0.2	Value determined using methodology described in Data Collection Handbook and NUREG/CR-7267	NR	NR	NR	NR	
Watershed area for nearby stream or pond (m^2)	P	3	D	1.01E+08	NJ-GeoWeb (NJDEP BGIS)	NR	NR	NR	NR	
Accuracy for water/soil computations	-	3	D	1.00E-03	RESRAD Default	NR	NR	NR	NR	

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Saturated Zone Hydrological Data										
Density of saturated zone (g/cm^3)	P	1	S	Truncated Normal	NUREG/CR-7267 distribution for site soil type - sand	1.5105	0.159	0.001	0.999	1.5105
Saturated zone total porosity	P	1	S	Truncated Normal	NUREG/CR-7267 distribution for site soil type - sand	0.43	0.06	0.001	0.999	0.43
Saturated zone effective porosity	P	1	D	0.25	OCNGS Hydrogeologic Investigation Report	NR	NR	NR	NR	
Saturated zone field capacity	P	3	D	0.18	Value based on site-specific soil type (sand); calculated using equation in NUREG/CR-7267	NR	NR	NR	NR	
Saturated zone hydraulic conductivity (m/y)	P	1	D	2741	OCNGS Hydrogeologic Investigation Report	NR	NR	NR	NR	
Saturated zone hydraulic gradient	P	2	D	3.25E-02 (all ROCs except H-3 and Tc-99)	75th percentile value					
			D	1.75E-02 (H-3)	25th percentile value					
			S	Uniform (Tc-99)	OCNGS Hydrogeologic Investigation Report	0.01	0.04			0.025
Saturated zone b parameter	P	2	S	Bounded Log Normal n	NUREG/CR-7267 distribution for site soil type – sand	- 0.0253	0.216	0.501	1.90	0.975
Water table drop rate (m/y)	P	3	D	0	CZ in SZ	NR	NR	NR	NR	
Well pump intake depth (m below water table)	P	2	D	4.42	Set to the distance from the water table to the lower boundary of contamination in the aquifer at the downgradient edge of the contaminated zone. NOTE: no impact for IU scenario.	NR	NR	NR	NR	
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	Min, and max value based on site irrigation and general case parameter values presented in NUREG/CR-7267.	407	567			487
Unsaturated Zone Hydrological Data										
Number of unsaturated zone strata	P	3	D	0	UZ above CZ and is assumed part of cover.	NR	NR	NR	NR	
Unsat. zone 1, thickness (m)	P	1	D	N/A	Input not required when number of UZ = 0.					
Unsat. zone 1, soil density (g/cm^3)	P	2	S	N/A	Input not required when number of UZ = 0.					
Unsat. zone 1, total porosity	P	2	S	N/A	Input not required when number of UZ = 0.					
Unsat. zone 1, effective porosity	P	2	D	N/A	Input not required when number of UZ = 0.					
Unsat. zone 1, field capacity	P	3	D	N/A	Input not required when number of UZ = 0.					
Unsat. zone 1, hydraulic conductivity (m/y)	P	2	D	N/A	Input not required when number of UZ = 0.					
Unsat. zone 1, soil-specific b parameter	P	2	S	N/A	Input not required when number of UZ = 0.					

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Occupancy										
Inhalation rate (m^3/y)	B	3	D	8400	NUREG/CR-7267	NR	NR	NR	NR	
Mass loading for inhalation (g/m^3)	P	2	S	Continuous linear	NUREG/CR-7267					2.3E-05
Exposure duration	B	3	D	30	RESRAD Default	NR	NR	NR	NR	
Indoor dust filtration factor	P	2	S	Uniform	NUREG/CR-7267	0.15	0.95			0.55
Shielding factor, external gamma	P	2	S	Bounded lognormal-n	NUREG/CR-7267	-1.3	0.59	0.044	1	0.2725
Fraction of time spent indoors	B	3	D	0.03	Fraction of calendar year assuming 1h/workday for daily work breaks	NR	NR	NR	NR	
Fraction of time spent outdoors	B	3	D	0.2	Fraction of calendar year assuming 7h/workday for outside tasks	NR	NR	NR	NR	
Shape factor flag, external gamma	P	3	D	Circular	Circular contaminated zone assumed	NR	NR	NR	NR	
Ingestion, Dietary										
Fruits, vegetables, grain consumption (kg/y)	B	2	D	N/A	Input not required - plant ingestion pathway inactive	NR	NR	NR	NR	
Leafy vegetable consumption (kg/y)	B	3	D	N/A	Input not required - plant ingestion pathway inactive	NR	NR	NR	NR	
Milk consumption (L/y)	B	2	D	N/A	Input not required - milk ingestion pathway inactive	NR	NR	NR	NR	
Meat and poultry consumption (kg/y)	B	3	D	N/A	Input not required - meat ingestion pathway inactive	NR	NR	NR	NR	
Fish consumption (kg/y)	B	3	D	20.6	NUREG/CR-5512, Vol. 3	NR	NR	NR	NR	
Other seafood consumption (kg/y)	B	3	D	0.9	RESRAD Default	NR	NR	NR	NR	
Soil ingestion rate (g/yr)	B	2	D	Triangular	NUREG/CR-7267	NR	NR	NR	NR	
Drinking water intake (L/y)	B	2	D	N/A	Input not required – drinking water pathway inactive	NR	NR	NR	NR	
Contamination fraction of drinking water	P	3	D	N/A	Input not required – drinking water pathway inactive	NR	NR	NR	NR	
Contamination fraction of household water	P	3		N/A	Input not required – water pathway inactive					
Contamination fraction of livestock water	P	3	D	N/A	Input not required – drinking water/ingestion pathways inactive	NR	NR	NR	NR	
Contamination fraction of irrigation water	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Contamination fraction of aquatic food	P	2	D	6.09E-01 (all ROCs)	75th percentile value					
Contamination fraction of plant food	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Contamination fraction of meat	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Contamination fraction of milk	P	3	D	N/A	Input not required – milk ingestion pathway inactive	NR	NR	NR	NR	

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Ingestion, Non-Dietary										
Livestock fodder intake for meat (kg/d)	M	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Livestock fodder intake for milk (kg/d)	M	3	D	N/A	Input not required – milk ingestion pathway inactive	NR	NR	NR	NR	
Livestock water intake for meat (L/d)	M	3	D	N/A	Input not required – water ingestion pathway inactive	NR	NR	NR	NR	
Livestock water intake for milk (L/d)	M	3	D	N/A	Input not required – milk ingestion pathway inactive	NR	NR	NR	NR	
Livestock soil intake (kg/d)	M	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Mass loading for foliar deposition (g/m^3)	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Depth of soil mixing layer (m)	P	2	S	Triangular	NUREG/CR-7267	0	0.15	0.6		0.23
Depth of roots (m)	P	1	S	N/A	Input not required – plant ingestion pathway inactive	0.3	4			1.85
Drinking water fraction from ground water	P	3	D	N/A	Input not required – drinking water ingestion pathway inactive	NR	NR	NR	NR	
Household water fraction from ground water	P	3		N/A	Input not required – drinking water pathway inactive					
Livestock water fraction from ground water	P	3	D	N/A	Input not required – drinking water/meat ingestion pathways inactive	NR	NR	NR	NR	
Irrigation fraction from ground water	P	3	D	N/A	Input not required – drinking water pathway inactive	NR	NR	NR	NR	
Wet weight crop yield for Non-Leafy (kg/m^2)	P	2	S	N/A	Input not required – plant ingestion pathway inactive	0.56	0.48	0.001	0.999	1.75
Wet weight crop yield for Leafy (kg/m^2)	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Wet weight crop yield for Fodder (kg/m^2)	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Growing Season for Non-Leafy (y)	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Growing Season for Leafy (y)	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Growing Season for Fodder (y)	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Translocation Factor for Non-Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Translocation Factor for Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Translocation Factor for Fodder	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Weathering Removal Constant for Vegetation (1/y)	P	2	S	N/A	Input not required – plant ingestion pathway inactive	5.1	18	84		33
Wet Foliar Interception Fraction for Non-Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Wet Foliar Interception Fraction for Leafy	P	2	S	N/A	Input not required – plant ingestion pathway inactive	0.06	0.67	0.95		0.58

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Wet Foliar Interception Fraction for Fodder	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Non-Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Leafy	P	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Dry Foliar Interception Fraction for Fodder	P	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Storage times of contaminated foodstuffs (days):										
Fruits, non-leafy vegetables, and grain	B	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Leafy vegetables	B	3	D	N/A	Input not required – plant ingestion pathway inactive	NR	NR	NR	NR	
Milk	B	3	D	N/A	Input not required – milk ingestion pathway inactive	NR	NR	NR	NR	
Meat and poultry	B	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Fish	B	3	D	7	RESRAD Default	NR	NR	NR	NR	
Crustacea and mollusks	B	3	D	7	RESRAD Default	NR	NR	NR	NR	
Well water	B	3	D	N/A	Input not required – drinking water pathway inactive	NR	NR	NR	NR	
Surface water	B	3	D	N/A	Input not required drinking water pathway inactive	NR	NR	NR	NR	
Livestock fodder	B	3	D	N/A	Input not required – meat ingestion pathway inactive	NR	NR	NR	NR	
Special Radionuclides (C-14)										
C-12 concentration in water (g/cm^3)	P	3	D	2.00E-05	RESRAD Default	NR	NR	NR	NR	
C-12 concentration in contaminated soil (g/g)	P	3	D	3.00E-02	RESRAD Default	NR	NR	NR	NR	
Fraction of vegetation carbon from soil	P	3	D	2.00E-02	RESRAD Default	NR	NR	NR	NR	
Fraction of vegetation carbon from air	P	3	D	9.80E-01	RESRAD Default	NR	NR	NR	NR	
C-14 evasion layer thickness in soil (m)	P	2	S	Triangular	NUREG/CR-7267	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	NR	NR	NR	NR	
C-12 evasion flux rate from soil (1/s)	P	3	D	1.00E-10	RESRAD Default	NR	NR	NR	NR	
Fraction of grain in beef cattle feed	B	3	D	0.2500	NUREG/CR-7267	NR	NR	NR	NR	
Fraction of grain in milk cow feed	B	3	D	0.1000	NUREG/CR-7267	NR	NR	NR	NR	

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Inhalation Dose Conversion Factors (mrem/pCi inhaled) from FGR11 (contained in RESRAD Dose Conversion Library)										
Ingestion Dose Conversion Factors (mrem/pCi ingested) from FGR11 (contained in RESRAD Dose Conversion Library)										
Plant Transfer Factors (pCi/g plant)/(pCi/g soil) **Note: Plant ingestion pathway closed – input for plant transfer factors not required for IU dose calculations.**										
Meat Transfer Factors (pCi/kg)/(pCi/d) **Note: Meat ingestion pathway closed – input for meat transfer factors not required for IU dose calculations.**										
Milk Transfer Factors (pCi/L)/(pCi/d) **Note: Milk ingestion pathway closed – input for milk transfer factors not required for IU dose calculations.**										
Bioaccumulation (Transfer) Factors for Fish ((pCi/kg)/(pCi/L))										
Ac-227	P	2	S	Lognormal-n	NUREG/CR-7267	3.2	1.1			2.5E+01
Am-241	P	2	D	5.14E+02	75th percentile value					
Am-243	P	2	S	Lognormal-n	NUREG/CR-7267	5.5	1.1			2.4E+02
C-14	P	2	D	9.28E+05	75th percentile value					
Cm-243	P	2	S	Lognormal-n	NUREG/CR-7267	3.4	1.1			3.0E+01
Cm-244	P	2	S	Lognormal-n	NUREG/CR-7267	3.4	1.1			3.0E+01
Co-60	P	2	D	1.35E+02	75th percentile value					
Cs-137	P	2	D	4.48E+03	75th percentile value					
Eu-152	P	2	D	3.95E+02	75th percentile value					
Eu-154	P	2	D	3.95E+02	75th percentile value					
Fe-55	P	2	D	5.90E+02	75th percentile value					
Gd-152	P	2	S	Lognormal-n	NUREG/CR-7267	3.4	1.1			3.0E+01
H-3	P	2	D	1.07E+00	75th percentile value					
Mn-54	P	2	S	Lognormal-n	NUREG/CR-7267	5.5	1.9			2.4E+02
Nb-94	P	2	D	6.27E+02	75th percentile value					
Ni-63	P	2	D	3.01E+01	75th percentile value					
Np-237	P	2	D	4.21E+01	75th percentile value					
Pa-231	P	2	S	Lognormal-n	NUREG/CR-7267	2.3	1.1			1.0E+01
Pb-210	P	2	S	Lognormal-n	NUREG/CR-7267	3.2	1.1			2.5E+02
Po-210	P	2	S	Lognormal-n	NUREG/CR-7267	3.6	1.5			3.7E+01
Pu-238	P	2	D	4.32E+04	75th percentile value					
Pu-239	P	2	D	4.32E+04	75th percentile value					
Pu-240	P	2	D	4.32E+04	75th percentile value					
Pu-241	P	2	D	4.32E+04	75th percentile value					
Ra-226	P	2	S	Lognormal-n	NUREG/CR-7267	1.4	1.9			4.1E+00
Ra-228	P	2	S	Lognormal-n	NUREG/CR-7267	1.4	1.9			4.1E+00
Sb-125	P	2	D	1.00E+02	75th percentile value					
Sr-90	P	2	D	7.72E+00	75th percentile value					

Parameter (unit)	Type[a]	Priority[b]	Treatment[c]	Value / Distribution	Basis	Distribution's Statistical Parameters[d]				Median / Mean
						1	2	3	4	
Tc-99	P	2	D	4.21E+01	75th percentile value					
Te-12m	P	2	S	Lognormal-n	NUREG/CR-7267	5.0	0.4			1.5E+02
Th-228	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.9E+01
Th-229	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.9E+01
Th-230	P	2	S	Lognormal-n	NUREG/CR-7267	4.6	1.1			9.9E+01
U-233	P	2	S	Lognormal-n	NUREG/CR-7267	0.0	2.5			1.0E+00
U-234	P	2	S	Lognormal-n	NUREG/CR-7267	0.0	2.5			1.0E+00
U-235	P	2	S	Lognormal-n	NUREG/CR-7267	0.0	2.5			1.0E+00
U-236	P	2	S	Lognormal-n	NUREG/CR-7267	0.0	2.5			1.0E+00
Bioaccumulation Factors for Crustacea/ Mollusks ((pCi/kg)/(pCi/L)) RESRAD default value for each radionuclide applied										
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	

Notes:

[a] P = physical, B = behavioral, M = metabolic

[b] 1 = high-priority parameter, 2 = medium-priority parameter, 3 = low-priority parameter

[c] D = deterministic, S = stochastic

N/A = not applicable

[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 = mode, 3 = maximum

Uniform: 1 = minimum, 2 = maximum

The development of the BFM $DCGL_{ep}$ is documented in Engineering Calculation ENG-OCS-015 (Reference 6-34). Table 6-29 presents the POM doses and values for $DCGL_{ep}$ by ROC.

Table 6-29 $DCGL_{ep}$ Values by ROC

ROC	POM Dose (mrem/y)	$DCGL_{ep}$ (pCi/m^2)
Am-241	2.52E-03	2.02E+11
C-14	1.42E-01	3.59E+09
Cm-243	5.04E-04	1.01E+12
Cm-244	1.22E-03	4.18E+11
Co-60	6.42E-06	7.94E+13
Cs-137	1.15E-04	4.43E+12
Eu-152	3.86E-06	1.32E+14
Eu-154	3.94E-06	1.29E+14
Fe-55	5.53E-09	9.22E+16
H-3	7.40E-08	6.89E+15
Mn-54	2.11E-07	2.42E+15
Nb-94	3.52E-06	1.45E+14
Ni-63	2.79E-07	1.83E+15
NP-237	2.13E-02	2.39E+10
Pu-238	1.75E-01	2.91E+09
Pu-239	4.53E-01	1.13E+09
Pu-240	4.49E-01	1.14E+09
Pu-241	1.15E-05	4.43E+13
SB-125	9.87E-06	5.17E+13
Sr-90	1.10E-04	4.64E+12
Tc-99	4.97E-05	1.03E+13

6.10 Development of DCGLs for Buried Pipe

Buried pipes are defined as below-ground pipes located outside of structures and basements. For the OCNGS site, buried piping segments from three plant systems are expected to remain in place at license termination. The three systems are the AOG Sump Drain system, the Torus Water Transfer system, and the Overboard Discharge System. The dimensions of the buried pipe segments are summarized by system in Table 6-30.

Table 6-30 Dimensions of Buried Pipes Remaining in Place

Description	Length (ft)	Diameter (ft)	Radius (ft)
AOG Sump Drain	175	0.125	0.06
Torus Water Transfer	1000	0.33	0.17
Overboard Discharge	1000	2.5	1.25

6.10.1 Conceptual Site Model and Assumptions for Buried Pipe

In the Buried Pipe scenario, residual internal surface contamination in the buried pipe segments associated with 3 systems (i.e., AOG Sump Drain piping, Torus Water Transfer piping, and Overboard Discharge piping) is instantaneously released to and uniformly dispersed in site soil via pipe disintegration in year zero, thereby creating a CV equal to the internal volume of the buried pipes. Groundwater is assumed at its maximum level (5 ft below grade). The CV is covered by a 3-ft soil cap plus 2-ft UZ soil. This modeling approach places the CZ entirely in the CZ. The physical pipe structures are assumed not to impede groundwater flow or migration of residual contamination.

The total CV created by the remaining buried piping is assumed to be present in one location. While this assumption is very conservative, it is bounding for survey areas where buried piping is present.

The annual dose for buried piping is estimated by applying the IU exposure pathways:

- Direct external radiation exposure pathway
- Inhalation exposure pathway
- Ingestion exposure via aquatic food from the intake/discharge canal
- Inadvertent ingestion of contaminated soil

6.10.2 Buried Pipe DCGL Values

Except for the input values that defined the CZ in the Buried Piping scenario (Table 6-31), parameter input values for the RESRAD-Onsite executions were the same as those used in the RESRAD-Onsite executions for the EP scenario, including the 75^{th} and 25^{th} percentile values for parameters identified a risk-sensitive in the probabilistic analyses for EPs, because the similar nature of the CV (i.e., 100% in SZ). The total volume and internal surface area for the buried pipe segments were determined to be 141.48 m^3 and 832.4 m^2, respectively. The largest pipe diameter (2.5ft) was assumed as the thickness for the CZ. Values for RESRAD-Onsite parameters that defined the CV for the Buried Pipe scenario are listed in Table 6-31.

Table 6-31 Values for RESRAD-Onsite Parameters

RESRAD-Onsite Parameter	Input Value
Area of the CZ	186.2 m^2
Thickness of the CZ	0.76 m
Length Parallel to Aquifer Flow	15.4 m
Cover Depth	1.52 m

The DCGL values for buried pipe ($DCGL_{bp}$) corresponding to an annual dose equal to 25 mrem were calculated using the following equation:

$$DCGL_{bp,i} = \frac{25}{(POM_i)(C_s)} \quad \textbf{Equation 6-15}$$

Where:

- $DCGL_{bp,i}$ = the $DCGL_{bp}$ value for the i^{th} ROC, pCi/m^2
- 25 = 10 CFR §20.1402 radiological criterion for unrestricted release, mrem/y
- POM_i = calculated RESRAD-Onsite POM for the i^{th} ROC, mrem/y per 1 pCi/g
- C_s = concentration in soil (pCi/g) resulting from an initial surface contamination of 1 pCi/m^2, calculated as follows:

$$C_s = \frac{(SC_{ic})(SA_p)}{(CV_p)(D_s)(CF)} \quad \textbf{Equation 6-16}$$

Where:

- C_s = 1 pCi/g per 1 pCi/m^2
- SC_{ic} = the initial pipe surface contamination, 1 pCi/m^2
- SA_p = the total pipe surface area, m^2
- CV_p = total buried pipe volume, m^3
- D_s = density of soil, 1.5105 g/cm^3 (the median value for the sand density distribution from NUREG/CR-7267 is assumed as the value for soil density)
- CF = unit conversion factor, 1E+06 cm^3/m^3

The development of $DCGL_{bp}$ values is documented in Engineering Calculation ENG-OCS-016 (Reference 6-35). The $DCGL_{bp}$ values are presented by ROC in Table 6-32.

