

**CLOSEOUT REPORT**  
**WASTE CONCENTRATION FACILITY (BLDG 811 - AREA  
OF CONCERN 10) AND SURROUNDING AREA**

**Brookhaven National Laboratory  
Upton, New York**



**October 2016  
(Revised January 2017)**

Prepared by:

Brookhaven Science Associates  
Environmental Protection Division  
Building 860  
Upton, NY 11973

U.S. Department of Energy  
Brookhaven Site Office  
Building 464  
Upton, NY 11973

*This page intentionally blank*

## ***Executive Summary***

Building 810 (Waste Transfer Facility), Building 811 (Waste Concentration Facility) and the surrounding area are associated with Area of Concern (AOC) 10 at Brookhaven National Laboratory (BNL). Decontamination and Dismantlement (D&D) of Buildings 810 and 811, the removal of the associated structures, and piping, and the subsequent Final Status Survey (FSS), referred to herein as the Building 811 Project, are a continuation of the D&D and soil cleanup activities established in the *Record of Decision – Operable Unit I and Radiologically Contaminated Soils (Including Areas of Concern 6, 8, 10, 16, 17, and 18*, BNL, 1999) (OU I ROD). The project was performed in accordance with the *Demolition Plan, Building 811 and Associated Structures* (BNL, 2015) and *Field Sampling Plan/Quality Assurance Project Plan Waste Concentration Facility (AOC 10) and Surrounding Area* (PWGC, 2015).

The work included the removal of; two buildings (810 and 811) and associated concrete foundations, concrete supports for the former above ground storage tanks, remaining portion of the old waste transfer lines and of the former steam pit, and excavation of radiologically contaminated soil. Soil excavation depth ranged from less than one foot to eighteen feet below ground surface.

All of the building debris, concrete, transfer lines and soil was packaged for disposal (approximately 1,660 cubic yards) and transported off-site as low level radioactive waste to Energy Solutions of Utah or Waste Control Specialists (WCS).

Remedial activities associated with the Building 811 Project were divided into two work phases (D&D and FSS) that commenced in July 2014 (with utility isolation) and were completed in September 2016. Upon completion of D&D activities, an FSS and Independent Verification (IV) of the associated excavations were completed to ensure that soil cleanup objectives were met in accordance with the OU I ROD (BNL, 1999). The soil cleanup objectives for radiological contamination were based on a dose to a resident (non-farmer) from the remaining concentrations of all radionuclides present of less than or equal to 15 millirem per year (mrem/year) above background after 50 years of institutional control by the Department of Energy (DOE), and industrial land use with no decay time (0 years). The NYSDEC guidance of 10 mrem/yr above background was adopted as an As-Low-As-Reasonably-Achievable (ALARA) goal that was considered during remediation planning.

The following summarizes the as-left conditions for the Building 811 Project and how they satisfy the requirements of the OU I ROD:

- The average cesium (Cs)-137 and radium (Ra)-226 concentrations remaining in the Building 811 Project soils are 3.854 picocuries per gram (pCi/g) and 0.214 pCi/g, respectively. Strontium (Sr)-90 concentrations were below Minimum Detectable Concentrations (MDC). The as-left average concentrations are well below the site cleanup values (Cs-137 = 23 pCi/g, Sr-90 = 15 pCi/g and Ra-226 =

5 pCi/g). The maximum concentrations detected in soil samples were as follows: 30.6 pCi/g for Cs-137 (final excavation surface) and 50.5 pCi/g below final excavation surface), less than MDC for Sr-90, and 0.846 pCi/g for Ra-226.

- For the Building 811 Project, the maximum projected dose to a resident (non-farmer) after 50 years of institutional controls is 3.9 mrem/yr. The maximum projected dose to an industrial worker with no decay time is 2.2 mrem/yr. The results of the dose assessment are well below the limits established in the OU I ROD, including the dose based soil cleanup objective of 15 mrem/yr above background and the New York State Department of Environmental Conservation (NYSDEC) cleanup guideline of 10 mrem/yr from Technical and Administrative Guidance Memorandum (TAGM) 4003, which was adopted as an As-Low-As-Reasonably-Achievable (ALARA) goal.
- Site restoration was completed in September 2016. Restoration included backfilling, re-grading and reseeded areas with Long Island native grasses.

Applicable BNL site utility drawings will be updated to include the as-left conditions of the Building 811 Project area.

Brookhaven Science Associates (BSA) will perform surveillance and maintenance activities. In addition to maintaining institutional controls for the area (i.e, land use controls, notifications and restrictions, work planning controls such as digging permits, and government ownership), BSA will ensure that routine monitoring/inspections are performed. DOE will ensure enforcement of all institutional controls. The area of the surficially-radiologically contaminated soil identified along the north fence line to the adjacent metal storage yard will be placed under institutional controls, added to the Land Use and Institutional Controls (LUIC) contaminated soil map and will be remediated as funds become available in the future.