Table 6-32 $DCGL_{bp}$ Values by ROC

ROC	POM Dose (mrem/y)	$DGCL_{bp}$ (pCi/m^2)
Am-241	1.07E-04	6.00E+10
C-14	3.72E-03	1.72E+09
Cm-243	1.04E-05	6.17E+11
Cm-244	2.83E-05	2.27E+11
Co-60	9.08E-07	7.07E+12
Cs-137	1.30E-05	4.93E+11
Eu-152	4.31E-07	1.49E+13
Eu-154	5.20E-07	1.23E+13
Fe-55	9.28E-10	6.91E+15
H-3	7.96E-10	8.06E+15
Mn-54	3.96E-08	1.62E+14
Nb-94	1.29E-07	4.97E+13
Ni-63	1.04E-08	6.17E+14
NP-237	5.16E-04	1.24E+10

ROC	POM Dose (mrem/y)	$DGCL_{bp}$ (pCi/m^2)
Pu-238	1.10E-02	5.83E+08
Pu-239	1.48E-02	4.33E+08
Pu-240	1.47E-02	4.36E+08
Pu-241	1.13E-04	5.68E+10
SB-125	1.60E-05	4.01E+11
Sr-90	5.57E-06	1.15E+12
Tc-99	5.13E-07	1.25E+13

6.11 Determination of Dose from Backfill Soil

The dose associated with the material used to fill the below-grade foundations of the RB, TB, and ORB will be estimated by a dose assessment using the RESRAD-Onsite code and analytical data from representative samples of the backfill material.

Soil from MARSSIM Class 3 areas outside the ONNGS PA will be used as backfill material. The contribution of dose from residual contamination in surface soil is a component of the site compliance dose (see Section 6.13). However, when that surface soil is excavated and placed in a new configuration as fill material, it is no longer considered surface soil; it represents another component of the site compliance dose.

The envisioned activity sequence for the backfill material is (1) successful FSS of the surface soil in the Class 3 area prior to excavation, (2) collection of representative soil samples during excavation, (3) transfer of the samples to a laboratory for analyses, and (3) modeling and dose assessment of the total volume of soil used as backfill material. The dose assessment results are incorporated as the dose contribution from fill material (D_s) in equation 6-15 to the estimated site compliance dose (see Section 6.13).

The total volume of soil required to fill the RB, TB, and ORB foundations will be the basis for the CV and below-grade CZ modeled by the RESRAD-Onsite code. Except for the RESRAD-Onsite parameters that define the CZ, input values will be the same as those used in developing the soil DCGL values. The source term will consist of the average concentrations for all ROCs identified by laboratory analyses. The IU scenario's critical receptor and exposure pathways will be assumed in the dose assessment for the fill material.

6.12 Groundwater Dose Contribution

OCNGS will continue monitoring site groundwater through decommissioning and license termination using the OCNGS Groundwater Protection Program, which, over the course of decommissioning, may be modified by closing or adding monitoring wells as necessary to prevent contamination of the groundwater or to enhance groundwater monitoring.

Positive detectable concentrations (i.e., above the achieved MDA value for the analysis), conservative values for determining the annual intake of contaminated material in aquatic foods, and ingestion dose conversion factors from FGR 11 are used to determine a dose from groundwater. Groundwater dose focuses on the aquatic food ingestion exposure because under the IU scenario, the aquatic food ingestion pathway is the only pathway opened for doses from site groundwater.

The dose for groundwater from an ROC is calculated using the following equations:

$$D_{gw,i} = (F_{af})(C_{af})(FTF_i)(GW_i)(DCF_i) \quad \textbf{Equation 6-17}$$

Where

$D_{gw,i}$ = Dose for ROC "i" via ingestion of aquatic food, mrem/y
F_{af} = Fraction of contaminated aquatic food, 0.609, unitless (from Table 6-28)
C_{af} = Fish and other aquatic food consumption, 21.5 kg/y (from Table 6-28)
FTF_i = Fish transfer (bioaccumulation) factor for ROC "i", pCi/kg per pCi/L (from Table 6-28)
GW_i = Detectable groundwater concentration of ROC "i", pCi/L

DCF_i = Ingestion DCF for ROC "i", mrem/pCi (from FGR 11, Table 2.2)

If laboratory analyses show no positive results for a given ROC, the dose assigned to the ROC is zero. The calculated dose is believed to be a conservative estimate for the aquatic food dose because of conservatism in values F_{af} and FTF_i, and the measured groundwater concentration is assumed constant over an exposure period of 1 year. As described in Section 6.13, the dose contribution from groundwater is included in the calculation of the compliance dose.

6.13 Compliance Dose Summation

The final (compliance) dose is calculated to demonstrate compliance with the NRC radiological criterion for unrestricted release (25 mrem/y). It is the summation of the dose contributions from all OCNGS site end-state media and is calculated by the equation:

$$\boldsymbol{D_c = D_s + D_{bldg} + D_{w/f} + D_{ep} + D_{bp} + D_f + D_{gw}} \quad \textbf{Equation 6-18}$$

Where:

- D_c = the calculated compliance dose, mrem/y
- D_s = dose contribution from site soil, mrem/y
- D_{bldg} = dose contribution from standing buildings, mrem/y
- $D_{w/f}$ = dose contribution for below-grade concrete foundations and structures, mrem/y
- D_{ep} = dose contribution from EPs in below-grade foundations, mrem/y
- D_{bp} = dose contribution from buried pipes, mrem/y
- D_f = dose contribution from soil used as backfill material, mrem/y
- D_{gw} = dose contribution for site groundwater, mrem/y

The dose contribution from each end-state medium is limited by a dose fraction assigned to that medium as a way of assuring that the summation of the dose contributions does not exceed the NRC radiological criteria for unrestricted release. The sum of the media dose fractions cannot be greater than 1 without the risk of exceeding the NRC criterion.

The dose fractions are implemented in developing operational criteria (e.g., operational DCGL values) set as decontamination/remediation targets. *A priori* dose fractions for site media are determined based on site characterization and cost-benefit considerations and are applied in developing operational criteria (e.g., operational DCGL values) established as decontamination/remediation targets. Operational DCGL values are administratively reduced versions of DCGL values based on the assigned dose fraction (see Section 5.2.7.6 in LTP Chapter

5) to assess the need for or effectiveness of decontamination/remediation efforts. Using operational DCGL values in characterization efforts or during FSS activities provides confidence that residual radioactive contamination associated with a site end-state medium does not result in a dose contribution greater than acceptable for the medium.

Dose fractions used in developing operational decontamination/remediation targets will be documented in radiological survey plans supporting the decontamination/remediation actions. After decontamination/remediation activities are completed, *a priori* dose fractions may be re-evaluated and revised for application in FSS activities. Dose fractions applied during FSS will be documented in Survey Unit FSS Plans.

6.14 References

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7

UPDATE OF SITE-SPECIFIC DECOMMISSIONING COSTS

LIST OF ACRONYMS

Acronym	Full Form
BLS	Bureau of Labor Statistics
DECON	Decontamination
HDI	Holtec Decommissioning International, LLC
ISDC	International Structure for Decommissioning Costing
ISFSI	Independent Spent Fuel Storage Installation
LTP	License Termination Plan
NDT	Nuclear Decommissioning Trust
NRC	United States Nuclear Regulatory Commission
OCNGS	Oyster Creek Nuclear Generating Station
WBS	Work Breakdown Structure

7 UPDATE OF SITE-SPECIFIC DECOMMISSIONING COSTS

7.1 Regulation and Guidance

In accordance with 10 CFR 50.82(a)(9)(ii)(F), Regulatory Guide 1.179, *Standard Format and Content of License Termination Plans for Nuclear Power Plants* (Reference 7-1), and Regulatory Guide 1.159, *Assuring the Availability of Funds for Decommissioning Nuclear Reactors* (Reference 7-2), the OCNGS site-specific cost estimate and funding plans are provided. Regulatory Guide 1.179 and NUREG-1700, *Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans* (Reference 7-3) provide guidance for the contents and the NRC staff's review of Chapter 7 of the LTP.

The LTP decommissioning cost estimate includes an evaluation of the following cost elements:

- cost assumptions used, including a contingency factor;
- major decommissioning activities and tasks;
- unit cost factors;
- estimated costs of decontamination and removal of equipment and structures;
- estimated costs of waste disposal, including applicable disposal site surcharges and transportation costs;
- estimated final survey costs; and
- estimated total costs.

The LTP focuses on detailed activity by activity cost estimates.

The LTP also compares the funds available for decommissioning with the calculated total cost from the licensee's detailed cost analysis. In addition, Regulatory Guide 1.159 explains in detail the methods for estimating decommissioning costs, as well as accepted financial assurance mechanisms.

The LTP cost estimate is based on credible engineering assumptions, and the assumptions are related to all major remaining decommissioning activities and tasks and are consistent with the information identified in Sections B3 and B4 of NUREG-1700.

The LTP cost estimate includes the cost of the remediation action being evaluated, the cost of transportation and disposal of the waste generated by the action, and other costs that are appropriate for the specific case. The current version of NUREG-1307, *Report on Waste Burial Charges* (Reference 7-4), provides guidance on estimating waste disposal costs.

7.2 Historical Information

By letter dated September 28, 2018, HDI submitted Notification of Revised Post-Shutdown Decommissioning Activities Report and Revised Site-Specific Decommissioning Cost Estimate for OCNGS (Reference 7-5).

OCNGS is currently undergoing decommissioning using the DECON method with a project goal of achieving unrestricted release of the site, except for the Independent Spent Fuel Storage Installation (ISFSI).

In accordance with the requirements of 10 CFR 50.82, HDI submits an annual report on the status of decommissioning funding, the financial assurance report, and the status of funding for managing irradiated fuel. The most recent report, submitted on March 29, 2024, summarized the

cost to complete decommissioning activities and the status of funding for the period ending December 31, 2023.

7.3 Decommissioning Cost Estimate

7.3.1 Cost Estimate Description and Methodology

This updated decommissioning cost estimate is based on regulatory requirements, site conditions, basis of estimate assumptions, low-level radioactive waste disposal standards, high-level radioactive waste management options, and site restoration requirements. The methods used to estimate decommissioning costs are based on sound engineering practices, previous decommissioning experience, existing contracts, and industry developments. The estimate considers the nature of the work, degree of scope definition, and availability of quantifiable cost and pricing data. Escalation of future decommissioning costs over the remaining decommissioning project life cycle are excluded.

The decommissioning costs in this Chapter are presented in 2023 dollars and represent the most recent update to the OCNGS cost estimate reflected in the Report on Status of Decommissioning Funding for Reactors and Independent Spent Fuel Storage Installations submitted by HDI on March 29, 2024 (Reference 7-6).

HDI's detailed decommissioning project schedule is used as the foundation for developing the decommissioning cost estimate model and the risk model. The schedule baseline is a detailed Critical Path Method (CPM) schedule developed with input from key decommissioning subcontractors and SMEs. The schedule and cost estimate is based on the International Structure for Decommissioning Costing (ISDC) for Nuclear Installations (Reference 7-7), Work Breakdown Structure (WBS), and the corresponding WBS dictionary.

A variety of methods were used to prepare this updated estimate. Common methods include:

- Experience gained from completed decommissioning activities
- Specific rates for decommissioning waste packaging, transportation, and disposal costs
- Subcontractor quotes
- Professional judgment/expert opinion

Unit cost factors are not used by HDI in the preparation of decommissioning cost estimates. The estimate captures costs associated with License Termination, in addition to costs associated with Spent Fuel Management and Site Restoration

7.3.2 Summary of Site-Specific Decommissioning Cost Estimate

The total estimate to complete decommissioning for OCNGS is $331M (in 2023 dollars).

Table 7-1 below presents costs to complete OCNGS decommissioning categorized by the Level 1 activities in the ISDC WBS. Table 7-2 presents selected Level 2 activities of interest in meeting NUREG-1700 acceptance criteria for LTP content.

Table 7-1 OCNGS Decommissioning Cost to Complete by Level 1 WBS

Activity	Cost
Pre-decommissioning actions (Principal Activities)	$3,923,100
Dismantling activities within the controlled area	$7,673,452
Waste processing, storage, and disposal	$96,658,263
Site infrastructure and operation	$13,643,153
Conventional dismantling, demolition, and site restoration	$31,119,127
Project management, engineering, and support	$47,292,162
Fuel and Nuclear Material	$136,604,483
Miscellaneous expenditures	$13,904,713
Contingency	$38,558,515
Totals	**$389,376,967**

Table 7-2 OCNGS Decommissioning Individual Cost Items

Individual Items in Cost Estimate	Cost
Final Survey	$1,785,148
Greater Than Class C Waste Disposal	$12,082,463

Pre-decommissioning activities include feasibility studies, contracting, licensing, planning and management, and other activities in preparation for dismantlement and demolition.

Dismantling activities within the controlled area include removing the contaminated and activated systems and structures from the radiologically controlled area and contaminated items outside of the controlled area. No waste management is included in this activity. At the end of this phase, the final radioactivity survey of buildings can be undertaken. The buildings are then ready for conventional demolition if this is part of the end-state strategy.

Waste processing, package acquisition, storage, transport, and disposal involve activities associated with managing decommissioning wastes resulting from dismantlement activities. This activity includes establishing support for the waste management system and the costs associated with waste packaging and transportation, in addition to disposal fees. HDI has entered into a contract for radioactive waste disposal that includes transportation costs; therefore, the cost associated with the conveyance of radioactive waste to the disposal facility is not separately reported.

Site infrastructure and operation involve activities related to site security and surveillance, operation and maintenance, upkeep, operation of support systems, and radiation and environmental safety monitoring.

Conventional dismantling, demolition, and site restoration are concerned with the activities for conventional dismantling of systems in premises outside of the controlled area and demolition of structures, both for buildings originally located within the controlled area and for buildings outside the controlled area. Some buildings can be refurbished for further use or considered assets arising from the decommissioning project. This activity includes the site cleanup, landscaping, and the final status survey. The management of conventional and hazardous waste from dismantling and demolition is included in the waste processing, storage, and disposal activity, where the management of all materials (inclusive of radioactive waste) is addressed.

Project management, engineering, and support involve all types of activities concerned with the management of decommissioning activities, engineering, technical, safety, and other relevant support during all phases of the decommissioning

Fuel and nuclear material include all activities defined within the decommissioning project for spent fuel and other special nuclear material.

Miscellaneous expenditures include fees, taxes, insurance, and other cost items directly related to a decommissioning project but cannot be allocated to other activities.

7.3.3 License Termination Costs

License Termination costs are those costs associated with the collective work required to plan, mobilize, and execute the removal of the radioactive contamination from the site, consistent with the definition of decommissioning per 10 CFR 50.2. The costs of Spent Fuel Management and Site Restoration are not considered part of the 10 CFR 50.2 definition of decommissioning and are listed separately per regulatory requirements. The estimated license termination expenses to complete the remaining dismantlement activities is $172M.

7.3.4 Spent Fuel Management Costs

Spent Fuel Management are the costs to safely manage spent fuel from asset sale and license transfer until successful transfer to the DOE. The current separate estimate of spent fuel management costs is $128M.

7.3.5 Site Restoration Costs

Site Restoration costs are those costs associated with conventional dismantling, demolition, and removal from the site of structures and systems after confirmation that radioactive contaminants have been removed. The current separate estimate for site restoration costs is $32M.

7.3.6 Contingency

Based on an evaluation of estimated uncertainty and potential risks, in addition to a review of industry experience with similar decommissioning projects, a Contingency Allowance of 15 percent was determined to be reasonable for the OCNGS decommissioning project. Risk-significant activities associated with the placement of spent fuel into dry storage and segmentation of reactor internals have been completed, thereby reducing the overall project risk profile. The Contingency Allowance is incorporated into the estimate of License Termination, Spent Fuel Management, and Site Restoration costs, with the exception of ISFSI decommissioning costs, which include a 25 percent Contingency Allowance consistent with the contingency evaluation criteria in NUREG-1757 Vol. 1, Rev. 2, "*Consolidated Decommissioning Guidance*" (Reference 7-8).

7.4 Decommissioning Funding Plan

The OCNGS Nuclear Decommissioning Trust (NDT) fund balance as of December 31, 2023, was $407M. This amount represents the market value of the NDT fund net any material current income tax liability on realized gains, interest, dividends, and other income of the trust. The trust fund amount is the total available for decommissioning, including costs of license termination, spent fuel management, and site restoration activities.

The estimates provided in this update have been inflated to 2023 dollars. The Bureau of Labor Statistics (BLS) data provided the basis for the decommissioning cost estimate inflation rate forecast. Decommissioning costs are inflated using a weighted average of BLS indices for labor, energy, consumer price index, materials, and equipment. HDI utilized NUREG-1307, Revision 19, "Report on Waste Burial Charges" (Reference 7-9), issued February 2023 for the burial inflation factor. A factor of 1.02 is used to calculate the inflation to 2023 dollars.

Financial assurance for decommissioning is provided by the prepayment method, coupled with an external trust fund, in accordance with 10 CFR 50.75(e)(1)(i) and 10 CFR 72.30(e)(1) as approved by the NRC in the license transfer to Oyster Creek Environmental Protection (OCEP) and HDI.

The site-specific DCE for decommissioning OCNGS demonstrates that adequate funding is available in the Nuclear Decommissioning Trust (NDT) fund to complete license termination. In addition to the license termination costs, site restoration and spent nuclear fuel management costs are included in this estimate; however, per regulatory requirements, the non-radiological estimates are segregated and listed separately

7.5 References

7-1 Regulatory Guide 1.179, *Standard Format and Content of License Termination Plans for Nuclear Power Plants*"

7-2 Regulatory Guide 1.159, "*Assuring the Availability of Funds for Decommissioning Nuclear Reactors*"

7-3 NUREG-1700, "*Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans*"

7-4 NUREG-1307, "*Report on Waste Burial Charges"*

7-5 Letter from HDI to NRC, "Notification of Revised Post-Shutdown Decommissioning Activities Report and Revised Site-Specific Decommissioning Cost Estimate for OCNGS", September 28, 2018

7-6 Letter from HDI to NRC, "Report on Status of Decommissioning Funding for Reactors and Independent Spent Fuel Storage Installations – Holtec International, LLC (HDI)", March 29, 2024

7-7 Nuclear Energy Agency Organization for Economic Co-operation and Development, "International Structure for Decommissioning Costing (ISDC) for Nuclear Installations", 2012

7-8 NUREG-1757 Vol. 1, Rev. 2, "*Consolidated Decommissioning Guidance*"

7-9 NUREG-1307, Revision 19, "*Report on Waste Burial Charges*"

8

SUPPLEMENT TO THE ENVIRONMENTAL REPORT

LIST OF ACRONYMS

Acronym	Full Form
ACS	American Community Survey
ALARA	As Low As Reasonably Achievable
AOC	Areas of Concern
AREOR	Annual Radiation Environmental Operating Reports
ARERR	Annual Radiological Effluent Release Reports
BGS	Below Grade Surface
BMP	Best Management Practice
BWR	Boiling Water Reactor
CFR	Code of Federal Regulations
CWS	Circulating Water System
DCE	Decommissioning Cost Estimate
DECON	Decontamination
°F	degree Fahrenheit
DOT	United States Department of Transportation
DWS	Dilution Water System
ENTOMB	Entombment
EPA	United States Environmental Protection Agency
ER	Environmental Report
ESA	Endangered Species Act
FES	Final Environmental Statement
GEIS	Generic Environmental Impact Statement
gpm	Gallons per minute
GTCC	Greater Than Class C
HDI	Holtec Decommissioning International
IPaC	Information for Planning and Consultation
ISFSI	Independent Spent Fuel Storage Installation
ISRA	Industrial Site Recovery Act
JCP&L	Jersey Central Power and Light
LLRW	Low-Level Radioactive Waste
LTP	License Termination Plan
MGD	Millions of Gallons per Day
MSL	Mean Sea Level
NAAQS	National Ambient Air Quality Standards
NJDEP	New Jersey Department of Environmental Protection
NJHPO	New Jersey Historic Preservation Office
NJPDES	New Jersey Pollutant Discharge Elimination System
NMFS	National Marine Fisheries Services

Acronym	Full Form
NOAA	National Oceanic and Atmospheric Administration
NO_X	Nitrogen Oxides
NRC	United States Nuclear Regulatory Commission
NRHP	National Register of Historic Places
OCEP	Oyster Creek Environmental Protection
OCNGS	Oyster Creek Nuclear Generating Station
OSHA	Occupational Safety and Health Association
PSDAR	Post-Shutdown Decommissioning Activities Report
RAI	Request for Additional Information
RCRA	Resource Conservation and Recovery Act
REMP	Radiological Environmental Monitoring Program
SAFSTOR	Safe Storage
SEIS	Supplemental Environmental Impact Statement
SESC	Soil Erosion and Sediment Control
SFP	Spent Fuel Pool
SW	Service Water
TSCA	Toxic Substances Control Act
USACE	United States Army Corps of Engineering
USCB	United States Census Bureau
USFWS	United States Fish and Wildlife Service
VOC	Volatile Organic Compound
WCS	Waste Control Specialists

8 SUPPLEMENT TO THE ENVIRONMENTAL REPORT

8.1 Introduction

In accordance with the requirements of 10 CFR §50.82(a)(9)(ii)(A), this chapter provides a supplement to the Environmental Report (ER) describing any new information or significant environmental change associated with the site-specific decommissioning and site closure activities performed at the Oyster Creek Nuclear Generating Station (OCNGS) site.

This chapter of the License Termination Plan (LTP) is prepared pursuant to 10 CFR §51.53(d) and 10 CFR §50.82(a)(9)(ii)(G), and generally follows the guidance in United States Nuclear Regulatory Commission (NRC) Regulatory Guide 1.179, Standard Format and Content of License Termination Plans for Nuclear Power Reactors (Reference 8-1). The contents of this chapter have also been reviewed against the appropriate sections of NUREG-1700, Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans (Reference 8-2), NUREG-1757, "Consolidated NMSS Decommissioning Guidance Decommissioning Process for Materials Licensees" (Reference 8-3) and NUREG-1748, Environmental Review Guidance for Licensing Actions Associated with NMSS Programs (Reference 8-4).

8.1.1 Purpose

This chapter supplements the following ERs and evaluations:

- Oyster Creek Nuclear Generating Station Environmental Report (ER), Amendment No. 2. (Reference 8-5).
- Applicants Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station, Renewal ER: (Reference 8-6).
- Oyster Creek Nuclear Generating Station Revised Post-Shutdown Decommissioning Activities Report and Revised Decommissioning Cost Estimate (PSDAR) (Reference 8-7).

Additional sources of environmental information and evaluations supporting this supplement include the Exelon Generation Company, LLC (Exelon) 2018 PSDAR - Safe Storage (SAFSTOR) PSDAR (Reference 8-8) and the Exelon 2018 PSDAR Updated ER (Reference 8-9).

This chapter documents an assessment of the environmental effects of decommissioning and license termination of OCNGS. The assessment determined that the environmental effects from decommissioning OCNGS are minimal, and no adverse effects are outside the bounds of NUREG-0586, Supplement 1, Final Generic Environmental Impact Statement (GEIS) on Decommissioning of Nuclear Facilities, Regarding the Decommissioning of Nuclear Power Reactors (Reference 8-10) or previously completed environmental impact statements, assessments, and evaluations.

This supplement to previously completed ERs, statements, assessments, and evaluations includes summaries of previously completed environmental evaluations and conclusions, and descriptions of new information and significant environmental change associated with decommissioning and license termination of OCNGS.

8.1.2 Background

OCNGS is a single unit Boiling Water Reactor (BWR-2) with a Mark I type containment. It is located in Lacey and Ocean Townships, Ocean County, New Jersey, approximately two miles south of the community of Forked River. OCNGS was licensed to generate 1930 megawatts-thermal. The renewed facility operating license for OCNGS allowed operation until April 9, 2029.

A brief history of the major milestones related to OCNGS construction and operational history is provided below.

- Construction Permit Issued: Dec 15, 1964
- Provisional Operating License Issued: April 9, 1969
- Commercial Operation: December 23, 1969
- Full Term Operating License Issued: July 2, 1991
- Original License Expiration: April 9, 2009
- Renewed License Expiration: April 9, 2029

By letter dated January 7, 2018, Exelon Generation Company, LLC announced its plan to retire OCNGS no later than December 31, 2018 (Reference 8-11). A February 14, 2018 supplement to this letter certified that operations would cease no later than October 31, 2018 (Reference 8-12). Exelon permanently shut down OCNGS on September 17, 2018. By letter dated September 25, 2018, Exelon certified to the NRC that it had permanently removed fuel from the reactor vessel (Reference 8-13).

On May 21, 2018, Exelon submitted a SAFSTOR PSDAR to initiate decommissioning of OCNGS under the SAFSTOR method.

By letter dated August 31, 2018 (Reference 8-14), Exelon submitted to the NRC an application for transfer of the OCNGS facility licenses to Oyster Creek Environmental Protection, LLC (OCEP) as owner and Holtec Decommissioning International, LLC (HDI) as operator. This transfer was complete on July 1, 2019 ((Reference 8-15).

On September 28, 2018, HDI submitted a Revised PSDAR and Decommissioning Cost Estimate (DCE) to address the acceleration of decommissioning activities, and changes to the decommissioning schedule and cost estimates. The Revised PSDAR and DCE established the decommissioning method as Decontamination (DECON).

8.2 Site Location and Description

OCNGS is located near the Atlantic Ocean within the State of New Jersey. The site location and nearby major features are shown on Figure 1-1. The site layout is shown on Figure 1-2. The operational area of the site is 152 acres in size and located mostly in Lacey Township in Ocean County, New Jersey. A small portion of the site is located in Ocean Township within Ocean County. The facility is located about two miles inland from the shore of Barnegat Bay and about seven miles west-northwest of Barnegat Light. The site is approximately nine miles south of Toms River, New Jersey, about fifty miles east of Philadelphia, Pennsylvania, and sixty miles south of Newark, New Jersey. The site is further identified by an Intake Canal flowing in from Barnegat Bay along the north and northwest sides of the operational area of OCNGS, and a

Discharge Canal along the southwest and south sides of the operational area. The Discharge Canal flows to the east through the Oyster Creek stream channel to Barnegat Bay. The stream channel is bordered to the north by the currently undeveloped, former Finninger Farm land and to the south by land developed for commercial and residential use.

The former Finninger Farm is a 579-acre property located east of U.S. Highway 9 and is outside the licensed plant site property. A small area east of U.S. Highway 9 and north of the Discharge Canal was used as a barge landing for delivery of large components during OCNGS construction, and occasionally during plant operation, but was never subject to the licensing requirements of the Atomic Energy Act of 1954 or the NRC's regulations. Property located west of OCNGS is an industrialized area including an operating electrical substation owned by First Energy (formerly Jersey Central Power and Light (JCP&L)) and various industrial buildings and facilities, some of which were used as support facilities for OCNGS operation.

The original plant site consisted of approximately 80 acres, all of which was owned by JCP&L. Coincident with the sale of OCNGS to AmerGen, approximately 572 acres of the original plant site was proposed to be removed from the site boundary and made available for unrestricted use subject to certain easements to support the continued operation of OCNGS. This parcel of land, referred to as the Forked River property, was the construction site for the cancelled Forked River nuclear project.

Dredging of portions of Oyster Creek and the Forked River to preserve navigability for recreational vessels and access to waterfront properties was conducted in 1978, 1984, and 1997 pursuant to an agreement with the New Jersey Board of Public Utilities and in accordance with applicable federal and state permits. The material was placed in an approximate 17.5-acre dewatering basin on the Finninger Farm property. In 2001, the NRC found that the placement of the dredged material would not have an adverse impact on the public and was acceptable (Reference 8-16). On December 8, 2017, the NRC confirmed that due to the low dose to a member of the public associated with the materials (< 1 mrem/year), the dredged materials and disposal area were never considered to be subject to licensing requirements of the Atomic Energy Act of 1954 (as amended), the NRC's regulations, or use restrictions (Reference 8-17).

Topography in the region consists of relatively level landscapes associated with the coastal plains (Chapter 1, Figure 1-1). Site elevation ranges from approximately 0 to 15 feet above mean sea level (MSL) immediately adjacent to the Intake and Discharge Canals to slightly more than 30 feet MSL in the northwest portion of the station property. The ground surface features are comparatively flat except for the man-made steep slopes at areas adjacent to the Intake and Discharge Canals. The terrain surrounding the site is relatively flat along the shoreline and gently rolling inland.

8.2.1 Site Description After Unrestricted Release

Following completion of decommissioning activities and verification that radiological criteria for license termination are met, the existing Part 50 license will be amended to reduce the site footprint to only that portion required for operation of the Independent Spent Fuel Storage Installation (ISFSI), with the remainder of the site being released for unrestricted use.

In addition to the infrastructure required to support the operation of the ISFSI, the following facilities, structures and components will remain for potential future use:

- Administration Building
- Site Emergency Building
- Materials Warehouse
- Low Level Radwaste Storage Facility
- Plant Security Access Facility
- Demineralized Water Storage Tank
- Intake, Discharge, and Dilution Water Structures and Canals
- Roads, pathways, and parking areas

8.3 Remaining Dismantlement and Decommissioning Activities

Remaining dismantlement and decommissioning activities include the removal of systems and components from the main power block facilities and demolition of the building structures to three feet below grade. Subgrade portions of remaining structures will be backfilled, graded, and stabilized. Remaining power block facilities include the Reactor Building, Turbine Building, Old Radwaste Building, and the Stack and Tunnels.

Components and equipment will be removed from the Intake, Dilution, and Discharge structures. The Dilution Water Structure, Discharge Structure, intake and discharge tunnels, and dilution water tunnel will be surveyed, remediated if needed to meet radiological release criteria, and left in place for potential future use.

Remaining support buildings, facilities, and equipment will be dismantled and demolished. Buried piping will be removed where safe and practicable.

Road, pathway, and parking surfaces will be removed as required to meet radiological release criteria or where the surfacing material is no longer needed.

Additional details regarding remaining dismantlement and decommissioning activities are presented in Chapter 3.

8.4 Post-Shutdown Decommissioning Activities Report

In September 2018, HDI submitted a Revised PSDAR in accordance with 10 CFR §50.82. HDI intends to decommission OCNGS in accordance with the DECON option as defined in the GEIS. HDI revises the PSDAR as necessary in accordance with the requirements of 10 CFR §50.82.

The PSDAR provides a description of planned decommissioning activities, a schedule for their accomplishment, an estimate of expected decommissioning costs, and the reasons for concluding

that the environmental impacts associated with site-specific decommissioning activities will comply with 10 CFR §50.82(a)(6)(ii).

The Revised PSDAR concluded that the potential environmental impacts associated with decommissioning OCNGS have been evaluated and are bounded by previously issued environmental impact statements and evaluations, or by the site-specific evaluations presented in the Revised PSDAR.

Major dismantlement, demolition, and decontamination activities that are scheduled to be completed prior to license termination and site release are summarized in Section 8.2 and described in detail in Chapter 3. These activities are not significantly different than those evaluated in the revised PSDAR, and no significant potential impacts associated with planned decommissioning activities beyond those identified in the PSDAR have been identified.

8.5 Oyster Creek Nuclear Generating Station Site Environmental Setting and Description

8.5.1 Geography and Demography

General location and descriptive information for OCNGS is provided in Section 8.2 above. Additional information regarding site features is provided below.

The nearest navigable waterway to the OCNGS is Barnegat Bay (Chapter 1, Figure 1-1). The average depth of the Bay is less than 5 feet with a range of less than 1 foot to 20 feet at mean low tide. The United States Army Corps of Engineers (USACE) maintains the Intracoastal Waterway, which crosses Barnegat Bay at a depth of 6 feet, mean water line.

The Island Beach peninsula and Long Beach Island provide a barrier between Barnegat Bay and the Atlantic Ocean (Chapter 1, Figure 1-1). These barriers and the limited depth of the bay minimize the range of tidal fluctuations. The typical high tide elevation in the area is 4.5 feet above MSL. Grade level in the OCNGS operational area is approximately 23 feet above MSL, well above the high tide elevation. There is no record of the site area being flooded or inundated even during storms with high tidal conditions.

Surface water bodies in the vicinity of the site consist of the South Branch of the Forked River, Oyster Creek, the Intake and Discharge Canals, and Barnegat Bay. The South Branch of the Forked River and Oyster Creek are fresh water sources from upland Pinelands areas. The Intake and Discharge Canals are saline due to their hydraulic connection to Barnegat Bay. Vernal ponds also exist in some of the undeveloped wooded areas to the west, south, and east of the site.

8.5.1.1 Population

The United States Census Bureau (USCB) provides the most reliable recent census data for Lacey and Ocean Townships, and Ocean County (Reference 8-18). The estimated total population on July 1, 2022 was 29,632 for Lacey Township, 9,001 for Ocean Township, and 655,735 for Ocean County.

8.5.1.2 Site Access, Land, and Water Use

OCNGS is accessible from U.S. Highway 9, a north-south highway located immediately west of the facility (Chapter 1, Figures 1-1 and 1-2). OCNGS is on land zoned as industrial. The facility

is in an unincorporated area within Lacey and Ocean Townships, Ocean County, New Jersey. OCNGS is located in the coastal pine barrens of New Jersey. The area immediately surrounding the plant is a mix of vacant lands, an industrialized area, and woodlands.

Recreational opportunities in the area include boating, fishing, camping, swimming, cycling, and bird watching. A multi-use, paved recreational trail, Barnegat Branch Trail, is present along the west side of U.S. Highway 9 adjacent to the site.

Decommissioning activities occur within the operational area of OCNGS and/or within areas previously disturbed during construction and operation of the plant.

8.5.2 Climate

The site is in a meteorological transition zone between the continent and the ocean and the weather at the site is conditioned by this location. Site weather is influenced on the average more by continental than by maritime weather.

The prevailing winds are offshore and typically average 7 to 11 miles per hour. The area has cold winters and warm summers. As measured at Toms River approximately 9 miles north of OCNGS from 1991 to 2020, the annual average temperature in Ocean County is approximately 52 °F with a low monthly average temperature of 21.7 °F in January and a maximum monthly average temperature of 85.5 °F in July (Reference 8-19). Maximum wind speeds in the area over the last 30 years, measured in Atlantic City, New Jersey, approximately 32 miles south of OCNGS, have occurred in December, January, June, and July and ranged from 78 to 87 miles per hour (Reference 8-20).

Extreme weather events occurring in New Jersey include high winds, severe thunderstorms, hailstorms, extreme temperatures, droughts, and infrequently, tropical systems. These extreme weather systems have all been experienced at OCNGS during its operating history; however, none of these severe weather events have resulted in significant impact to the plant facilities or operations.

8.5.3 Topography, Geology, and Seismology

8.5.3.1 Topography

The Site lies within the Coastal Plain Physiographic Province a generally seaward-dipping wedge of Cretaceous and Tertiary sediments sloping gently to the southeast from 10 to 60 feet per mile (Reference 8-21). The topography of the Site is generally flat with elevations ranging from approximately 10 to 25 feet above MSL. Topography of the site and surrounding areas are shown in Chapter 1, Figure 1-1.

8.5.3.2 Geology

The regional stratigraphy includes beds of sand, gravel, clay, and marl dipping gently to the southeast. These Tertiary-Age coastal plain deposits are overlain by more recent sands and gravels. Three stratigraphic units underlie the Oyster Creek region: the Cape May (Pleistocene-Age – 1-2 million years before present), Cohansey (Miocene-Age – 7-25 million years before present), and the older Kirkwood (Miocene-Age) Formations.

The Cape May Formation has an average thickness of forty feet and consists of a light gray to tan, medium to fine sand, with trace silt and coarse sand. It is poorly compacted and commonly contains a thin, shallow black clay bed in coastal areas. The Cohansey Formation lies beneath the Cape May Formation. The average thickness of the Cohansey Formation is sixty feet and is primarily composed of a red-brown and tan, medium to fine sand, trace silt, coarse sand, and some coarse-to-fine gravel. Lenticular beds of clay are sometimes found. The lower portions of the Cohansey are densely compacted.

The Cohansey is underlain by the Kirkwood Formation which consists of light gray to yellow-brown micaceous ilmenite, lignite, very fine to fine grained quartz sand, and some coarse-to-fine gravel. It is densely compacted and extends from a depth of about 100 feet to at least 250 feet below the surface.

Site geology has been extensively investigated with a long history of core sampling, groundwater level measurements, and groundwater sampling and analysis that began with a preliminary Site survey in 1960. Surface elevation in the vicinity of plant structures is approximately 23 feet above MSL.

The stratigraphic units identified below, listed from land surface to increasing depth, are present at the site.

Surficial deposits consist of sand with trace amounts of silt and range in thickness from land surface to 38 feet below grade surface (bgs) with localized areas of greater thickness up to 53 feet bgs. The fill has been interpreted to be soil excavated from the Cape May Formation and placed during site development activities.

The Cape May Formation varies in thickness from 0 to 21.5 feet and is present at land surface where it has not been excavated and covered with fill and is also present in the subsurface beneath the fill at varying thicknesses.

The Cape May Formation is underlain by the Upper Clay, a hard, plastic organic clay with dense, fine-grained sand and silt lenses within the clay matrix. The Upper Clay is generally 15 to 18 feet thick where not affected by excavation.

The Cohansey Formation underlies the Upper Clay and consists of medium to fine-grained silty sand containing pockets of coarse-to-fine-grained sand, sandy silt, and gravel.

The Lower Clay beneath the Cohansey is a dense medium to fine-grained sand with traces of organic silt and containing layers and inclusions of hard organic clay. The Lower Clay is estimated to be 10 to 20 feet thick.

The Kirkwood Formation is present beneath the Lower Clay and consists of silty, fine-grained sand extending to a depth of 500 feet bgs or more.

8.5.3.3 Seismology

The OCNGS is in an area of minor earthquake activity. Based on the seismic history of the region described in the 1972 Operating ER and 1974 operating stage Final Environmental Statement (FES) (Reference 8-22), significant ground motion from earthquakes is unlikely. A small number of minor earthquakes with epicenters in Ocean County have occurred since 1938 (Reference 8-23), with none noted to have caused significant damage.

8.5.4 Hydrology and Hydrogeology

The site includes a constructed Intake Canal located along the northwest and north sides of the plant area, and a Discharge Canal located along the southwest and south sides of the plant area. The South Fork of the Forked River is located to the north and Oyster Creek is located to the south of OCNGS. Barnegat Bay is located approximately 1.9 miles east of OCNGS.

A dam separates the Intake and Discharge Canals adjacent to the west side of the OCNGS plant. During operation, intake water was drawn from the South Fork of the Forked River approximately three-quarters of a mile upstream from the river's outlet to Barnegat Bay. Intake water was withdrawn from the canal on the north side of the dam. Water was discharged from the plant on the south side of the dam and flowed to Barnegat Bay through the Discharge Canal.

Unconfined water bearing zones are present in both the Cape May and Cohansey formations at the site. The presence of clay layers result in slightly artesian (confined) conditions in localized areas, but in general the water bearing zones in these formations communicate hydrologically.

The Lower Clay functions as a confining layer between the shallow, unconfined water bearing zones and the underlying Kirkwood formation. The Kirkwood aquifer exists under confined conditions.

Ground water flow in the shallow, unconfined water bearing zone is controlled by the Intake and Discharge Canals. Within the area bounded by the canals, the shallow ground water flow direction is to the west. Outside the canals, regional flow is generally toward the southeast toward Barnegat Bay.