# Table of Contents

|                                                                       |            |
|-----------------------------------------------------------------------|------------|
| EXECUTIVE SUMMARY .....                                               | I          |
| <b>TABLE OF CONTENTS .....</b>                                        | <b>III</b> |
| <b>ACRONYM LIST .....</b>                                             | <b>VII</b> |
| <b>1.0 INTRODUCTION .....</b>                                         | <b>1</b>   |
| 1.1 PURPOSE .....                                                     | 1          |
| 1.2 SITE DESCRIPTION AND OPERATIONAL HISTORY .....                    | 2          |
| 1.2.1 Waste Concentration Facility (Building 811 - AOC10) .....       | 5          |
| 1.2.2 Building 810 .....                                              | 6          |
| 1.3 REGULATORY AND ENFORCEMENT HISTORY .....                          | 6          |
| 1.4 SITE INVESTIGATION .....                                          | 7          |
| 1.5 PREVIOUS REMEDIAL ACTIVITIES .....                                | 8          |
| 1.6 BNL OPERABLE UNITS .....                                          | 9          |
| <b>2.0 OPERABLE UNIT BACKGROUND .....</b>                             | <b>12</b>  |
| 2.1 SITE CLEANUP CRITERIA .....                                       | 12         |
| 2.2 DESIGN CRITERIA .....                                             | 12         |
| <b>TABLE 2-1 CONTAMINANTS OF CONCERN – BUILDING 811 PROJECT .....</b> | <b>13</b>  |
| 2.3 COMMUNITY RELATIONS ACTIVITIES .....                              | 14         |
| 2.3.1 BNL Community Relations .....                                   | 14         |
| 2.3.2 Community Involvement .....                                     | 14         |
| <b>3.0 CONSTRUCTION ACTIVITIES .....</b>                              | <b>15</b>  |
| 3.1 BUILDING D&D .....                                                | 15         |
| 3.1.1 Building 810 .....                                              | 16         |
| 3.1.2 Building 811 .....                                              | 18         |
| 3.1.3 Aboveground/Underground Structures and Soil Removal .....       | 19         |
| 3.2 FINAL STATUS SURVEY AND SAMPLING .....                            | 22         |
| 3.2.1 Final Status Survey Design .....                                | 23         |
| 3.2.2 Final Status Survey and Sampling Results .....                  | 24         |
| <b>3.2.3 Sign Test and Elevated Measurement Comparison .....</b>      | <b>32</b>  |
| 3.2.4 Post Remediation Dose Assessment .....                          | 33         |
| 3.2.5 Final Status Survey Conclusions .....                           | 37         |
| 3.2.6 Final Status Survey Independent Verification .....              | 37         |
| 3.3 WASTE MANAGEMENT .....                                            | 37         |
| 3.3.1 Waste Characterization, Handling and Disposal .....             | 37         |
| 3.3.2 Pollution Prevention and Waste Minimization Opportunities ..... | 39         |
| 3.4 SITE RESTORATION .....                                            | 39         |
| <b>4.0 CHRONOLOGY OF EVENTS .....</b>                                 | <b>40</b>  |
| <b>5.0 PERFORMANCE STANDARDS &amp; QUALITY CONTROL .....</b>          | <b>41</b>  |
| <b>6.0 FINAL INSPECTION AND CERTIFICATIONS .....</b>                  | <b>42</b>  |
| 6.1 INDUSTRIAL HYGIENE OVERSIGHT & MONITORING .....                   | 42         |
| 6.2 RADIOLOGICAL OVERSIGHT & MONITORING .....                         | 42         |

|             |                                                   |           |
|-------------|---------------------------------------------------|-----------|
| <b>7.0</b>  | <b>OPERATION AND MAINTENANCE ACTIVITIES .....</b> | <b>44</b> |
| <b>8.0</b>  | <b>SUMMARY OF PROJECT COSTS .....</b>             | <b>46</b> |
| <b>9.0</b>  | <b>OBSERVATIONS AND LESSONS LEARNED .....</b>     | <b>47</b> |
| <b>10.0</b> | <b>PROTECTIVENESS.....</b>                        | <b>48</b> |
| <b>11.0</b> | <b>FIVE YEAR REVIEW .....</b>                     | <b>49</b> |
|             | <b>REFERENCES.....</b>                            | <b>51</b> |

## **FIGURES**

- Figure 1-1: Location of Brookhaven National Laboratory  
Figure 1-2: Building 811 Project Location at BNL  
Figure 1-3: Buildings 810 and 811 Site Plan  
Figure 1-4: Previous Remedial Actions  
Figure 1-5: 2005 FSS Location and AOC 10 and Surrounding Area Boundary  
Figure 3-1: Preliminary Walkover Survey Data and Sampling Results  
Figure 3-2: AOC 10 and Surrounding Area Survey Units and Sampling Locations  
Figure 3-3: SU-1 and SU-2 FSS Gamma Walkover Survey Results Showing Hotspots (Un-collimated Probe)  
Figure 3-4: SU-1 and SU-2 FSS Gamma Walkover Survey Results after Hotspot Remediation (Un-collimated Probe)  
Figure 7-1 As-Left Fence Line Survey and ISOCs Soil Sample Results

## **TABLES**

- Table 2-1: Contaminants of Concern – Waste Concentration Facility AOC 10  
Table 3-1: Building 811 Project – ISOCS Overburden Soil Sampling Results  
Table 3-2: Hotspot Sampling Summary  
Table 3-3: Summary of SU-1 & SU-2 Soil Sample Results for Radionuclides  
Table 3-4: SU-1 & SU-2 Surface Soil Sample Results for Radionuclides  
Table 3-5: SU-1 and SU-2 Surface Sample Results with MDC  
Table 3-6: SU-1 and SU-2 Composite Sample Results with MDC  
Table 3-7: Modified Investigation Level for Composite Samples  
Table 3-8: SU-1 & SU-2 Geoprobe Soil Sample Results for Radionuclides  
Table 3-9: Sign Test for SU-1  
Table 3-10: Elevated Measurement Comparison for SU-1  
Table 3-11: Sign Test for SU-2  
Table 3-12: Summary of Post-Remediation Dose Assessment Results  
Table 3-13: Project Waste Summary  
Table 4-1: Chronology of Remedial Events for the Building 811 Project  
Table 10-1: Building 811 Project FRDP Issue Summary

## **PHOTOGRAPHS**

- Photo 1: View of Building 811 Looking Northwest  
Photo 2: View of Building 810  
Photo 3: Demolition of Building 810  
Photo 4: Demolition of Building 810 Foundation  
Photo 5: Demolition of Building 811  
Photo 6: Removal of AST Concrete Supports  
Photo 7: Waste transfer line Removal  
Photo 8: Completed Building 811 Excavation, Looking South (prior to partial backfill of the deepest portion and grading of side slopes)  
Photo 9: Performing Radiological Walkover Survey in SU-1  
Photo 10: Shipping Project Waste via Rail