8.6 Environmental Effects of Decommissioning

The most significant potential environmental effects of decommissioning activities are associated with radiation exposure, structures demolition, and the disposal of radioactive waste. As described further in Sections 8.7 and 8.8, decommissioning OCNGS is anticipated to have a minimal and insignificant adverse environmental impact and significant beneficial impacts.

8.7 Radiological Effects of Decommissioning

8.7.1 Occupational Radiation Exposure

The occupational dose for decommissioning of OCNGS considers the dose received from occupational activities required for the dismantling and demolition of the plant through completion of the work, and occupational dose due to radioactive waste shipments. The occupational dose is maintained ALARA and below the dose limits in 10 CFR §20, and within the range of cumulative occupational dose estimates for decommissioning BWR plants of 700 – 1874 person-rem provided in Table 4-1 of the GEIS.

The NRC concluded in the GEIS that because the radiologic impacts of decommissioning will remain within regulatory limits, they are considered to be small and are bounded by the GEIS.

Additional information regarding the estimated occupational dose associated with decommissioning and license termination is provided in Chapter 3.

8.7.2 Offsite Radiation Exposure and Monitoring

Section 4.3.8 of the GEIS considered doses from liquid and gaseous effluents when evaluating the potential impacts of decommissioning activities on the public. Table G-15 of the GEIS compared effluent releases between operating facilities and decommissioning facilities and concluded that decommissioning releases are lower. The GEIS also concluded that the collective dose, and the dose to the maximally exposed individual from decommissioning activities, are expected to be well within the regulatory standards in 10 CFR §20 and §50. In Section 7.1 of the Supplemental Environmental Impact Statement (SEIS) (Reference 8-24), no new or significant information was identified during the NRC's independent review of OCNGS to indicate that public radiation dose impacts would occur during decommissioning beyond those discussed in the GEIS.

The radiological characteristics of the OCNGS decommissioning are monitored in accordance with HDI's Offsite Dose Calculation Manual and Radiological Environmental Monitoring Program (REMP). Effluent control includes the operation of monitoring systems, in-plant and environmental sampling and analyses programs, quality assurance programs for the effluent and environmental programs, and procedures covering effluent and environmental monitoring.

REMP reports containing the results of onsite and offsite monitoring indicate that direct radiation from sources have been below the 40 CFR §190 limits. The REMP continues as required by Part 50 license until removal of spent fuel from the ISFSI and termination of the license.

The NRC concluded that the radiological impacts to members of the public are small when maintained within regulatory limits and are therefore bounded by the GEIS.

8.7.3 Environmental Effects of Accidents and Decommissioning Events

The likelihood of a large offsite radiological release that impacts public health and safety after permanent shutdown of OCNGS is considerably lower than the likelihood of a release from the plant during power operation.

All spent fuel has been removed from the reactor, placed in dry storage canisters, and moved to the ISFSI. Therefore, no potential remains for releases associated with fuel related accidents. There are no accidents associated with remaining dismantlement activities that could result in significant radiological exposure to members of the public.

The potential for decommissioning activities to result in offsite radiological releases (i.e., releases related to decontamination, dismantlement, and waste handling activities) will be minimized by use of procedures designed to minimize the likelihood and consequences of such releases.

The potential for impacts related to OCNGS decommissioning on radiological accidents are small and are bounded by the GEIS.

8.7.4 Storage and Disposal of Low-Level Radioactive Waste

Regulations that apply to the transportation of hazardous, mixed-waste, and radioactive material promulgated by the United States Department of Transportation (DOT) are contained in 49 CFR §171-177. NRC regulations related to transportation of low-level radioactive waste (LLRW) are contained in 10 CFR §71, Packaging and Transportation of Radioactive Material. These regulations contain requirements for transport vehicles, maximum radiation levels for packages and vehicles, special packaging requirements, driver training, vehicle and packaging inspections,

marking and labeling of packages, placarding of vehicles, and training of emergency personnel to respond to mishaps. Highway routing restrictions for certain shipments of LLRW are also included in DOT regulations. NRC regulations contain performance requirements for certain types of transportation packages of radioactive material. In addition, federal and state regulations govern the size and weights of trucks. NRC assumes that equipment, materials, and waste transportation are conducted within applicable regulations.

Based on the nuclide concentrations, LLRWs are classified as Class A, Class B, or Class C. Waste that exceeds Class C levels is called "greater than Class C" (GTCC). OCNGS GTCC waste will be stored in its own container within the ISFSI facility until a geologic repository is available. Class A, B, and C waste will be classified for proper handling, transport, and disposal.

Radiological waste generated during the dismantling and demolition of OCNGS will consist of radiologically contaminated waste or mixed waste. Mixed waste contains elevated levels of radionuclides along with non-radiological constituents that result in the waste being classified as both radiological waste and hazardous waste under the Resource Conservation and Recovery Act (RCRA). Radiological wastes containing non-radiological contaminants that do not result in a RCRA-hazardous classification will be managed as radiological waste. Radiological and mixed wastes will be managed in accordance with applicable regulations and disposed at facilities authorized to accept them.

The estimated volume of radioactive waste in cubic feet associated with OCNGS decommissioning destined for disposal at a LLRW (Class A, B, or C) disposal facility or GTCC geologic repository is summarized below:

- Class A: 1,400,000 ft^3
- Class B/C: 3,164 ft^3
- GTCC: 4,800 ft^3

The estimated LLRW volume (Class A, B, and C) for OCNGS that is destined for disposal will be approximately 1,403,164 ft^3 using the DECON method. The anticipated waste volume for OCNGS decommissioning is bounded by the high-end estimate of 1.5 million ft^3 listed in Table 4-7 of the GEIS associated with decommissioning of a facility to unrestricted conditions.

Transportation methods for shipment of LLRW to licensed waste facilities include truck, rail, and potentially barge. There is no longer any direct rail service to the OCNGS site. Therefore, some waste destined for disposal at the Waste Control Specialists (WCS) facility in Texas is transported via truck to the nearest rail loading facility where it is transferred to rail. Some LLRW is shipped exclusively by truck to the WCS facility or other waste disposal or processing facilities. There have been no barge shipments of radioactive waste to date.

As of October 2023, there has been a total of 884 waste shipments of radioactive material from OCNGS to a licensed disposal facility; 425 shipments to the waste facility by truck only and 459 shipments that were transloaded onto rail cars for the trip to the waste facility by train. These shipments are then transported by truck from a transload yard near the waste facility to the disposal site.

Non-radiological wastes generated during the dismantling and demolition (e.g., contaminated and uncontaminated construction debris, universal waste, RCRA-hazardous and non-hazardous contaminated material, Toxic Substance Control Act regulated material) will be characterized as required by state and federal regulations and managed accordingly.

8.7.5 Spent Fuel Storage

All spent nuclear fuel has been transferred to the ISFSI. The NRC has determined that for all Category 1 impacts associated with the storage of spent fuel on site, the potential impacts are small, and disproportionately high and adverse impacts to environmental justice populations are not expected (Reference 8-25). The potential for environmental impacts to special status species and habitats during decommissioning were previously evaluated in the Revised PSDAR and independently evaluated in Section 8.8.8 of this LTP chapter and found to be bounded by previous environmental impact statements and reports and the independent evaluation presented herein.

8.7.6 Radiological Criteria for License Termination

Chapter 6, Compliance with the Radiological Criteria for License Termination, provides the methodology for achieving unrestricted release of the OCNGS site. Following decommissioning, residual radioactivity will be limited to levels that comply with the NRC's annual dose limit of 25 mrem, the New Jersey remediation requirement of 15 mrem, and ALARA.

8.8 Non-Radiological Effects of Decommissioning

The following subsections provide an assessment of the non-radiological impacts of decommissioning and site release. The evaluations presented in Revised PSDAR, and other environmental evaluations (as applicable), remain valid and are summarized below.

8.8.1 Onsite/Offsite Land Use

The NRC concluded in the GEIS that the experience of plants being decommissioned has not included any need for additional land offsite. No changes to land use beyond the site boundary are anticipated during decommissioning.

Decommissioning activities will occur within onsite areas previously disturbed during plant construction or operations. Stormwater and industrial discharges from the site are regulated under an existing New Jersey Pollutant Discharge Elimination System (NJPDES) permit issued by the New Jersey Department of Environmental Protection (NJDEP), and construction activities not already covered by the existing permit require project-specific stormwater permits from the NJDEP.

8.8.1.1 Onsite Land Use

The site location is shown in Chapter 1, Figure 1-1 and property boundaries are shown in Chapter 1, Figure 1-2. Land uses within the OCNGS site are industrial, open water (i.e., intake and discharge canals), and undeveloped areas. OCNGS is the sole industrial use of the site. As documented in the FES, construction of OCNGS involved disturbance of 350 acres and little, if any, of the operational area was left undisturbed.

Most of the property immediately to the west of the OCNGS property (between OCNGS and the Garden State Parkway) is owned by FirstEnergy, an Ohio utility. A smaller parcel within the

FirstEnergy property contains a 66-megawatt electric dual-fired combustion turbine power plant owned by Forked River Power, LLC and is only used during high energy demand periods. The property to the west also contains a transmission substation system and a parcel recently purchased to support an offshore wind farm development project. The project was discontinued by its developer in November 2023.

Some areas undergoing decommissioning have been and will be disturbed as part of demolition and dismantlement activities. Where necessary the disturbed areas (e.g., excavations, building basements) are filled or regraded to create or restore an acceptable grade. Land disturbances more than 5,000 ft^2 in area are authorized by the Ocean County Soil Conservation District Sediment Control Act. HDI has obtained a Soil Erosion and Sediment Control Plan (SESC) for decommissioning soil disturbances (Reference 8-26). The SESC prescribes soil erosion and sediment control measures, vegetative cover, soil stabilization, and soil profile and grading design. Current plans for site restoration do not include general recontouring or revegetating otherwise undisturbed areas except as required to meet release criteria.

As addressed in the Exelon Generation PSDAR Request for Additional Information (RAI) Response (Reference 8-27) and in Figure 3.4 of the FES, the previously disturbed area includes a barge landing area on the north bank of Oyster Creek immediately east of U.S. Highway 9. The area was used for moving large plant components during original construction and periodically during plant operation for removal and delivery of other large components.

HDI may elect to ship large plant components and demolition debris by barge using the landing. The transfer of large plant components to the barge landing would cause only temporary and short duration disturbance to land that has been previously disturbed for similar purposes and would result in no land use changes.

If HDI elects to use barge transportation, dredging between the barge landing and Barnegat Bay may be required to provide enough depth for barge navigation. If dredging is necessary, it will be conducted under USACE and appropriate NJDEP Division of Land Use Regulation permits which require consideration of environmental impacts as part of the permitting process.

8.8.2 Off-Site Land Use

OCNGS and the nearby surrounding land are within the Pinelands National Reserve. OCNGS and surrounding land are categorized by the Pinelands Land Capacity map as rural development area and forest (Reference 8-28). Development within the Pinelands National Reserve is strictly controlled (Reference 8-29). The land cover within 10 miles of the site is dominantly various types of forest or shrubs and developed land of various intensities. The development is concentrated near U.S. Highway 9, the Garden State Parkway and along the coast.

OCNGS and the surrounding area are shown in Chapter 1, Figure 1-2. OCNGS is bordered by U.S. Highway 9 and the former Finninger Farm on the east. A dewatering basin for dredge materials generated during dredging of portions of Oyster Creek and the Forked River in 1978, 1984, and 1997 is located within the former Finninger Farm property. Detailed information regarding the basin is provided in Section 8.2 of this chapter.

The Barnegat Branch Trail, a multi-use, paved recreational path, parallels the west side of Highway 9. Adjacent to the western border of OCNGS is industrial property including office space, training facilities, an electrical switchyard, and the meteorological tower.

The nearest residence is located 3,073 feet southwest of the OCNGS Reactor Building (Reference 8-30). Additional information regarding land uses in the OCNGS area is provided in Chapter 1.

8.8.2.1 Conclusion

Decommissioning activities will be conducted on land previously disturbed during construction and operation of OCNGS. HDI anticipates no new land uses as a result of decommissioning and is not aware of any changes to anticipated decommissioning activities that would affect the evaluation of potential environmental impacts associated with onsite/offsite land use presented in the Revised PSDAR, or that are significantly different than those considered in the GEIS. Therefore, HDI concludes that the potential impacts to land onsite and offsite are small and are bounded by the GEIS.

8.8.3 Water Use

The operational demand for once-through cooling water and makeup water has been dramatically decreased as a result of plant shutdown. The Circulating Water System (CWS) consists of cooling water pumps to supply once-through, non-contact cooling water for the plant nuclear generating systems. During normal plant operation the CWS withdrew approximately 460,000 gallons per minute (gpm) of seawater from Barnegat Bay via the Forked River and an Intake Canal, then discharged the heated water via the Discharge Canal and Oyster Creek channel to Barnegat Bay. A Dilution Water System (DWS) pumped water from the intake canal and discharged it directly to the discharge canal where it mixed with the heated CWS cooling water to reduce the temperature of water flowing to Barnegat Bay.

The CWS and DWS were taken out of service after plant shutdown, eliminating water withdrawals, discharges, and thermal load associated with the CWS.

The NJPDES permit (Reference 8-31) for OCNGS stipulates that beginning January 1, 2020, OCNGS reduce its surface water intake to the greater of 40,000 gpm (57.6 MGD) or the flow commensurate with that achievable using closed-cycle cooling.

A Service Water (SW) system consisting of two intake water pumps operated during normal plant operation for non-contact cooling and other purposes at a flow rate of up to 12,000 gpm and remains in service to support decommissioning. The SW system draws water from the Intake Canal and returns it to the Discharge Canal. The SW system was used for non-contact cooling of the Spent Fuel Pool (SFP) and for other purposes from plant shutdown until June 2023 when all spent fuel was removed from the SFP and placed in dry storage at the ISFSI. The termination of SFP non-contact cooling eliminated the discharge of waste heat to Barnegat Bay via the Discharge Canal. The SW pumps remain in periodic use to support decommissioning activities and will be permanently secured and removed when no longer needed. Typical SW average withdrawals from the intake canal for ongoing decommissioning activities are 3,200 gpm for approximately 11 hours per month. Water withdrawals and discharges are conducted in accordance with the terms and conditions of an NJPDES permit and NRC requirements.

OCNGS monitors radiological releases from the facility and reports annual releases to the NRC in annual radiological effluent release reports (ARERR). OCNGS also monitors the environment (including air, surface water, groundwater, sediment, vegetation, and aquatic biota) on and near the facility for radiological impacts through its REMP and reports the results annually to the NRC in annual radioactive environmental operating reports (AREOR).

OCNGS decommissioning was initiated in mid-2019. Radiological monitoring results since the start of decommissioning indicate that liquid effluents from decommissioning activities do not result in significant radiation exposure to the public or the environment surrounding OCNGS and are well below standards set by the NRC and the United States Environmental Protection Agency (EPA) (References 8-32 through 8-39). The decommissioning of OCNGS has had no adverse radiological impact on people or the environment.

OCNGS monitors groundwater quality on and off site through its Radiological Groundwater Protection Program and submits annual reports to the NRC in the AREORs. Releases of contaminated water occurred in 2009 resulting in a plume of tritium west of the turbine building. Active remediation of the plume was initiated in 2010 in consultation with the NJDEP and was terminated with agency concurrence in October 2019. Tritium levels in the groundwater continue to trend downward. Radionuclides in groundwater range from non-detect to levels well below background and/or the NRC, EPA, and state of New Jersey groundwater quality standards for radionuclides.

Two onsite groundwater wells provide water for potable and non-potable domestic uses and for the sanitation system. During plant operation, the wells were also used for reactor make up water. The use of potable water has decreased after plant shutdown commensurate with reductions in plant staffing levels. Operation of the onsite ground water wells and sanitation system will be discontinued when no longer needed to support decommissioning activities.

In the license renewal SEIS, NRC staff concluded that the impact of continued plant groundwater use on groundwater availability and quality would be small during the license renewal term. Furthermore, when the plant stops operating, there would be a reduction in the use of well water because reactor makeup water would no longer be required and there would be reduced potable water consumption and sanitary use as the size of the plant staff decreases. Therefore, the NRC staff reasoned in the SEIS that the impact on groundwater use and quality from shutdown of the plant would also be small. The impacts of OCNGS groundwater use throughout the decommissioning process are similar to those previously considered in the license renewal SEIS for operation or shutdown of the plant and in the GEIS for decommissioning and would also be small.

8.8.3.1 Conclusion

There are no anticipated unique water uses associated with the decommissioning of OCNGS that are not addressed by the evaluation of the reference facility in Section 4.3.2 of the GEIS which concluded that water use at decommissioning nuclear reactor facilities is significantly smaller than water use during operation and is considered to be small.

Therefore, HDI concludes that the potential for environmental impacts on water use associated with remaining decommissioning activities for OCNGS is bounded by the GEIS.

8.8.4 Water Quality (Non-Radiological)

The potential environmental impacts on non-radiological water quality were considered within the context of planned decommissioning activities in the Revised PSDAR, including the potential for non-radiological impacts to ground water.

Industrial and some site stormwater discharges to surface water from the facility are subject to the terms and conditions of the existing NJPDES permit. The remaining stormwater discharges

are covered by an Ocean County SESC plan for land disturbances more than 5,000 ft^2 which authorizes stormwater discharges subject to required Best Management Practices (BMP) under a state general stormwater permit. In addition to the specific permit requirements, selection and implementation of BMPs for stormwater that may be generated from areas disturbed by decommissioning activities is also required. Sanitary waste generated at the site is currently discharged to Lacey Township Municipal Utilities Authority and will continue to be discharged to this facility. As decommissioning proceeds, management of sanitary wastewater may be transitioned to temporary, contained onsite facilities with transport of the sanitary waste to offsite facilities permitted to receive, treat, and dispose of the wastes.

OCNGS complies with applicable regulations requiring reporting of hazardous materials spills, and reasonable precautions are taken to prevent or mitigate spills of hazardous materials.

Investigation and remediation activities for non-radiological Areas of Concern (AOC) are being conducted by HDI and a prior property owner in accordance with New Jersey's Industrial Site Remediation Act (ISRA) and associated regulations and guidance. The work is overseen by the state's Site Remediation Program. HDI's investigation and remediation of AOCs is complete. Investigation and remediation of AOCs by the prior property owner (First Energy) is ongoing and will continue until complete. If additional non-radiological AOCs are discovered during decommissioning, they will be addressed in accordance with applicable local, state, and federal laws and regulations.

Reductions in groundwater use during decommissioning are not expected to alter groundwater flow paths or otherwise affect ongoing remedial activities.

As described and evaluated in the Revised PSDAR, if barging large plant components and demolition debris from OCNGS to Barnegat Bay is selected as a transportation method, dredging for navigation may be needed. Dredging, if conducted, will be implemented in accordance with applicable federal, state, and local permits, including required environmental impact evaluation(s) and certifications. The NRC has concluded the impact of dredging to remove accumulated sediments in the vicinity of intake and discharge structures and to maintain barge shipping has not been found to be a problem for surface water quality (Reference 8-32).

The NRC concluded in the GEIS that the potential impacts to water quality at decommissioning plants are small and neither detectable nor destabilizing. The SEIS found that there would be no impacts on water quality associated with OCNGS decommissioning beyond those discussed in the GEIS.

8.8.4.1 Conclusion

There are no anticipated decommissioning activities at OCNGS with a potential to impact non-radiological water quality that are not addressed by the evaluation of the reference facility in the GEIS.

Therefore, HDI concludes that impacts of OCNGS decommissioning on water quality are small and bounded by the GEIS.

8.8.5 Air Quality

The potential environmental impacts on air quality were considered within the context of planned decommissioning activities in the Revised PSDAR. HDI will maintain existing air permits for

equipment that will be used during OCNGS decommissioning. Federal, state, and local regulations pertaining to air quality will remain in effect to regulate emissions associated with fugitive dust, criteria air pollutants, hazardous air pollutants, and ozone depleting gases, including maintenance of and compliance with existing permits, and acquisition of new permits if needed.

Ocean County is designated as an Ozone National Ambient Air Quality Standards (NAAQS), but the plant area is not a NAAQS for particulates, SO_2, CO, NO_2, or lead. Ozone is an air pollutant known to cause health effects and negatively impact air quality in the state of New Jersey and is formed when Nitrogen Oxides (NOx) and volatile organic compounds (VOCs) react in the presence of sunlight.

OCNGS is not subject to federal Title V requirements authorized under the Clean Air Act but does maintain NJDEP air permit certificates for various equipment and source operations that meet New Jersey Administrative Code (N.J.A.C.) 7:27 thresholds. OCNGS' current pollutant emissions for oxides of NOx and VOC total 0.09-tons/year and 0.83-tons/year, respectively. Consequently, OCNGS is not considered a significant contributor of ground-level ozone in New Jersey.

Potential impacts to air quality from decommissioning activities could result from motor vehicle emissions, diesel generator emissions, and other construction-related equipment emissions, as well as fugitive dust from removal, dismantlement, demolition, concrete crushing, and backfill activities. These activities are similar to construction activities considered by NRC in the GEIS.

Emissions from mechanical equipment (e.g., generators, boilers, construction equipment, etc.) are operated in compliance with local, state, and federal regulations, and where applicable, air permits issued by the appropriate authorities. BMPs to control fugitive dust emissions (e.g., enclosures, fugitive dust capture systems, water sprays, etc.) are implemented in accordance with detailed plans that include the specific BMPs and monitoring programs applicable to the activities.

The OCNGS radiological air monitoring program remains in place to monitor potential release paths from the plant and potential exposure pathways in the environment, including monitoring of air particulates. Decommissioning was initiated in 2019 and has not resulted in significant radiation exposure of the people or environment surrounding OCNGS. Monitoring results are well below levels set by the NRC and EPA and show no radioactivity from particulates attributable to the decommissioning of OCNGS (References 8-36 through 8-39).

8.8.5.1 Conclusion

The GEIS concluded that air quality impacts associated with decommissioning are small, the SEIS concluded that there would be no impacts on air quality associated with OCNGS decommissioning beyond those discussed in the GEIS. There are no anticipated decommissioning activities at OCNGS that were not addressed in the GEIS, SEIS, Revised PSDAR, and this supplement.

Therefore, HDI concludes the potential impacts of OCNGS decommissioning to air quality are small and are bounded by previously issued environmental impact statements.

8.8.6 Aquatic Ecology

Aquatic ecology at OCNGS encompasses the plants and animals in the Intake and Discharge Canals, the South Branch of the Forked River, and Barnegat Bay. Aquatic ecology also includes the interaction of those organisms with each other and the environment.

The potential for impacts from the modification, abandonment in place, removal of shoreline structures, and if selected for use, the potential for use of barges and dredging at OCNGS are similar to those present at the reference plants evaluated in the GEIS. Activities with the potential to affect aquatic ecology will be conducted in accordance with the requirements of the activity-specific permits required for these activities. These anticipated and potential activities were evaluated in the Revised PSDAR and determined to be bounded by the GEIS.

8.8.6.1 Conclusion

The GEIS concludes that for decommissioning activities that do not disturb lands beyond operational areas, the effects on aquatic ecology are not detectable or destabilizing, and that effects on aquatic ecology related to use of a barge loading area and dredging for barge navigation are small. The SEIS found that there would be no impacts on ecological resources associated with decommissioning beyond those discussed in the GEIS.

There are no anticipated decommissioning activities associated with potential impacts aquatic ecology that are not addressed in the GEIS.

Therefore, HDI concludes that the potential for environmental impacts to aquatic ecology is small and bounded by previously issued environmental impact statements.

8.8.7 Terrestrial Ecology

Terrestrial ecology considers the plants and animals near OCNGS, as well as the interaction of those organisms with each other and the environment. Evaluations of impacts to terrestrial ecology are usually directed at important habitats and species, including plant and animals that are important to industry, recreational activities, the area ecosystems, and those protected by endangered species regulations and legislation.

It is not anticipated that habitat will be affected beyond the previously disturbed areas used for plant construction and operation of OCNGS, and appropriate BMPs will be used to control indirect disturbances.

8.8.7.1 Conclusion

The GEIS concludes that if BMPs are used to control indirect disturbances and habitat disturbances are limited to operational areas, the potential impacts to terrestrial ecology are small. The SEIS found that there would be no impacts on ecological resources associated with decommissioning beyond those discussed in the GEIS.

There are no anticipated decommissioning activities associated with potential impacts to terrestrial ecology that were not addressed in the GEIS.

Therefore, HDI concludes that the potential for environmental impacts to terrestrial ecology is small and bounded by previously issued environmental impact statements.

8.8.8 Threatened and Endangered Species

The GEIS does not make a generic determination on the impact of decommissioning to threatened and endangered species.

State and federally listed threatened and endangered species potentially occurring in the vicinity of OCNGS were previously identified in the Updated ER and the Revised PSDAR.

Federally listed threatened and endangered species (excluding marine species) potentially present in the OCNGS area have been updated using information available in the United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) database (Reference 8-40). No critical habitat is identified as present in the OCNGS area in the IPaC database.

Federally listed marine threatened and endangered species potentially present in the OCNGS area were identified through review of the National Oceanic and Atmospheric Administration (NOAA) Endangered Species Act (ESA) Section 7 Mapper database for the Greater Atlantic Region (Reference 8-41).

The federally listed species potentially present in the OCNGS area are listed below.

Table 8-1 Federal Listed Threatened and Endangered Species Potentially Present at OCNGS

Scientific Name	Common Name	Status
Fish		
Acipenser oxyrinchus oxyrincus	Atlantic Sturgeon	Endangered
Acipenser brevirostrum	Shortnose Sturgeon	Endangered
Reptiles		
Caretta caretta	Loggerhead Sea Turtle	Threatened
Chelonia mydas	Green Sea Turtle	Threatened
Clemmys muhlenbergii	Bog turtle	Threatened
Dermochelys coriacea	Atlantic Leatherback	Endangered
Eretmochelys imbricata	Atlantic Hawksbill	Not Present
Lepidochelys kempii	Kemp's Ridley	Endangered
Birds		
Calidris canutus	Red Knot	Threatened
Charadrius melodus	Piping Plover	Threatened
Laterallus jamaicecensis	Eastern Black Rail	Threatened
Sterna dougallii	Roseate Tern	Endangered
Mammals		
Myotis septentrionalis	Northern Long-Eared Bat	Endangered
Perimyotis subflavis	TriColored Bat	Proposed Endangered
Insects		
Danous plexippus	Monarch Butterfly	Threatened
Flowering Plants		
Schwalbea americana	American Chaffseed	Endangered
Rynchspora knieskernii	Knieskern's Beaked-rush	Threatened
Amaranthus pumilus	Seabeach Amaranth	Threatened
Aeschynome virginica	Sensitive Joint-Vetch	Threatened
Helonias bullata	Swamp Pink	Threatened

8.8.8.1 Terrestrial Listed Species

The federally listed terrestrial protected species identified as potentially present near the site is similar to that evaluated in the SEIS, the Updated ER, and the Revised PSDAR. Federally protected plant species addressed in prior environmental evaluations include the threatened Seabeach Amaranth, Swamp Pink, Knieskern's Beak-rush, and the endangered American Chaffseed. The threatened Northern Long-Eared Bat was identified as the only mammal potentially present near OCNGS. Federally listed birds included the threatened Red Knot and Piping Plover, the endangered Roseate Tern, and the no longer federally listed Bald Eagle. Invertebrates consisted of the threatened Northeastern Beach Tiger Beetle and the endangered American Burying Beetle. The SEIS reported that none of the protected species were known to occur in the OCNGS affected area.

Federally protected terrestrial species potentially present near OCNGS not previously evaluated include the proposed endangered Tri-Colored Bat, the threatened Bog Turtle, and the threatened Monarch Butterfly. The threatened Sensitive Joint-Vetch (a flowering plant) also was identified as potentially present in the area. The Northern Long-Eared Bat federal status was changed from threatened to endangered in November 2022.

8.8.8.2 TriColored Bat

The TriColored Bat (*Perimyotis subflavis*) was listed as proposed endangered in 2023. The primary stressor supporting the listing is white-nose syndrome, a fungal disease causing high mortality in affected TriColored Bat populations within the species range. The TriColored Bat is one of the smallest bats native to North America. During the spring, summer, and fall (non-hibernating seasons), TriColored Bats primarily roost among leaf clusters of live or recently dead deciduous hardwood trees. In the southern and northern portions of the range, TriColored Bats will also roost in Spanish moss (*Tillandsia usneoides*) and *Usnea trichodea* lichen, respectively. In addition, TriColored Bats have been observed roosting during summer among pine needles, eastern red cedar (*Juniperus virginiana*), within artificial roosts like barns, beneath porch roofs, bridges, concrete bunkers, and, rarely, within caves. Female TriColored Bats exhibit high site fidelity, returning year after year to the same summer roosting locations. Female TriColored Bats form maternity colonies and switch roost trees regularly. Males roost singly. During the winter, TriColored Bats hibernate in caves and mines; although, in the southern United States, where caves are sparse, TriColored Bats often hibernate in road culverts and sometimes in tree cavities and abandoned water wells. TriColored Bats exhibit high site fidelity, with many individuals returning year after year to the same hibernaculum. The current known range of the TriColored Bat includes the OCNGS area (Reference 8-42)**.**

Suitable roosting and maternity habitat for the TriColored Bat is potentially present near OCNGS; however, no occurrences of the species have been documented at the site. A sonic bat survey recently conducted on the adjacent Finninger Farm property detected no evidence of the presence of myotis species bats (Reference 8-43).

8.8.8.3 Northern Long-Eared Bat

The Northern Long-Eared Bat (*Myotis septentrionalis*) was listed as endangered under the ESA in 2015 and reclassified as endangered in 2023. The classification was changed in response to increase stress on the species caused by white-nose syndrome, a fungal disease causing high

mortality across the species range. This species of bat is medium-sized, about 3 to 3.7 inches in length and a 9 to 10 inch wingspan. Northern Long-Eared Bats spend winter hibernating in caves and mines, called hibernacula. During the summer and portions of the fall and spring, Northern Long-Eared Bats may be found roosting singly or in colonies underneath bark, in cavities or in crevices of live trees and snags, or dead trees. Males and non-reproductive females may also roost in cooler places, such as caves and mines. The species has also been found, although less commonly, roosting in structures, such as barns and sheds. Northern Long-Eared Bats use forested areas for roosting, foraging, and commuting between summer and winter habitat. The Northern Long-Eared Bat feeds on insects (moths, flies, leafhoppers, caddisflies, and beetles, catching them in flight or from vegetation. The current known range of the Northern Long-Eared Bat includes the OCNGS area (Reference 8-44).

Suitable roosting and maternity habitat for the Northern Long-Eared Bat is potentially present near OCNGS; however, no occurrences of the Northern Long-Eared Bat have been documented at the site. A sonic bat survey conducted in 2022 on the adjacent Finninger Farm property detected no evidence of the presence of myotis species bats.

8.8.8.4 Bog Turtle

The Bog Turtle (G*lyptemys muhlenburgii*) was listed as threatened in 1997. The Bog Turtle is long-lived and the smallest species of turtle in North America growing to a length of up to 4.5 inches. The turtles are dark brown with an orange-yellow blotch behind the tympanium (ears) and flecks of range or yellow on the head, neck, and limbs. Bog Turtles are semi-aquatic and occupy shallow, sparsely shaded wetlands, spending time in the water and on top of hummocks within the wetlands. They nest in elevated areas in late spring to early summer with hatching occurring in late August to September and generally hibernate under the roots of trees, shrubs, rock walls, or burrows from September to April. The Bog Turtle is omnivorous consuming invertebrates (slugs, worms, insects), carrion, seeds, berries, and plant leaves (Reference 8-45).

Suitable habitat for the Bog Turtle may be present in the OCNGS area; however, Bog Turtles have not been identified as present at or near OCNGS.

8.8.8.5 Monarch Butterfly

The Monarch Butterfly (*Danous plexippus)* is a candidate species under the ESA. Adult monarch butterflies are large and conspicuous, with bright orange wings surrounded by a black border and covered with black veins. The black border has a double row of white spots, present on the upper side of the wings. Adult monarchs feed on the nectar of many flowers during breeding and migration, but they can only lay eggs on milkweed plants. For overwintering monarchs, habitat with a specific microclimate is needed for protection from the elements, as well as moderate temperatures to avoid freezing. Monarch butterflies require healthy and abundant milkweed plants for laying eggs on and as a food source for larvae or caterpillars. By consuming milkweed plants, monarchs obtain toxins, called cardenolides, that provide a defense against predators. Additionally, flower nectar is needed for adults throughout the breeding season, migration, and overwintering. Monarchs are native to North and South America but have since spread to many other locations where milkweed and suitable temperatures exist (Reference 8-46).

According to the USFWS, the current known range of the Monarch Butterfly extends across the contiguous United States and overlaps with the 6-mile vicinity of the OCNGS site. Suitable habitat for the Monarch Butterfly is potentially present in undeveloped portions of the OCNGS site that are not maintained by mowing.

8.8.8.6 Sensitive Joint-Vetch

The Sensitive Joint-Vetch (*Aeschynomene virginica)* was listed as threatened in 1992 and is an annual legume that typically grows to a height of three to six feet and in some cases up to 8 feet. Habitat occurs in freshwater or slightly brackish tidal marshes along river system segments near the coast subject to twice-daily tidal flooding. The plant has yellow flowers streaked with red and produces pods that turn brown when ripe.

The Sensitive Joint-Vetch has been identified as present in isolated locations within New Jersey but has not been identified as present at or near OCNGS (Reference 8-47).

8.8.8.7 Aquatic/Marine Listed Species

No protected fish species were found in pre-operational surveys of freshwater reaches of Oyster Creek and the South Branch of the Forked River or in Barnegat Bay. Atlantic sturgeon and Shortnose sturgeon are found in the Delaware River in New Jersey, but none of the resource agencies contacted by the NRC in 2006 when OCNGS was seeking to renew its operating license evidenced concern about these species. Neither has been collected by biologists conducting ecological studies at OCNGS.

In a Biological Opinion issued in November 2006, the National Marine Fisheries Service (NMFS) concluded that operation of OCNGS over the license renewal term was "likely to adversely affect but not likely to jeopardize" the continued existence of loggerhead, Kemp's ridley, or green sea turtles. On November 21, 2011, NMFS issued a revised Biological Opinion and again concluded that continued operation of OCNGS over the renewal term (2009-2029) "may adversely affect but is not likely to jeopardize the continued existence of endangered Kemp's ridley, green, or threatened loggerhead sea turtles."

Reinitiation of consultation for the ESA Section 7 Biological Opinion with the NMFS was requested by Exelon on October 16, 2018 (Reference 8-48) to consider amending the 2011 Biological Opinion to be more relevant to a permanently shut down plant and the corresponding reduced effects on listed species. On May 29, 2020, NRC issued a new Biological Opinion (Reference 8-49) concluding that the potential for impacts on threatened and endangered sea turtles were unlikely during decommissioning under the low-flow velocity and thermal discharge conditions associated with the shutdown plant. The NRC also considered the potential impacts of barging as a transportation method for large components and other materials and dredging for navigation (if needed) to support the barging.

The NMFS' Biological Opinion concluded that the proposed action (meaning the decommissioning actions considered) may adversely affect but is not likely to jeopardize the continued existence of the threatened and endangered sea turtles. The opinion also recognized that no critical habitat is designated in the action area and will therefore not be affected by the proposed action. No take of threatened and endangered sea turtles was expected by the NMFS and no Incidental Take Statement was included in the new Biological Opinion.

The state listed threatened, endangered, and special concern species potentially present in the vicinity of OCNGS, listed in Table 8-2, were obtained from the NJDEP Natural Heritage Program in November 2023 (Reference 8-50).

Table 8-2 State Listed Species Potentially Present in OCNGS Vicinity

Scientific Name	Common Name	State Status[a]
Vascular plant		
Eupatorium resinosum	Pine Barren Boneset	E
Juncus caesariensis	New Jersey Rush	E
Invertebrates		
Hespera attalus slossonae	Dotted Skipper	SC
Neonympha helicta	Georgia Satyr	SC
Amphibians		
Hyla andersonii	Pine Barrens Treefrog	T
Reptiles		
Caretta caretta	Atlantic Loggerhead	E
Chelinia mydis	Atlantic Green Turtle	T
Clemmy's guttata	Spotted Turtle	T
Lepidochelys kempii	Kemp's or Atlantic Ridley	E
Pituophis m. melanoleucus	Northern Pine Snake	T
Terrapin Carolina carolina	Eastern Box Turtle	SC
Birds		
Accipiter cooperi	Copper's Hawk	SC
Ammodramus savannarum	Grasshopper Sparrow	SC
Egretta caerulea	Little Blue Heron	SC
Egretta thula	Snowy Egret	SC
Egretta tricolor	Tricolored Heron	SC
Haliaeetus leucocephalus	Bald Eagle	E
Nycticorax nycticorax BR	Black-crowned Night-heron	SC
Plegadis falcinellus	Glossy Ibis	SC
Rynchops niger	Black Skimmer	E
Sterna hirundo	Common Tern	SC
Strix varia	Barred Owl	T

[a] T = state threatened: E = state endangered: SC = state species of special concern

The number of state-listed species previously identified as potentially present in the OCNGS area is reduced from those identified in previous evaluations. The updated list includes species previously identified and evaluated, and several not previously identified as potentially present in the site area.

The GEIS lists stabilization, large component removal, decontamination and dismantlement (removal of contaminated soil), and structure dismantlement as activities with potential to impact threatened and endangered species. Decommissioning activities at OCNGS with greatest potential for directly and indirectly affecting sensitive terrestrial species are those scheduled for late phases, when large plant components may be moved to the barge landing, and major reactor and support structures will be razed.

There is sufficient space within the operational area for all decommissioning activities (save movement of large plant components to the barge landing if conducted) and temporary storage of

materials and equipment. Because there is ample open space in the operational area to support OCNGS decommissioning operations, no undeveloped land outside of the site operational area that provides high-quality habitat has or will be disturbed, unless movement of large components to the barge landing would have such an effect.

Moving large plant components from the power block area to the barge landing will likely involve heavy equipment and could produce some minor soil disturbance. These activities will be of short duration and take place in previously disturbed areas on HDI-owned land that has very little value as wildlife habitat. No protected terrestrial species will be affected by this activity.

8.8.8.8 Conclusion

Based on the site-specific information presented above, there are no anticipated decommissioning activities likely to result in significant adverse effects to protected species and no additional mitigation is warranted.

Therefore, HDI concludes that the potential for environmental impacts to threatened and endangered species and critical habitat is small. If changes in planned decommissioning activities, or to protected species or critical habitat designations occur that affect this conclusion, HDI will update its evaluation and conclusions in accordance with applicable laws and regulations and consider mitigation as required.

8.8.9 Occupational Safety

Occupational issues are related to human health and safety. Section 4.3.10 of the GEIS evaluated physical, chemical, ergonomic, and biological hazards and concluded that impacts due to occupational issues would be small for all plants based on strict adherence to NRC and Occupational Safety and Health Administration (OSHA) standards, practices, and procedures. There are no anticipated decommissioning activities at OCNGS that would alter the conclusion in the GEIS.

8.8.9.1 Conclusion

HDI concludes that the potential for adverse impacts associated with occupational safety are bounded by the GEIS.

8.8.10 Cost

A detailed discussion of site project costs is presented in Chapter 7.

8.8.11 Socioeconomics

As anticipated in the GEIS and Revised PSDAR, an overall decrease in the plant work force and tax payments to local municipalities have occurred, primarily impacting Ocean County and Lacey Township.

A workforce of up to 700 employees supported the operation of OCNGS. As the plant transitioned to decommissioning, an overall decrease in plant workforce and tax payments has occurred. The changes during decommissioning primarily impact Ocean County where the majority of the operating plant workforce lived and Lacey Township which received the preponderance of OCNGS property tax payments. OCNGS is not a significant source of tax

revenue for state and local government. Plant property tax payments during operation were a small percentage of Lacey Township revenue and remain so during decommissioning.