Photo 11:      Placing clean fill at previous location of Building 811

**APPENDICES (See Attached Disc)**

Appendix A: Building 811 Project Final Status Survey Analytical Results

Appendix B: Building 811 Project RESRAD Summary Reports

Appendix C: Building 811 Project ORISE IV Report

Appendix D: Building 811 Project Waste Characterization Data

Appendix E: Backfill Material Analytical Data

Appendix F: Data Verification and Validation Checklists



## ACRONYM LIST

|         |                                                                    |
|---------|--------------------------------------------------------------------|
| AST     | Above-Ground Storage Tank                                          |
| ACM     | Asbestos-Containing Material                                       |
| ALARA   | As-Low-As-Reasonably-Achievable                                    |
| ANL     | Argonne National Laboratory                                        |
| AOC     | Area of Concern                                                    |
| BNL     | Brookhaven National Laboratory                                     |
| BGRR    | Brookhaven Graphite Research Reactor                               |
| Bgs     | Below Ground Surface                                               |
| BSA     | Brookhaven Science Associates                                      |
| CAC     | Community Advisory Council                                         |
| CDM     | CDM Federal Programs                                               |
| CPM     | Counts per Minute                                                  |
| CERCLA  | Comprehensive Environmental Response, Compensation & Liability Act |
| Ci      | Curies                                                             |
| Co      | Cobalt                                                             |
| Cs      | Cesium                                                             |
| DAC     | Derived Air Concentration                                          |
| DCGL    | Derived Concentration Guidance Level                               |
| D&D     | Decontamination and Dismantlement                                  |
| DOE     | Department Of Energy                                               |
| DQO     | Data Quality Objective                                             |
| EM      | Environmental Management                                           |
| EPA     | United States Environmental Protection Agency                      |
| EMC     | Elevated Measurement Comparison                                    |
| EPD     | Environmental Protection Division                                  |
| ES      | Energy Solutions of Utah                                           |
| F&O     | Facilities and Operations                                          |
| FRDP    | Facility Review Disposition Project                                |
| FS      | Feasibility Study                                                  |
| FSP     | Field Sampling Plan                                                |
| FSS     | Final Status Survey                                                |
| GPS     | Global Positioning System                                          |
| H       | Tritium                                                            |
| HFBR    | High Flux Beam Reactor                                             |
| IAG     | Interagency Agreement                                              |
| IH      | Industrial Hygiene                                                 |
| IVS     | Independent Verification Survey                                    |
| JSA     | Job Safety Analysis                                                |
| LLRW    | Low-Level Radioactive Waste                                        |
| MARSSIM | Multi-Agency Radiological Survey and Site Investigation Manual     |
| MDC     | Minimum Detectable Concentration                                   |
| mrem/yr | Millirem per Year                                                  |
| NaI     | Sodium Iodide                                                      |

|         |                                                           |
|---------|-----------------------------------------------------------|
| NESHAPs | National Emissions Standards for Hazardous Air Pollutants |
| NYCRR   | New York Codes, Rules and Regulations                     |
| NYSDEC  | New York State Department of Environmental Conservation   |
| ORISE   | Oak Ridge Institute for Science and Education             |
| OSWER   | Office of Solid Waste and Emergency Response              |
| OU      | Operable Unit                                             |
| pCi/g   | Picocuries per Gram                                       |
| PCBs    | Polychlorinated Biphenyls                                 |
| PRAP    | Proposed Remedial Action Plan                             |
| Pu      | Plutonium                                                 |
| PWGC    | P.W. Grosser Consulting, Inc.                             |
| QAPP    | Quality Assurance Project Plan                            |
| QA      | Quality Assurance                                         |
| QC      | Quality Control                                           |
| Ra      | Radium                                                    |
| RCD     | Radiological Controls Division                            |
| RCT     | Radiological Controls Technician                          |
| RESRAD  | Residual Radioactivity Computer Code                      |
| RI      | Remedial Investigation                                    |
| ROD     | Record of Decision                                        |
| RWP     | Radiological Work Permit                                  |
| SBMS    | Standards Based Management System                         |
| SCO     | Soil Cleanup Objective                                    |
| SOP     | Standard Operating Procedure                              |
| Sr      | Strontium                                                 |
| SU      | Survey Unit                                               |
| TAGM    | Technical and Administrative Guidance Memorandum          |
| TLD     | Thermoluminescent Dosimeter                               |
| U       | Uranium                                                   |
| USC     | United States Code                                        |
| UST     | Underground Storage Tank                                  |
| V       | Volts                                                     |
| WAC     | Waste Acceptance Criteria                                 |
| WMF     | Waste Management Facility                                 |
| WCF     | Waste Concentration Facility                              |

## 1.0 INTRODUCTION

### 1.1 Purpose

The purpose of this closeout report is to document the completed actions associated with the decontamination and dismantlement (D&D) of Buildings 811 (Waste Concentration Facility) and 810 (Waste Transfer Facility). This closeout report also documents the removal of a section of abandoned waste transfer lines, old sanitary lines, above-ground storage tank (AST) concrete supports, and contaminated soil, as well as the subsequent final status survey (FSS). This work is referred to herein as the “Building 811 Project.” Building 811 and the surrounding area is designated as Area of Concern (AOC) 10 at Brookhaven National Laboratory (BNL).

Remedial activities associated with the Building 811 Project were performed by BNL’s Facilities and Operations (F&O), seconded and task order subcontractors, BNL’s Radiological Control Division (RCD), and BNL’s Environmental Protection Division (EPD) personnel. Independent verification of the FSS was performed by the Department of Energy (DOE) independent verification contractor, Oak Ridge Institute for Science and Education (ORISE).

Work was performed in accordance with the *Record of Decision – Operable Unit I and Radiologically Contaminated Soils (Including Areas of Concern 6, 8, 10, 16, 17, and 18, BNL, 1999)*, and the *Demolition Plan, Building 811 and Associated Structures* (BNL, 2015). The FSS was performed in accordance with the *Field Sampling Plan/Quality Assurance Project Plan Waste Concentration Facility (AOC 10) and Surrounding Area* (PWGC, 2015) (FSP/QAPP).

The scope of work for the Building 811 Project included the following:

- Dismantlement and removal of Buildings 810 and 811, including structures, foundations, systems and components;
- Removal of the remaining underground waste transfer lines;
- Partial removal of sanitary sewer lines;
- Removal of the former steam pit vault;
- Removal of associated contaminated asphalt, concrete and soil;
- Packaging, transport, and disposal of radiologically contaminated project waste to an off-site permitted facility;
- Performing a FSS of the areas that encompass the footprints of Building 811, 810 and the surrounding area;
- An independent verification of the FSS performed by ORISE;
- Restoration of the areas; and

- Preparing a dose assessment and a closeout report.

## 1.2 Site Description and Operational History

The BNL site covers almost 5,300 acres, much of which is wooded. It is an irregular polygon, and each side is approximately 2.5 miles long. The developed portion of the BNL site includes the principal facilities, which are located near the center of the BNL site on relatively high ground. The developed portion is approximately 1,650 acres, 500 acres of which were originally developed for U.S. Army use. Large, specialized research facilities occupy 200 acres and another 400 acres are occupied by roads, parking lots and connecting areas. The remaining 550 acres are occupied by outlying facilities including an apartment area, Sewage Treatment Plant, firebreaks, and the Former Landfill Area. Approximately 500 acres of land on the eastern portion of the site has been designated as the Upton Ecological Reserve. DOE has granted an easement on approximately 200 acres of land on the east and southeast portion of the site for the operation of the Long Island Solar Farm. This 32 megawatt (MW) direct current solar photovoltaic power plant was constructed in 2011.

The terrain is gently rolling, with elevations varying between 40 to 120 feet above mean sea level. The land lies on the western rim of the shallow Peconic River watershed, with a tributary of the Peconic River rising in marshy areas in the northern section of the tract. The sole-source aquifer beneath BNL comprises three water-bearing units: the upper glacial deposits, the Magothy Formation, and the Lloyd Sand Member of the Raritan Formation. These units are hydraulically connected and make up a single zone of saturation with varying physical properties extending from a depth of 45 to 1,500 feet below the land surface. These three water-bearing units are designated as a “sole source aquifer” by the U.S. Environmental Protection Agency (EPA) and serve as the primary source of drinking water for Nassau and Suffolk counties.

A map illustrating the location of the BNL site is presented as Figure 1-1.

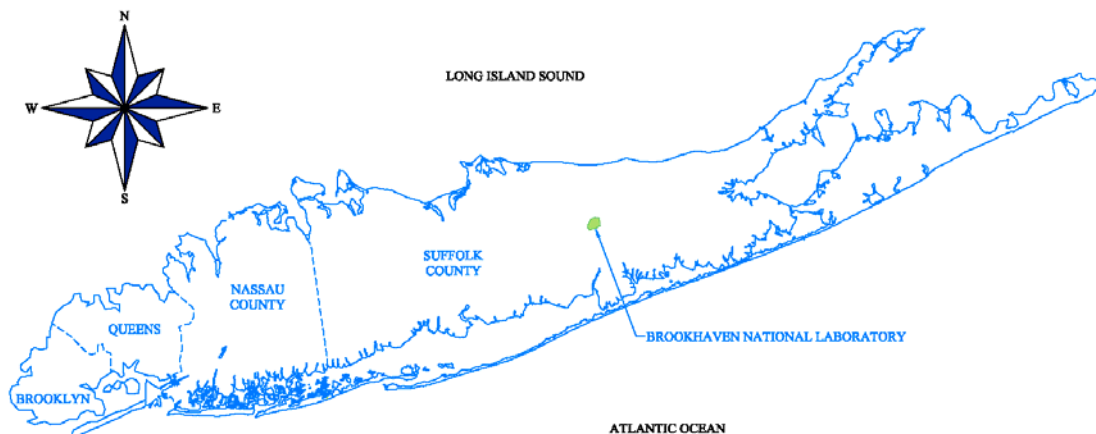


Figure 1-1 – Location of Brookhaven National Laboratory

Buildings 810 and 811 are part of the BNL Central Complex, which is centrally located within the BNL Site, as shown in Figure 1-2. During its period of operation, Building 811 was the central facility for the receipt, processing, and volume reduction of aqueous radioactive waste. The basement of Building 811 was also the receiving point for the D-Waste lines that serviced the High Flux Beam Reactor (HFBR), Brookhaven Graphite Research Reactor (BGRR), and Hot Lab (801) and the termination point for the A & B-waste lines coming from Building 801.