Workforce reductions due to transition to decommissioning have reduced the positive economic impact that the highly skilled and well-paid operating plant workforce had on the local economy.

The reduction in workforce is expected to result in less overall commuting hours on local and regional transportation routes.

As noted in the GEIS, for plants being decommissioned using the DECON method with decommissioning beginning shortly after shutdown, socioeconomic impacts of plant closure are mitigated with less immediate impacts than would occur with the SAFSTOR and Entombment methods.

8.8.11.1 Conclusion

The GEIS concluded that the socioeconomic impacts of decommissioning are neither detectable nor destabilizing, and that mitigation measures are not warranted. There are no potential impacts to socioeconomic conditions anticipated for decommissioning of OCNGS that were not considered in the GEIS.

Therefore, HDI concludes that the potential for socioeconomic impacts is bounded by the GEIS.

8.8.12 Environmental Justice

The GEIS determined environmental justice to be an environmental impact area for which no generic conclusion could be determined due to its site-specific nature. A detailed site-specific evaluation of potential impacts to environmental justice populations associated with OCNGS decommissioning was presented in the Updated ER and considered in the Revised PSDAR and HDI's responses to the NRC's Request for Additional Information (Reference 8-51) regarding the Revised PSDAR.

The Updated ER concluded that because the potential impacts to all resource areas associated with decommissioning of OCNGS are predicted to be small, there can be no disproportionately high and adverse impact or effects on members of the public, including minority and low-income populations, resulting from the decommissioning of OCNGS.

An independent analysis of the information presented in the Updated ER was provided in the HDI RAI Response and similarly concluded that because decommissioning impacts to all resource areas, including potential transportation impacts associated with the delivery and use of dismantlement equipment and the removal and disposal of waste material, would be small. The anticipated effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. Because no member of the public will be substantially affected, there can be no disproportionately high and adverse impact or effects on minority and low-income populations resulting from the decommissioning of OCNGS. Based on these site-specific findings, HDI concluded that the impacts of decommissioning OCNGS on minority and low-income populations are small.

An updated analysis of environmental justice populations in the OCNGS area is provided below.

The NRC performs environmental justice analyses utilizing a 50-mile radius around the plant as the environmental area of potential impact. The US NRC Office Instruction Number LIC-203,

Revision 4 (Reference 8-52) defines the 50-mile radius as the geographic area for comparative analysis. HDI has adopted this approach for identifying the minority and low-income populations that could be affected by the decommissioning of OCNGS. ArcGIS geographic information system software was used to combine USCB TIGER line data (Reference 8-53) with USCB 2020 American Community Survey census data or USCB Decennial data to determine minority and low-income characteristics on a block-group level. Census block groups were included if any of their area lay within 50 miles of Oyster Creek. The 50-mile region includes 3,313 block groups and includes portions of New Jersey, New York, and Pennsylvania (Reference 8-54).

8.8.12.1 Minority Populations

The NRC procedural guidance for performing environmental assessments and considering environmental issues defines a "minority" population as American Indian or Alaskan Native; Asian; Native Hawaiian/other Pacific Islander; Black or African American; some other race; two or more races; the aggregate of all minority races; aggregate of all minority races and Hispanic ethnicity; or Hispanic ethnicity. The guidance indicates that a minority population exists if either of the two following conditions exists:

- Exceeds 50 Percent - the minority population in the census block group exceeds 50 percent, or
- More than 20 Percentage Points Greater - the minority population percentage is significantly greater (typically at least 20 percentage points) in the census block group than the minority population percentage in the geographic area chosen for comparative analysis.

NRC guidance calls for use of the most recent USCB decennial census data. HDI used 2020 census count data to determine the percentage of the total populations in the three states that belong to each minority group, and to identify minority populations within 50-miles of Oyster Creek.

For each minority group, USCB minority population numbers for each block group were divided by the total population within that block group to obtain the percent of the block group's population that belonged to the minority group. For each of the 3,313 block groups within 50 miles of Oyster Creek, the percent of the population in each minority category was calculated and compared to the corresponding geographic area's minority threshold percentages to determine the presence of a minority population.

Using the 50-mile region as the geographic area for comparison, block group data in the region was summed for each minority category. The summed data was then divided by the total population in the region to develop the percentage of each minority group. This set of percentages were then used to produce the demographic characteristics of the 50-mile region described below (References 8-53 and 8-54):

- American Indian or Alaskan Native – 0.41 percent
- Asian – 8.54 percent
- Native Hawaiian/other Pacific Islander – 0.04 percent
- Black or African American – 12.01 percent
- Some other race – 8.17 percent

- Two or more races – 8.06 percent
- Aggregate of all minority races – 37.2 percent
- Aggregate of all minority races and Hispanic ethnicity – 39.77 percent
- Hispanic ethnicity – 15.83 percent

The analysis indicated that several block groups were identified as containing minority populations. This is summarized in Table 8-3 and Figure 8-1 through Figure 8-7. The nearest minority population is located approximately 6 miles east of the site. The block group contains a Two or More Races population of approximately 83.33 percent, an aggregate of all minority races population of approximately 100 percent and an aggregate of all minority races and Hispanic ethnicity population of approximately 100 percent. The analysis also indicates that none of the block groups in the region met the Native Hawaiian or Other Pacific Islander category or Two or More Race category criteria. As such, no figures were provided for the Native Hawaiian or Other Pacific Islander category or Two or More Race populations.

Table 8-3 Minority Population Information

County	State	2020 Block Groups	American Indian or Alaskan Native	Asian	Native Hawaiian / Other Pacific Islander	Black or African American	Some Other Race	Two or More Races	Aggregate of all Minority Races	Aggregate of all Minority Races and Hispanic Ethnicity	Hispanic Ethnicity
Bucks	PA	226	0	5	0	3	1	3	15	23	3
Montgomery	PA	11	0	1	0	0	0	0	0	0	0
Philadelphia	PA	362	0	13	0	79	35	3	193	204	59
Queens	NY	1	0	0	0	0	0	0	0	0	0
Richmond	NY	52	0	0	0	0	0	0	0	0	0
Atlantic	NJ	194	0	8	0	33	13	0	67	74	24
Burlington	NJ	311	0	5	0	46	0	1	62	73	1
Camden	NJ	379	0	3	0	85	42	1	137	147	70
Cape May	NJ	30	0	0	0	0	0	0	0	0	0
Cumberland	NJ	37	0	0	0	0	6	1	18	23	20
Gloucester	NJ	132	0	0	0	3	0	0	6	10	0
Mercer	NJ	271	0	32	0	61	45	4	136	143	54
Middlesex	NJ	381	0	105	0	8	66	2	202	211	77
Monmouth	NJ	474	0	7	0	25	20	0	62	64	31
Ocean	NJ	406	0	0	0	0	2	2	10	11	7
Salem	NJ	3	0	0	0	0	0	0	0	0	0
Somerset	NJ	43	0	17	0	10	4	0	28	30	6
Total		**3313**	**0**	**196**	**0**	**353**	**234**	**17**	**936**	**1013**	**352**