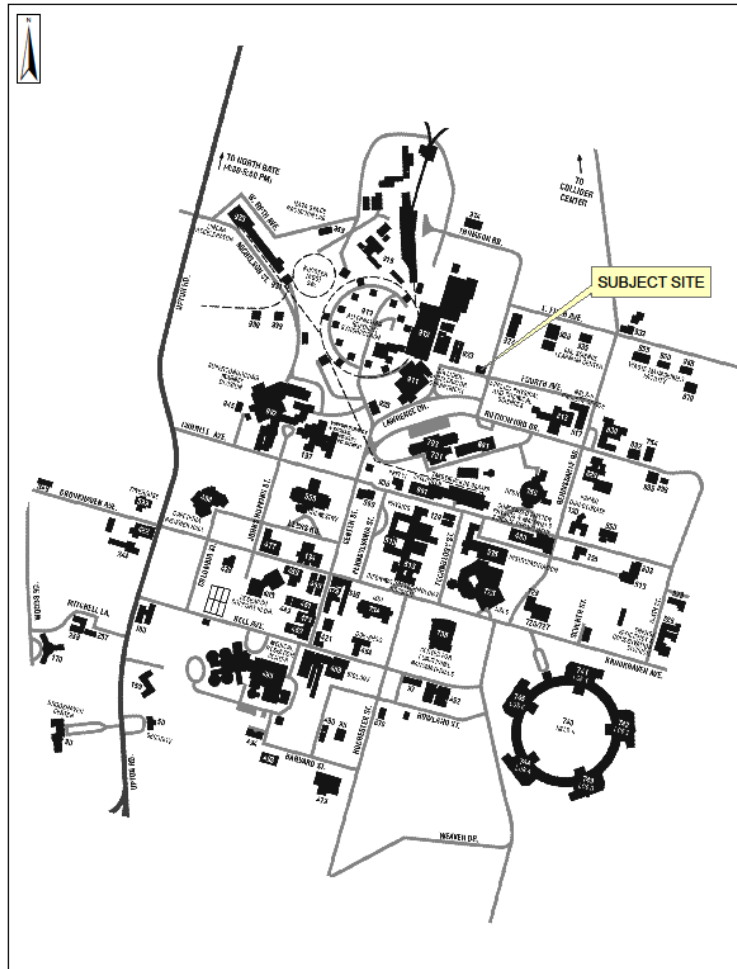


Figure 1-2 – Building 811 Project Location at BNL

BNL consolidated its waste management operations to the Waste Management Facility (WMF) in September 2008, thus eliminating the need for its liquid operations at the Waste Concentration Facility (WCF).

The locations of the Waste Transfer and Concentration Facility (Buildings 810/811) are illustrated in Figure 1-3.



Figure 1-3 – Buildings 810 and 811 Site Plan

### 1.2.1 Waste Concentration Facility (Building 811 - AOC10)

A portion of the BNL facility known as the Waste Concentration Facility has been used since 1947 as a facility for processing and concentrating liquid radioactive wastes received from the BGRR, the Hot Laboratory Complex (Building 801), and the HFBR. Liquid wastes were stored in three 100,000 gallon ASTs (known as D Tanks) from 1947 to 1987. Past operations and practices, including three documented leaks from the ASTs, caused both surface and deep soil contamination that required remediation. The location of AOC 10 is provided on Figure 1-3.



Photograph 1 – View of Building 811 Looking Northwest

Constructed in the early 1950s, Building 811 is a single-story, above-grade structure approximately 34 feet long by 32 feet wide and sits approximately 26 feet above grade. The building walls were constructed of 12 inch x 8 inch x 16 inch concrete masonry units.

With exception of 480 volt (V) electrical power, all utilities that serviced Building 811 during its period of operation were isolated in 2014 as part of the preparatory work for building demolition. The following services have been disconnected, and removed (“air-gapped”) back to a point clear of the excavation associated with the demolition of the building:

- Steam and Condensate
- Potable Water
- Telephone Service and Data



- Fire Protection System
- Fire Alarm System

The building sanitary system discharged via a buried 4-inch diameter cast iron line that runs from the building's west side to a BNL sanitary system collection basin located just north of Building 810. The sanitary system fixtures inside of Building 811 were removed and the drain lines were capped or plugged in 2014.

### **1.2.2 Building 810**

Building 810 (Waste Transfer Facility) was added to the Waste Concentration Facility as a waste storage and transfer area upgrade. The upgrade consisted principally of the addition of the two 22,000 gallon secondarily contained ASTs and associated piping, pumps, and valves to increase system storage capacity and reliability. Building 810 was designed to provide a liquid waste transfer station that complies with Article 12 of the Suffolk County Sanitary Code, provide a protected area replacing the previous liquid waste processing with contractor provided microfiltration/reverse osmosis (discontinued 1999), and provide interim onsite storage of containerized liquid wastes. Building 810 is immediately adjacent to Building 811, and was considered an integral part of the Building 811 liquid waste operations. Building 810 was free released and demolished down to the building foundation.



Photograph 2 – View of Building 810

## **1.3 Regulatory and Enforcement History**

In 1980, the BNL site was placed on New York State's Department of Environmental Conservation (NYSDEC) list of Inactive Hazardous Waste Sites. On December 21, 1989, the BNL site was included on the EPA National Priorities List because of soil and



groundwater contamination that resulted from BNL's past operations. Subsequently, EPA, NYSDEC, and DOE entered into a Federal Facilities Agreement (herein referred to as the Interagency Agreement; [IAG]) that became effective in May 1992 (Administrative Docket Number: II-CERCLA-FFA-00201) to coordinate the cleanup.

The IAG identified AOCs that were grouped into Operable Units (OUs) to be evaluated for response actions. The IAG required a remedial investigation (RI)/feasibility study (FS) for OU I, pursuant to 42 United States Code (USC) 9601 et seq., to meet Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) requirements. OU I consists of areas of soil contamination at the BNL site where waste was historically managed or disposed.

Upon completion and review of the results of the RI/FS for OU I, the OU I ROD, was signed in August 1999. The OU I ROD (BNL, 1999) specified the excavation and off-site disposal of radiologically and chemically contaminated soils.

The cleanup goal for this project is as prescribed in the OU I ROD (BNL, 1999). Upon completion of remediation, a dose evaluation will be performed to ensure that the resultant dose based cleanup goal of less than 15 millirem per year (mrem/yr) above background to the residential user in 50 years is achieved. The previously developed cleanup values and Derived Concentration Guideline Limits (DCGL) as stated in the OU I ROD (BNL, 1999) are: 23 picocuries (pCi)/gram (g) for Cesium-137 (Cs-137), 5 pCi/g for Radium-226 (Ra-226), and 15 pCi/g for Strontium-90 (Sr-90).

## **1.4 Site Investigation**

A *BNL Final Remedial Investigation/Risk Assessment – Final Report, Operable Unit I/VI*, (CDM Federal 1996) (OU I/VI RI/RA) was conducted to evaluate the nature and extent of contamination, and the potential risks associated with AOC 10. A *Final Feasibility Study Report for OU I Radiologically Contaminated Soils* (CDM Federal 1999) was prepared to evaluate the alternatives for remediating the radiologically contaminated soils and other areas of concern. In addition, supplemental investigations of the soils, underground storage tanks (USTs), and associated piping and components were conducted to further delineate the extent of contamination.

Soil characterization was documented in the *Engineering Evaluation/Cost Assessment for the D Tanks Removal Action* (Dames and Moore, 1993). Eight borings were installed to between 7 and 12 feet below ground surface (bgs). Elevated levels of Cs-137 (maximum 1,486 pCi/g) and Sr-90 (maximum 454 pCi/g) were detected in several surface soil samples. Subsurface soils were also contaminated in the 5-7 feet bgs interval at two boring locations (maximum Cs-137 of 41 pCi/g and maximum Sr-90 of 148 pCi/g) and in the 10-12 feet bgs interval (maximum Cs-137 of 22 pCi/g and maximum Sr-90 of 45 pCi/g).

IT Corp performed further characterization of soils associated with the former tank, which is documented, in the OU II/VII RI Report (IT Corp., 1993). Surface soil samples

were collected from eight sites at depths of up to one foot bgs. Subsurface soil borings samples were also collected from seven sites at a depth of 23 feet to 25 feet bgs. Samples were analyzed for gross alpha and beta activity, tritium, Sr-89/90, isotopic thorium, isotopic americium, and gamma emitters by gamma spectroscopy. The only radiological parameter or radiochemical species detected in samples above its calculated risk-based cleanup value for future residential use was Cs-137, which was detected at 43.3 pCi/g at one surface soil location. No radioactive contaminants were found above cleanup values in any of the subsurface samples. BNL conducted a review of the data sources and compiled the existing data for Cs-137 results. This evaluation identified and documented additional Cs-137 contamination around the perimeter of the D-Tanks pad and adjacent to Building 810.

Prior to the construction of Building 810, soil sampling was carried out in the footprint where the foundation was to be poured, and it was determined that soil in the building footprint was below the AOC 10 Cleanup Values.

## **1.5 Previous Remedial Activities**

In 1995, the removal of the three 100,000 gallon D-waste ASTs and associated piping was documented in the *Closeout Report for Brookhaven National Laboratory “D” Tanks Removal Action* (IT Corp., 1995).

In 2001, the removal of wastes from the six UST’s was documented in the *Closeout Report, Removal Treatment, and Disposal of Radioactive and Mixed Waste Sludge from Building 811 Tanks* (URS Corp, 2001).

The 2004, removal of six A/B waste storage tanks from the Building 811 yard was documented in the *Closeout Report, Brookhaven National Laboratory, Operable Unit I, Area of Concern 10* (AOC 10), Waste Concentration Facility (Weston Solutions, 2005). The scope of the remedial action included the excavation of contaminated soil from within AOC 10 (associated with the former above grade D waste tanks, from beneath the A/B waste tank vaults, and other locations within AOC 10, and performance of a FSS). The FSS calculated a dose to a resident after 50 years of institutional control of 3.75 mrem/yr, which met the cleanup goal of less than 15 mrem/yr above background. The only area within AOC 10 that was not included in the remediation, FSS and dose assessment was the foot print of Building 811, which includes an area around the perimeter of Building 811 extending approximately 10 feet, and the southeast corner of the AOC.

Between 2007 and 2010, decommissioning and removal of the two 25,000 gallon and two 22,000 gallon D-waste ASTs and associated above-ground piping were performed.

The A/B waste transfer line and co-located piping removal project was completed in 2010. The waste lines between Building 801 and Building 811 were removed and a FSS was performed for the section of line between Building 801 and the southeast fence line

of Building 811. The A/B waste lines within AOC 10 (between the fence line and Building 811) were removed, a demarcation fabric was placed and the excavation was backfilled with clean fill.

Other remedial activities performed within AOC 10 and Surrounding Area includes:

- Removal of the original D-waste and co-located steam lines from the east/west buried pipe trench;
- Removal of the Building 811 evaporator system and associated equipment and components;
- Free release of Building 810; and
- Removal of equipment and lead from Building 811, as well as partial decontamination of Building 811.

The locations of the previous remedial activities are summarized on Figure 1-4. The area included in the 2005 AOC 10 FSS is provided on Figure 1-5. The Surrounding Area (Building 810 and the former 25,000 and 22,000 gallon AST locations are shown on Figure 1-5.

## **1.6 BNL Operable Units**

As part of remedial efforts at BNL, 32 AOCs were identified and grouped into seven OUs. The seven OUs were subsequently reduced to six OUs as a result of combining OU II and OU VII.

This report documents completion of remedial actions associated with AOC 10. As described in Section 2.1, the cleanup goals established in the OU I ROD were used for the Waste Concentration Facility (Building 811 – AOC 10) and Surrounding Area Project.