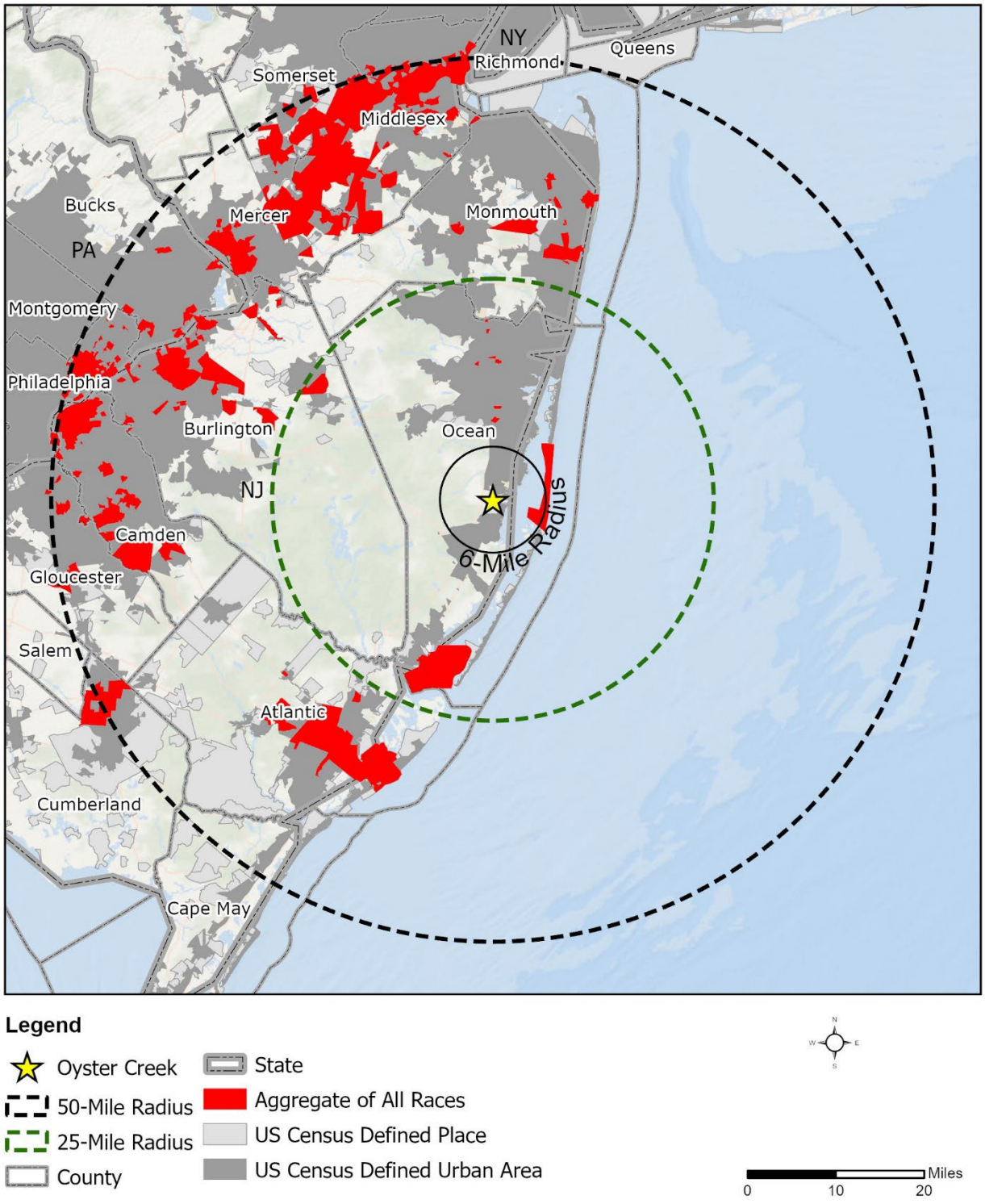


Figure 8-1 Aggregate of All Races Populations

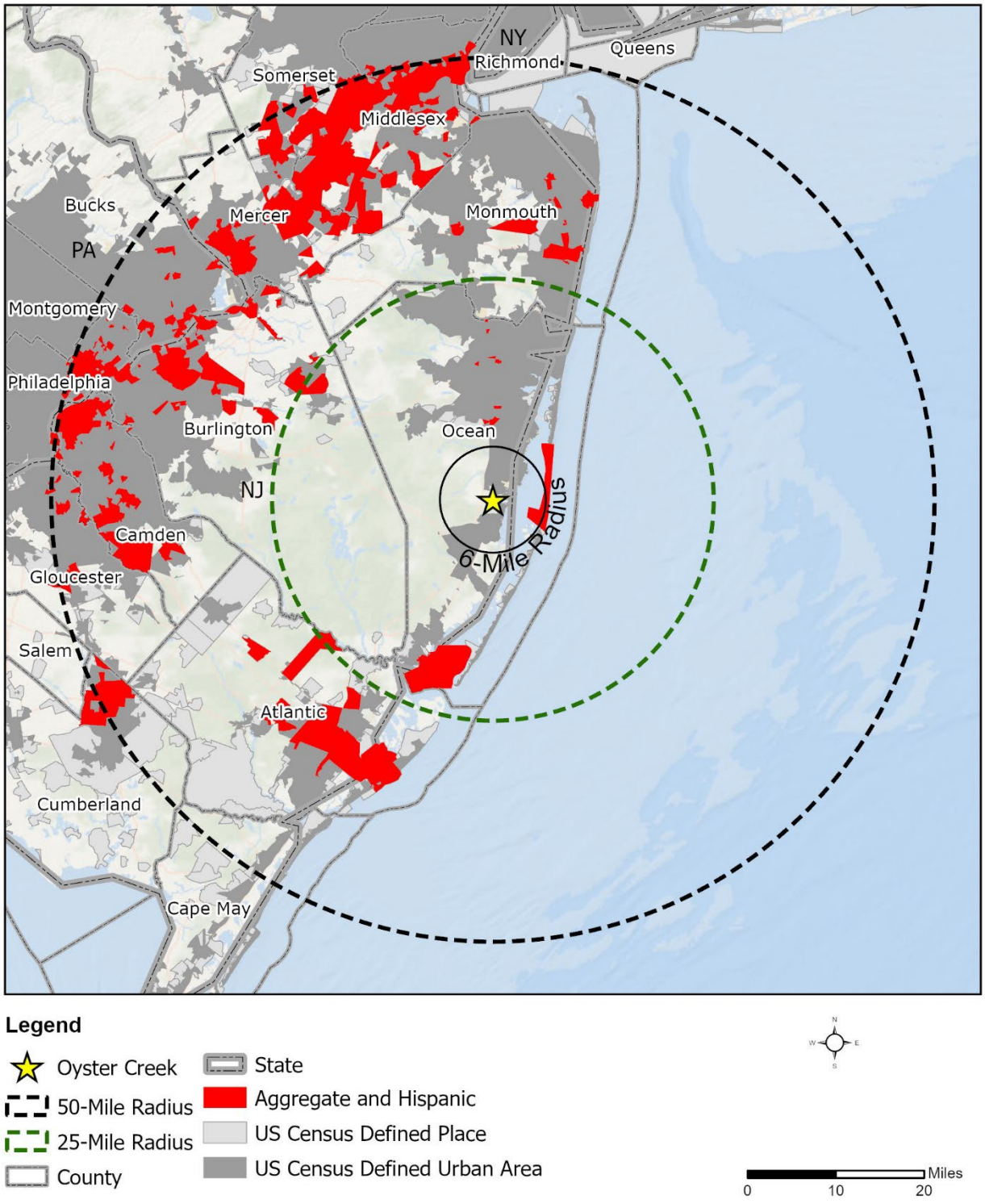


Figure 8-2 Aggregate and Hispanic Populations

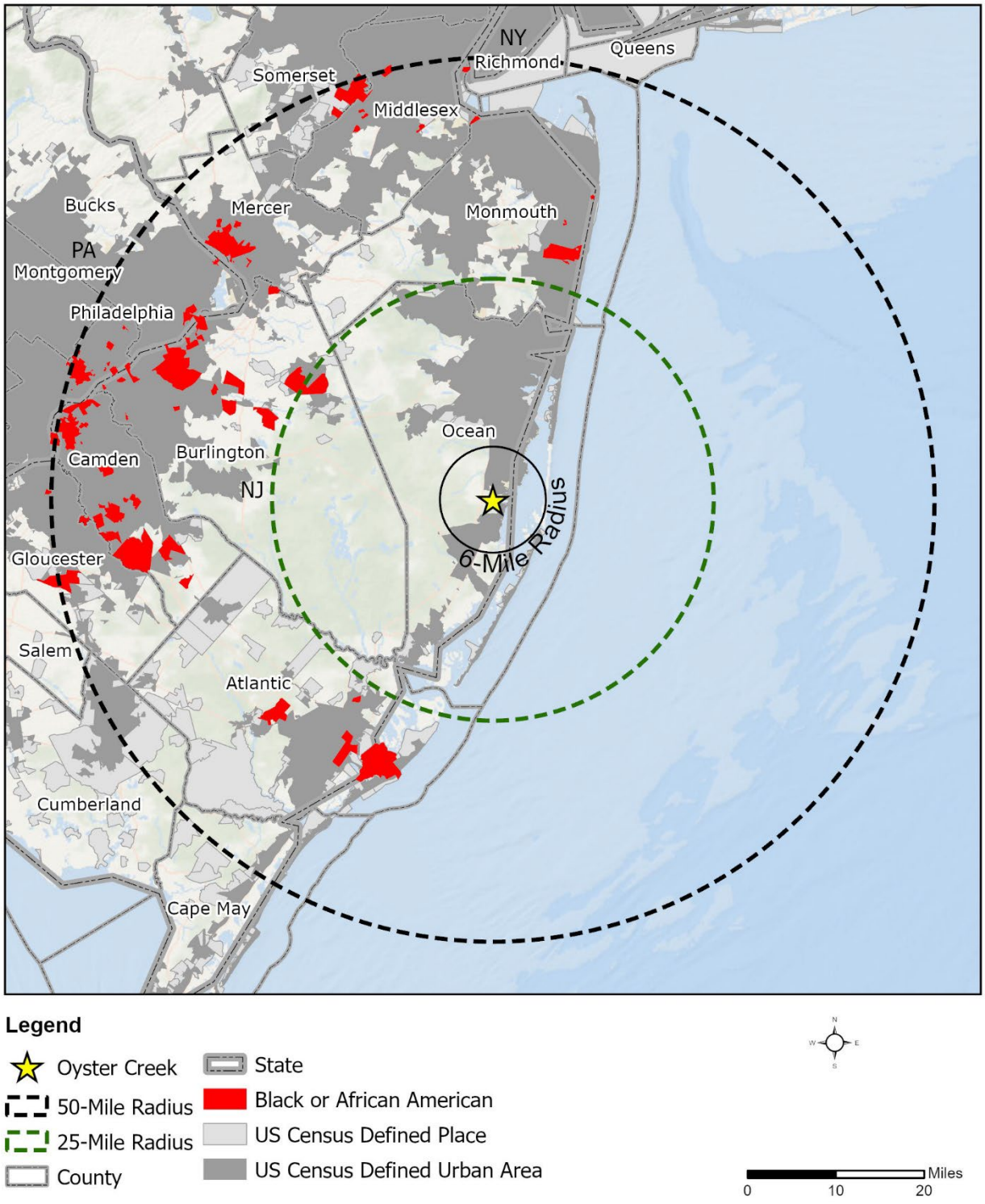


Figure 8-3 Black or African American Populations

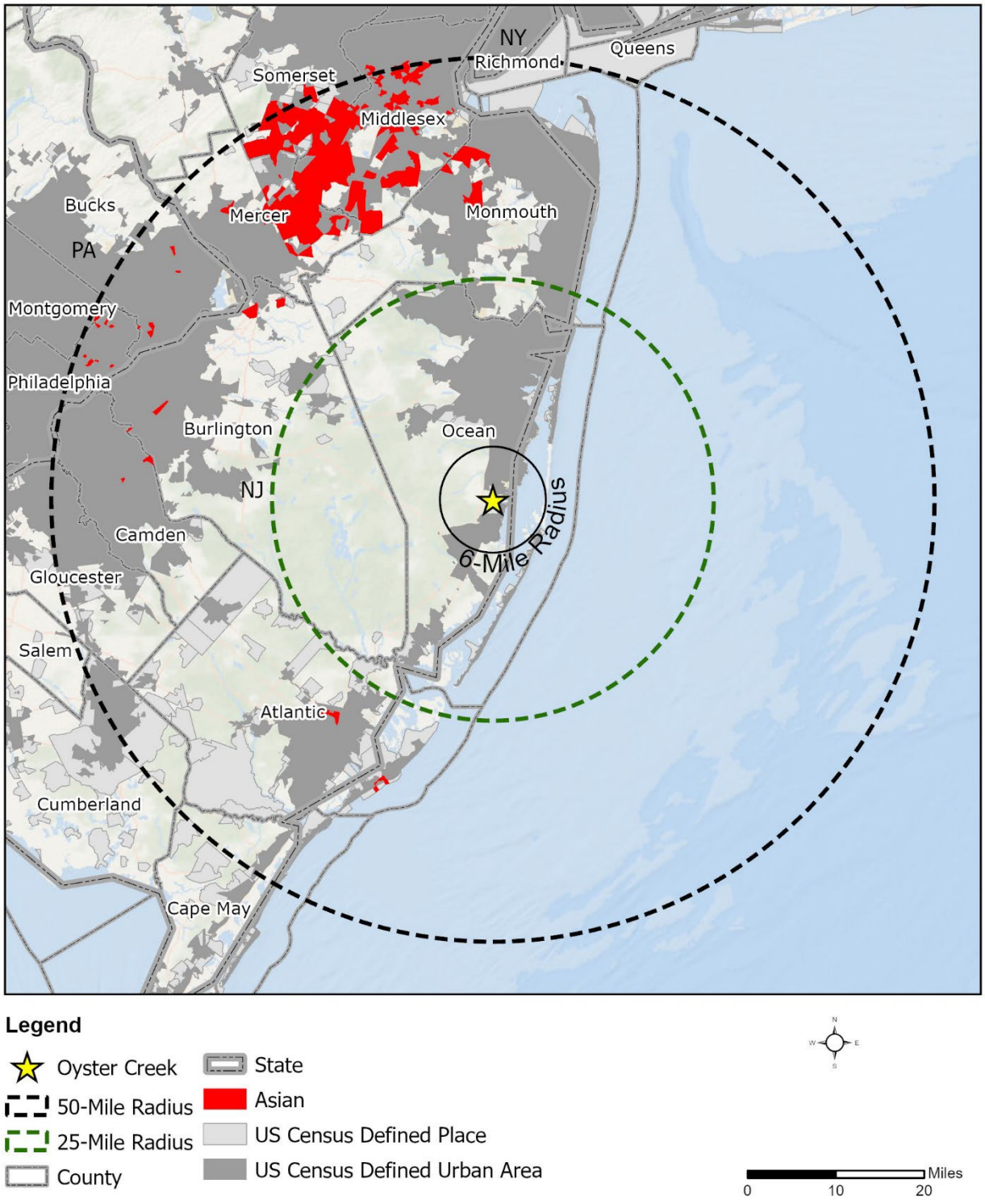


Figure 8-4 Asian Populations

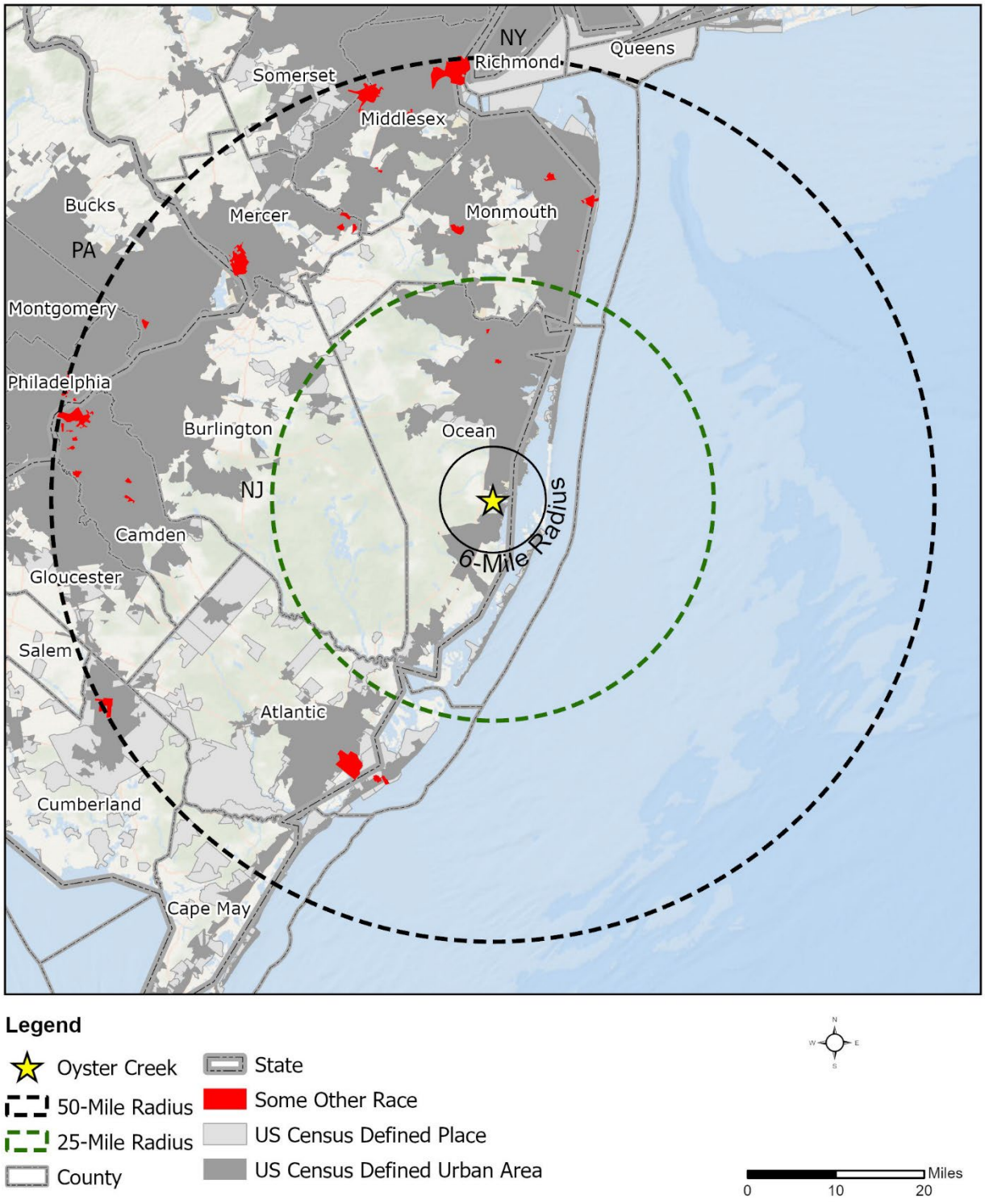


Figure 8-5 Some Other Race Populations

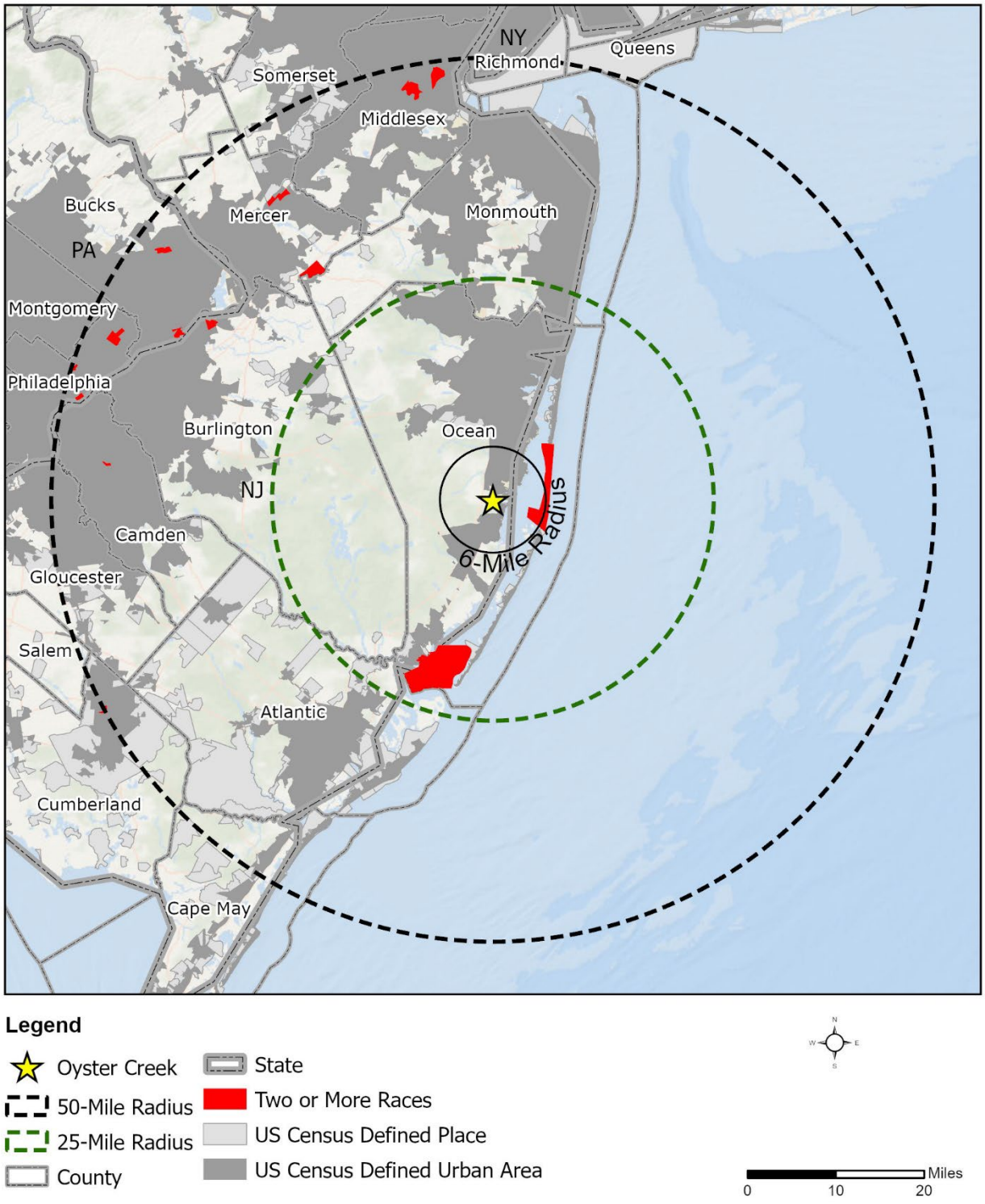


Figure 8-6 Two or More Races Populations

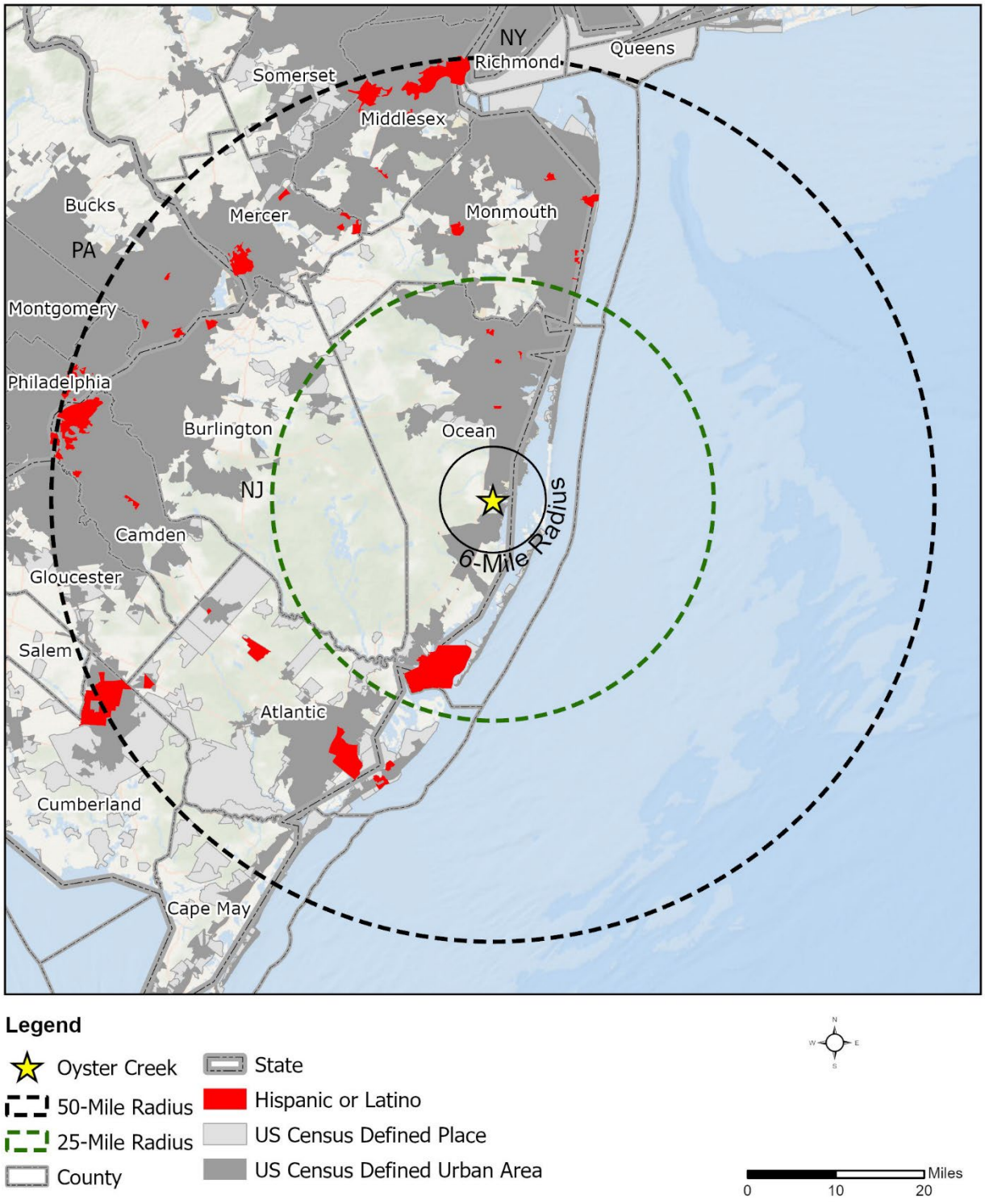


Figure 8-7 Hispanic or Latino Ethnicity Populations

8.8.12.2 Low Income Populations

NRC guidance defines "low-income" by using USCB statistical poverty thresholds (NRC 2013). The analysis indicates that approximately 10.26 percent of the regional households and approximately 10.4 percent of regional individuals meet or exceed the low-income criteria (References 8-53 and 8-55). To calculate those percentages, the number of low-income households and individuals was divided by the total number of households or persons in each block group to obtain the percentage for that block group. A low-income population is considered to be present if either of the two following conditions exists:

- Exceeds 50% – the low-income households or individuals within census block group exceeds 50%, or
- More than 20 Percentage Points Greater – the percentage of households or individuals below the poverty level in a census block group is significantly greater (typically at least 20 points) than the low-income household population or population percentage in the geographic area chosen for comparative analysis.

To establish minimum thresholds for the individual low-income category, the population with an income below the poverty level for the region was divided by the total population for whom poverty status is determined in the region. To establish minimum thresholds for the household low-income category, the household population count with an income below the poverty level for the region was divided by the total household population count in the region.

The analysis indicated that several block groups were identified as containing low-income populations. This is summarized in Table 8-4, Figure 8-8, and Figure 8-9. The nearest low-income population is located approximately 3.0 miles south of the site. The block group contains a low-income individual population of approximately 31.55 percent. The block group does not contain a low-income household population as defined by the criteria. This implies that the low-income population is concentrated into fewer households than the rest of the population in that block group.

Table 8-4 Low-Income Population Information

County	State	2020	Low Income Individuals	Low Income Household
		Block Groups		
Bucks	PA	226	3	2
Montgomery	PA	11	0	0
Philadelphia	PA	362	83	72
Queens	NY	1	0	0
Richmond	NY	52	1	2
Atlantic	NJ	194	29	25
Burlington	NJ	311	6	3
Camden	NJ	379	44	39
Cape May	NJ	30	1	0
Cumberland	NJ	37	3	2
Gloucester	NJ	132	6	5

County	State	2020 Block Groups	Low Income Individuals	Low Income Household
Mercer	NJ	271	31	31
Middlesex	NJ	381	39	37
Monmouth	NJ	474	18	19
Ocean	NJ	406	24	25
Salem	NJ	3	0	0
Somerset	NJ	43	1	0
Total		**3313**	**289**	**262**

The number of block groups meeting the definition of minority and low-income populations within a 50-mile radius of OCNGS has increased when compared to the results presented in the Updated ER; however, the distribution and distance of the block groups from OCNGS are similar to those evaluated in the Updated ER and HDI RAI Response).