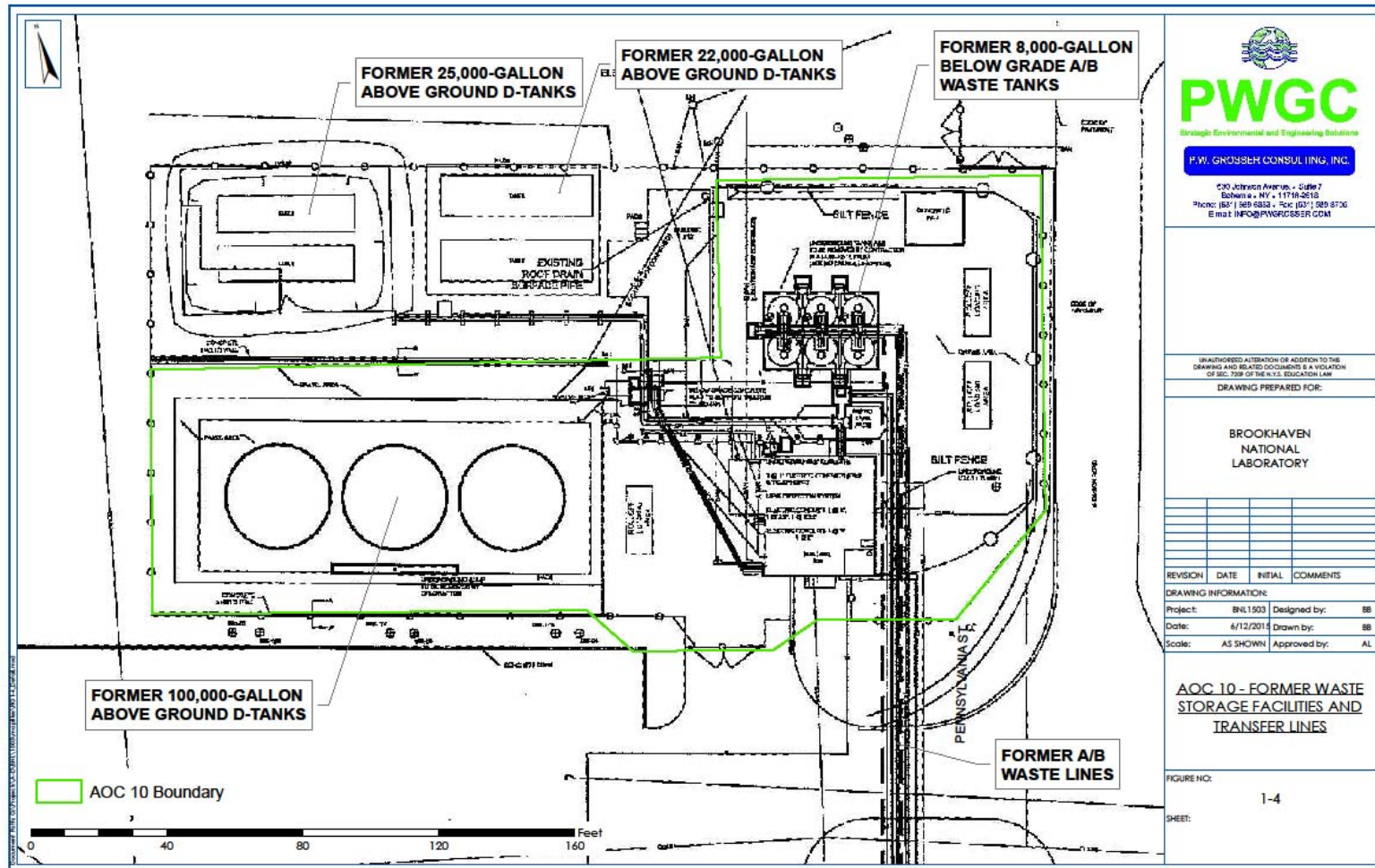


Figure 1-4 – Previous Remedial Actions

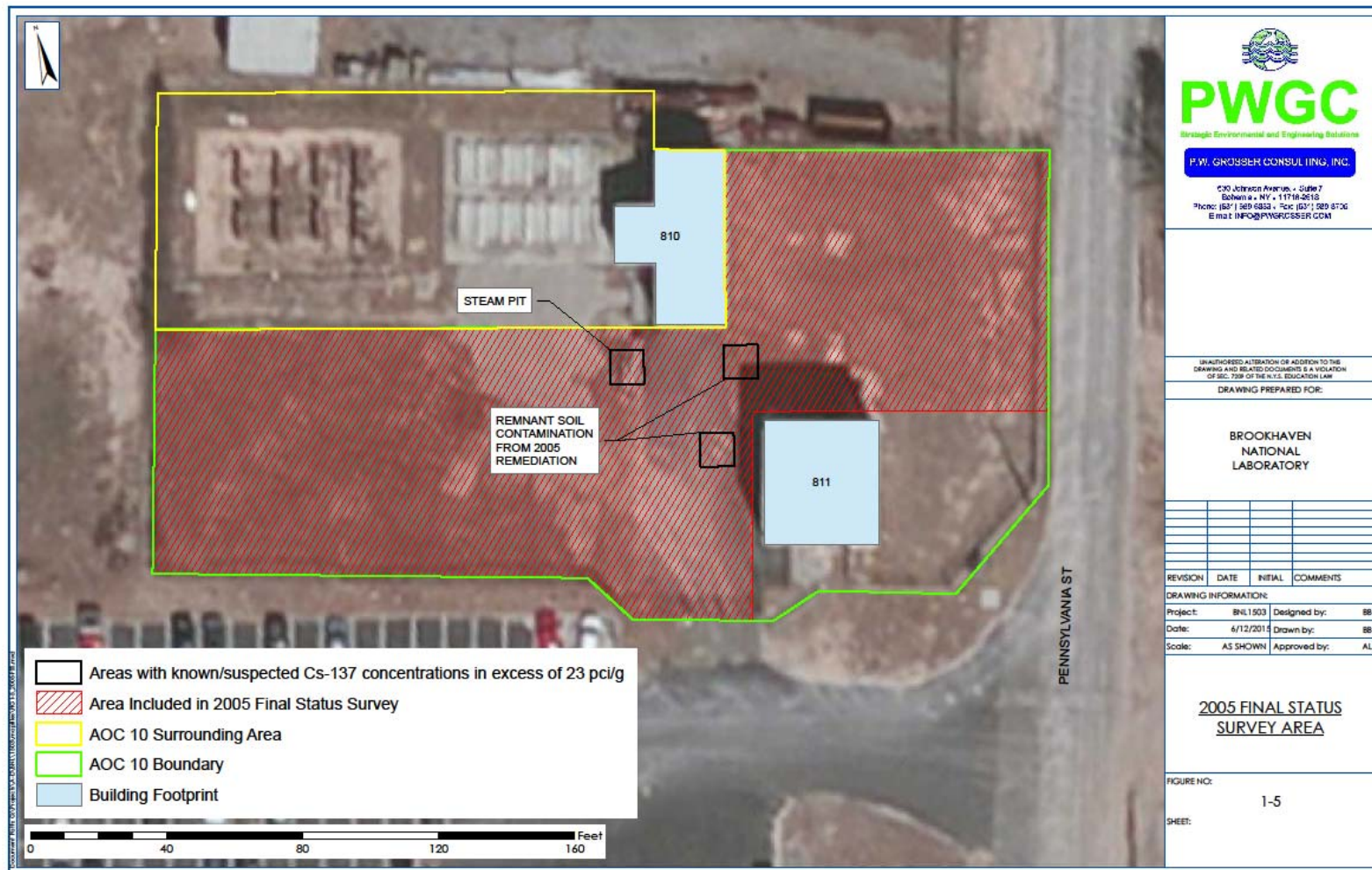


Figure 1-5 – 2005 FSS Location and AOC 10 and Surrounding Area Boundary

## **2.0 OPERABLE UNIT BACKGROUND**

### **2.1 Site Cleanup Criteria**

The cleanup goal for the site is 15 mrem/yr above background as detailed in the OU I ROD (BNL, 1999). The cleanup goal is protective of both residential and industrial uses after 50 years of institutional controls. The OUI ROD (BNL, 1999) lists Cs-137, Sr-90, and Ra-226 as contaminants of concern, and identifies cleanup values for these radionuclides to be used as guidance in achieving the sites cleanup goal.

The cleanup values were taken directly from the OUI ROD, Table 4, "Soil Cleanup Levels for Principal Radiological Contaminants at BNL". The Cs-137 value is based on a dose of 15 mrem/yr above background and residential land use with 50 years of institutional control of the site. The Sr-90 goal is based on an evaluation of groundwater impacts. It is also protective of residential and industrial use. The Ra-226 goal of 5 pCi/g for surface soil is based on DOE Order 5400.5 (now DOE Order 458.1, Admin Change 3) and is commonly used by the Environmental Protection Agency. In addition to radionuclide specific levels, a post remediation sampling and dose assessment is required by the OUI ROD to ensure that the dose from all radionuclides present is less than 15 mrem/yr above background considering 50 years of institutional controls.

Radionuclide cleanup values are provided in Table 2-1. Previous characterizations have not detected additional radionuclides above their respective cleanup values; however, selected soils samples were analyzed for these additional radionuclides (H-3, U-238, Pu-238, and Pu-239/240).

The cleanup values for the radionuclides of concern were taken from the OU I ROD (BNL, 1999), from the FS (CDM Federal, 1999), and from the OU I/VI RI/RA (CDM, 1996). The NYSDEC guidance of 10 mrem/yr above background was adopted as an As-Low-As-Reasonably-Achievable (ALARA) goal that was considered during remediation planning.

### **2.2 Design Criteria**

Technical procedures and design criteria for the Building 811 Project were established in the OUI ROD, the *Demolition Plan Building 811 and Associated Structures* (BNL, 2015), the FSP/QAPP (PWGC, 2015) and the *Excavation Plan for Building 811 and Surrounding Area* (BNL, 2015b). The remedial design included:

- Procedures for the D&D of Building 811;
- Procedures for the exposure and removal of underground structures and transfer piping associated with Building 811 and Building 810;



- Procedures for the excavation and handling of any contaminated soil associated with the Project;
- A plan and process for ensuring the total exposure from all radioisotopes does not exceed 15 mrem/yr above background following the 50-year period for institutional control for the site;
- Methods to reduce waste volumes that require offsite disposal; and
- An approach for sampling to confirm that the cleanup goal have been achieved for the Project.

**Table 2-1 Contaminants of Concern – Building 811 Project**

| <b>Radionuclides of Concern</b>                | <b>Residential Cleanup Value (pCi/g)</b>   | <b>Source of Cleanup Value</b>    |