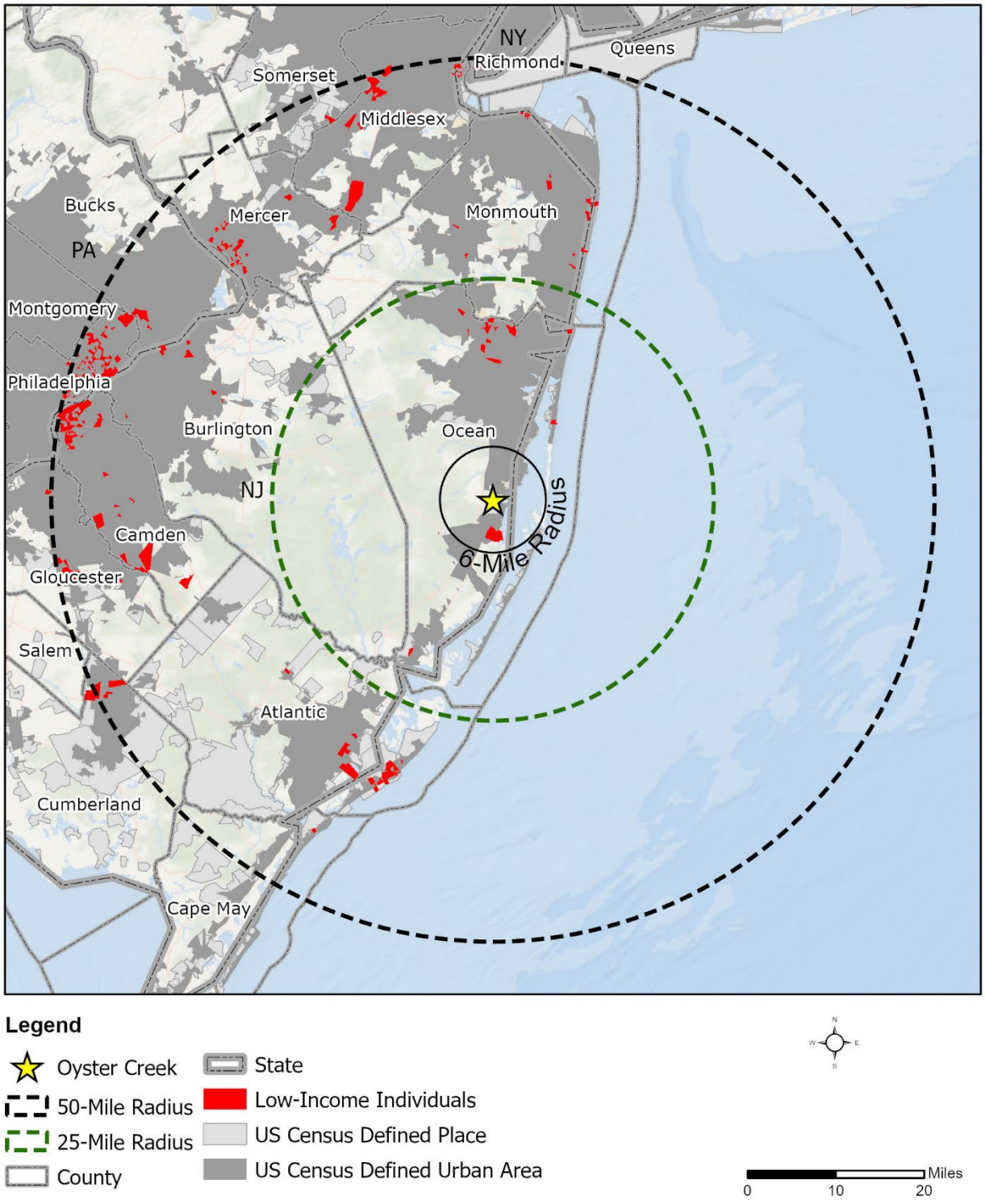


Figure 8-8 Low-Income Individuals

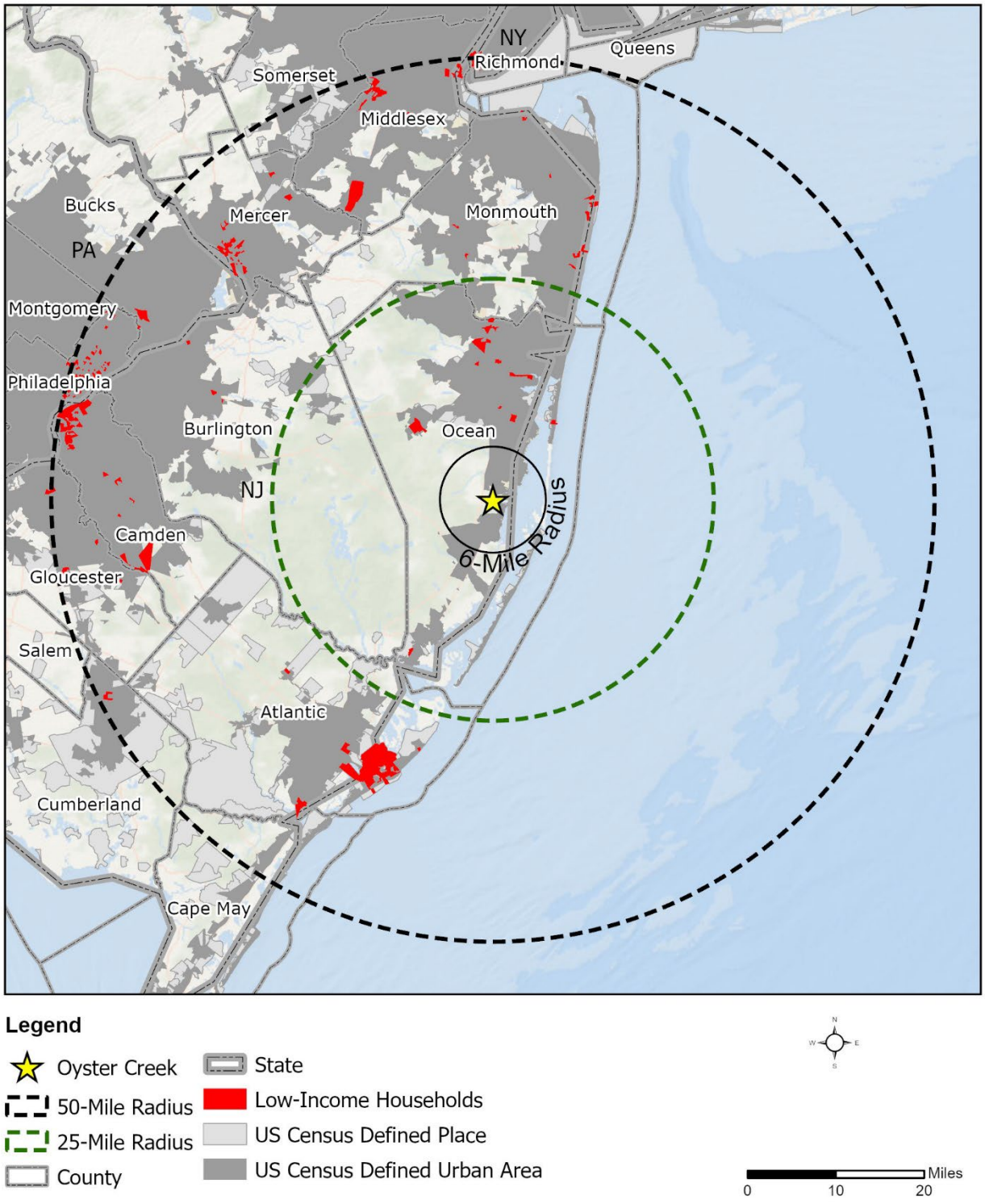


Figure 8-9 Low-Income Households

8.8.12.3 Conclusion

Based on the updated findings, the conclusions reached in the HDI RAI Response that because decommissioning impacts to all resource areas, including potential transportation impacts associated with the delivery and use of dismantlement equipment and the removal and disposal of waste material, would be small. The anticipated effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource, remain valid. Because no member of the public will be substantially affected, there can be no disproportionately high and adverse impact or effects on minority and low-income populations resulting from the decommissioning of OCNGS.

Based on the site-specific analysis presented above, there are no anticipated decommissioning activities associated with license termination that would alter the conclusions reached in the HDI RAI Response that the potential for impacts to low income and minority populations is small.

Therefore, HDI concludes that the potential for impacts to environmental justice impacts is small.

8.8.13 Cultural, Historical, and Archaeological Resources

The GEIS determined that potential effects of decommissioning on cultural, historical, and archeological resources would be small for all plants when the decommissioning activities are confined to the operational area; however, impacts outside the operational area "must be determined through site-specific analysis."

No historic properties, including prehistoric and historic archaeological sites, above-ground historic structures or traditional cultural properties listed on the National Register of Historic Places (NRHP) are found within the OCNGS operational area. The FES indicated that the agency sought comment on archaeological and historical resources from the State of New Jersey. No record of cultural, historical, or archaeological resources that might be affected by the plant's operation were identified. The 2005 Renewal ER for OCNGS reports that no archaeological sites or historic properties would be affected by the continued operation of OCNGS and that the New Jersey Historic Preservation Office (NJHPO) concluded that continued operation of OCNGS would not "adversely affect cultural or historic resources at the plant or its immediate environs," because no expansion or structural modifications were planned, and maintenance activities would be limited to previously disturbed areas.

The NRC conducted an independent file search and concluded in the SEIS that it did not appear license renewal would adversely affect cultural resources within the operational and previously disturbed areas of OCNGS and concluded that the impact of continued operation of OCNGS on cultural resources would be small.

A current list of sites included in the NJHPO's list of places on the New Jersey and National Registers within a 6-mile radius of OCNGS is provided in Table 8-3.

Table 8-5 Registered Historic Places Within a 6-Mile Radius of OCNGS

Historic Place
Cedar Creek Trestle (Barnegat Branch Railroad (ID#4959) – Barnegat Branch Railroad over Cedar Creek (Lacey Township)
Double Trouble State Park Historic District (ID#2276) - Keswick Road at Double Trouble Road (Lacey and Berkeley Townships)
Garden State Parkway Historic District (ID#3874) – Entire Garden State Parkway right-of-way (Barnegat, Ocean, and Lacey Townships)
Joseph Holmes Mill Site / Raceway Site (ID#2303) (Lacey Township)
103 North Main Street (ID#4556) – 103 North Main Street
117 North Main Street (ID#4557) – 117 North Main Street
126 North Main Street (ID#4558) – 103 North Main Street
North Branch of the Forked River Trestle (Barnegat Branch Railroad) (ID#4951)
Oyster Creek Trestle (Barnegat Branch Railroad) (ID#4953) – Barnegat Branch Railroad over Oyster Creek (Ocean Township)
Falkinburg Farmstead (ID#2318) – 28 Westcott Avenue (Ocean Township)
Oyster Creek Paleoindian Spot Find Archeological Site (ID#5907) (Ocean Township)
Barnegat Historic District (ID#3401) – US Route 9 (east and west) and Bay Avenue (Barnegat Township)
Mary Etta Cox House – 353 North Main Street (Barnegat Township)
Cedar Creek Trestle (Barnegat Branch Railroad over Cedar Creek) ID#4959 (Berkeley Township)
Forked River Coast Guard Station No. 112 (ID#3403) – NJ Route 35 (Island Beach State Park) (Berkeley Township)
Island Beach State Park Historic District (ID#5951) (Berkeley Township)

Three of the sites identified above are located near OCNGS. The Oyster Creek Trestle crosses Oyster Creek (also used as the discharge canal) immediately southeast of OCNGS. The trestle is now part of the Barnegat Branch Trail and will not be disturbed during decommissioning. If dredging is conducted in Oyster Creek channel for transport of large plant components and materials, it will occur downstream of the trestle and be subject to permits and certifications requiring consideration of historical sites. The Oyster Creek Paleoindian Spot Find site is located on the Finninger Farm property near but not within the area previously used to access the barge landing. The location will not be disturbed if HDI elects to use barging as a transportation method. All other identified historic sites within 6 miles of OCNGS are located at greater distances and will not be affected by any decommissioning activities.

The barge landing and access road are areas of prior ground disturbance and any improvements to the landing or access road are expected to be limited to previously disturbed areas. If dredging in Oyster Creek Inlet or portions of Barnegat Bay is necessary, dredging would be performed under a USACE permit requiring review of potential impacts to cultural resources as part of the permitting process. Dredging, if needed, is anticipated to follow the channel established during channel construction; consequently, it is unlikely that any marine archaeological resources would be disturbed by dredging.

Decommissioning activities are being conducted within the previously disturbed OCNGS operational area, except for possible use of the existing barge landing on the north bank of Oyster

Creek. Clean backfill for demolished building and structure foundations will be sourced from onsite demolition activities. If required, additional clean fill will be obtained from offsite sources meeting local and state permitting and regulatory requirements. It is anticipated that these sources will represent previously disturbed land or other areas already cleared of cultural resources.

No Historic American Buildings Survey/Historic American Engineering Record documentation of the OCNGS has been prepared to date, and although it is well known that the plant is being decommissioned, there has been no request from the New Jersey Historic Preservation Office or other agencies to do so.

OCNGS is a typical mid-twentieth century light water reactor; however, as New Jersey's first nuclear power station, it may be of some historical interest at the State or local level. Recognizing its importance to local history and former employees, a collection of memorabilia, artifacts, videos, and photos that chronicle OCNGS was compiled. The collection was donated to local historical societies (e.g., Lacey Township, Waretown, and Ocean County Historical societies) for their collections and archives. In addition, engineering drawings from the station have been retained by Exelon and Holtec records management.

8.8.13.1 Conclusion

The GEIS determined that impacts on cultural, historic, and archaeological resources from decommissioning activities within operational areas would be small. Currently, no historic properties, including prehistoric and historic archaeological sites, above-ground historic structures or traditional cultural properties listed on the NJRHP or NRHP are present within the OCNGS operational or previously disturbed areas.

There are no anticipated decommissioning activities at OCNGS that would affect the conclusions reached in the GEIS.

Therefore, HDI concludes that the potential for impacts to cultural, historical, and archaeological effects associated with decommissioning are small and bounded by GEIS and the site-specific evaluation in this supplement.

8.8.14 Aesthetic Issues

The GEIS concludes that the removal of structures is generally considered beneficial to the aesthetic impacts of the site, and that the potential aesthetic impacts of decommissioning are small.

The impact of decommissioning activities at OCNGS will be temporary and consistent with the aesthetics of an industrial plant. Upon completion of decommissioning activities in support of partial license release (except for the ISFSI and some building and facilities that will be preserved for potential reuse) the OCNGS property is proposed to consist of land restored for unrestricted use consisting of undeveloped open areas, tidal canals, and freshwater streams.

The ISFSI will be decommissioned and restored for unrestricted use after removal of the spent fuel and GTCC waste by the Department of Energy.

8.8.14.1 Conclusion

There are no anticipated decommissioning or license termination activities at OCNGS that would alter the conclusions reached in the Revised PSDAR that aesthetic impacts would be small, are likely to be beneficial, and are bounded by the GEIS.

8.8.15 Noise

The SEIS states that "…noise generated by OCNGS operations is mitigated at the nearest offsite receptor because the plant is buffered by undeveloped land along Forked River to the north of the site and Oyster Creek to the south. Between the river and creek, the plant is buffered toward the east by a small, wooded area along the length of U.S. Highway 9, thus reducing the conspicuousness of any noise generated by OCNGS operations.

General noise levels during the remainder of the decommissioning process are not expected to be any more severe than during refueling outages and are not expected to present an audible intrusion on the surrounding community. Some decommissioning activities may result in higher-than-normal onsite noise levels (i.e., some types of demolition activities). However, these noise levels would be temporary and are not expected to result in an audible intrusion on the surrounding community.

8.8.15.1 Conclusion

Section 4.3.16 of the GEIS indicates that noise impacts are not detectable or destabilizing and makes a generic conclusion that potential noise impacts are small. Based on the standard decommissioning approach proposed for OCNGS, HDI concludes that the impacts of OCNGS decommissioning on noise are bounded by the GEIS.

8.8.16 Irretrievable Resources

Irreversible commitments are commitments of resources that cannot be recovered, and irretrievable commitments of resources are those that are lost only for a period of time.

Uranium is a natural resource that is irretrievably consumed during power operation. After the plant is shutdown, uranium is no longer consumed. The use of the environment (air, water, land) is not considered to represent a significant irreversible or irretrievable resource commitment, but rather a relatively short-term investment. Since the OCNGS site will be decommissioned to meet the unrestricted release criteria found in 10 CFR §20.1402, the land is not considered an irreversible resource. The only irretrievable resources that would occur during decommissioning would be materials used to decontaminate the facility (i.e., rags, solvents, gases, and tools), and the fuel used for decommissioning activities and transportation of materials to and from the site. However, the use of these resources is minor.

8.8.16.1 Conclusion

The NRC concluded in Section 4.3.18 of the GEIS that the impacts of decommissioning on irreversible and irretrievable commitments of resources are small. There are no impacts on irreversible and irretrievable commitments of resources associated with decommissioning of OCNGS that are significantly different than those considered in the GEIS.

Therefore, HDI concludes that the potential impacts on these resources are small and bounded by the GEIS.

8.8.17 Traffic Transportation

The GEIS concludes that non-radiological and radiological impacts of decommissioning transportation are small.

Waste shipments will occur over an extended period of time and will not result in significant changes to local traffic density or patterns, or significant dose to workers or the public, and is not expected to result in measurable deterioration of affected roads or a destabilizing increase in traffic density. If selected as a transportation method, a portion of the waste may be removed from the site by barge and transported to an appropriate offsite location where it will be transferred to railcars or trucks for shipment to an appropriate disposal facility. If implemented, barge transportation will reduce the number of shipments from the site over local roadways. Construction and operation of a barge slip for this purpose will increase marine vessel traffic in the area. It is expected that these activities will not cause a navigational safety hazard or a substantial delay in the normal movements of commercial or recreational vessels.

8.8.17.1 Conclusion

HDI concludes that there are no unique features or site-specific conditions at OCNGS that would alter the findings of the GEIS or the Revised PSDAR that no significant impacts associated with transportation are likely to occur and are bounded by the GEIS.

8.9 Cumulative Impacts

In the SEIS the NRC concluded that the potential cumulative impacts associated with continued operation of OCNGS would be small and further concluded that no new and significant information was identified indicating that potential impacts associated with decommissioning would be different from those discussed in the SEIS or in the GEIS.

Decommissioning of OCNGS has been ongoing since 2019 and has included termination of most of the water use and discharge associated with the cooling water system, demolition and dismantling of some of the plant structures, and transportation of waste off-site. Remaining decommissioning activities for obtaining partial release of the NRC license include continued demolition and dismantling of plant structures, transportation of remaining waste off-site, if selected and implemented dredging and the use of barges for off-site transportation of large plant components and other materials, and radiological site characterization and restoration. All of these potential impacts are addressed in other sections of this chapter.

The ISFSI will remain in operation after partial release. Management of the ISFSI is passive with no waste generated during its operation and includes minimal security and utility services already in place. Potential impacts associated with continued operation of the ISFSI are addressed in Section 8.7.5. The ISFSI will be decommissioned and restored for unrestricted use after removal of the spent fuel and GTCC waste by the Department of Energy.

Decommissioning will result in an overall reduction in environmental impacts associated with OCNGS. Cumulative impacts to the community consist of a temporary increase in truck traffic for waste transport (addressed in Sections 8.7.4 and 8.8.17), and socioeconomic impact (loss of jobs and an eventual reduction in local tax revenues) addressed in Section 8.8.11.

An off-shore wind turbine project proposed to use a portion of the OCNGS licensed property for power transmission and connection to the grid was recently abandoned by its developer. Consequently, no known cumulative impacts associated with future development of the OCNGS property are anticipated.

8.9.1 Conclusion

HDI is not aware of any new or significant information associated with decommissioning of OCNGS that would result in significant cumulative impacts to the environment or local communities. Therefore, HDI concludes that the potential cumulative impacts associated with decommissioning of OCNGS are small.

8.10 Overview of Regulations Governing Decommissioning Activities and Site Release

8.10.1 Federal Requirements

Federal requirements for decommissioning of OCNGS primarily fall under the laws, regulations, and guidance issued by the NRC, EPA, and OSHA. A summary of federal requirements is provided below. The summary is not intended to be all-inclusive.

8.10.1.1 Nuclear Regulatory Commission

The lead agency for decommissioning and license termination of nuclear power plants is the NRC in accordance with Title 10 of the Code of Federal Regulations (CFR). The NRC has jurisdiction over the major decommissioning elements listed below in accordance with the identified Title 10 CFR parts.

- §20 – Radiation Protection
- §50 – Decommissioning Activities
- §51 – Environmental Protection
- §61 – Disposal of Radioactive Waste
- §71 - Packaging and Transportation of Radioactive Waste (49 CFR §171 through §174 also applies)
- §72 – Licensing Requirements for Storage of Spent Fuel, High-Level Radioactive Waste, GTCC Waste, and ISFSIs
- §73 – Physical Protection of Plants and Materials

These regulations include jurisdiction over radiological liquid effluent releases and air emissions and site restoration standards for license termination.

8.10.1.2 United States Environmental Protection Agency

The EPA regulations that apply to decommissioning of OCNGS are included in Title 40 of the CFR and are listed below. Responsibility for implementation and oversight of some EPA regulations are delegated in whole or in part to the State of New Jersey but are included below for completeness.

- §61 – Asbestos Handling and Removal
- §122 through §125 – National Pollutant Discharge Elimination System

- §141 – Safe Drinking Water Standards
- §190 – Radiation Protection Standards for Nuclear Power Operations
- §260 through §272 – Resource Conservation and Recovery Act (RCRA)
- §280 – Underground Storage Tanks
- §761 – Toxic Substances Control Act (TSCA)
- §129 through §132 – Clean Water Act

8.10.1.3 Occupational Health and Safety Administration

Worker health and safety protection in New Jersey is regulated by the federal OSHA and includes requirements for respiratory protection, hearing, illumination, scaffolding, crane and rigging safety, trenching, workplace chemical usage and release response, and worker protection for site remediation.

8.10.2 State and Local Requirements

8.10.2.1 New Jersey Department of Environmental Protection

NJDEP is the agency responsible for managing New Jersey's natural resources (air, land, water) and has jurisdiction over environmental pollution within the state, including in some cases, delegated jurisdiction for implementing federal EPA regulations and programs. During decommissioning and license termination, NJDEP regulates land-use aspects of site work, solid waste handling and disposal, industrial effluents and stormwater discharges, air emissions, protection of aquatic and terrestrial biota, site remediation, underground and above ground storage tanks, and historic preservation. The State of New Jersey laws, regulations, and guidance applicable to decommissioning and license termination of OCNGS include the ISRA which requires owners of facilities with specific industrial classification to investigate and remediate property as part of the ownership transfer process.

8.10.2.2 Local Governments

Local governments, including Ocean County, Lacey Township, and Forked River may also regulate certain decommissioning activities and license termination elements through issuance of construction permits, zoning determinations, traffic requirements, sanitary wastewater services and permitting, etc. Local governments also provide certain emergency response and law enforcement support services to OCNGS.

8.11 Conclusion

This LTP Chapter 8 documents an assessment of the environmental effects of decommissioning and license termination of OCNGS and provides supplemental information, as available, to previously conducted environmental impact assessments and evaluations. This assessment has determined that the environmental effects from decommissioning OCNGS are being minimized to the extent practicable and that no anticipated adverse effects are outside the bounds of those described in the GEIS, the environmental impact evaluations presented in the Revised PSDAR, and other environmental impact statements, assessments and evaluations referenced in this chapter.

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