|------------------------------------------------|--------------------------------------------|-----------------------------------|
| Cs-137                                         | 23                                         | OU I ROD (BNL 1999)               |
| Sr-90                                          | 15                                         | OU I ROD (BNL 1999)               |
| Ra-226 (a)                                     | 5                                          | OU I ROD (BNL 1999) and DOE 458.1 |
| <b>Additional Radionuclides for Evaluation</b> | <b>Estimated Cleanup Value (pCi/g) (b)</b> |                                   |
| H-3                                            | 1,010 (c)                                  |                                   |
| U-235                                          | 4.6 (d)                                    |                                   |
| U-238                                          | 4.7 (d)                                    |                                   |
| Pu-238                                         | 57                                         |                                   |
| Pu-239/240                                     | 35                                         |                                   |
| Am-241                                         | 34                                         |                                   |

- a. Note: Ra-226 is not expected at levels exceeding the cleanup criteria, but it is listed as a radioactive contaminant of concern based on its specific listing in the OU I ROD and guidance from DOE order 458.1.
- b. Note: Each value listed for additional radionuclides for evaluation is the estimated cleanup value if the individual radionuclide was the only radionuclide present. The demonstration that the site is acceptable would be based on a RESRAD evaluation using all BNL-related radionuclides detected.
- c. If tritium is detected in soil samples, a RESRAD evaluation will be conducted using the tritium soil concentration.
- d. Values listed for uranium are based on 4 millirem per year from groundwater consumption.

## **2.3 Community Relations Activities**

### **2.3.1 BNL Community Relations**

The BNL Community Involvement Plan was published April 15, 1999. In accordance with this plan and CERCLA Sections 113 (k)(2)(B)(i-v) and 117, the Community Relations Program focuses on informing and involving the public in the decision-making process to ensure that the views of the internal and external stakeholder communities are considered. A variety of activities are used to provide information and to seek public participation, including holding community meetings, information sessions, and preparing and distributing fact sheets. The Administrative Record, which documents the basis for removal and remedial actions, was established and is maintained at the libraries listed below:

Brookhaven National Laboratory  
Research Library, Bldg. 477A  
Upton, NY 11973  
631-344-3483 or 631-344-3489

Stony Brook University  
Melville Library  
Special Collections and University Archives  
Room E-2320  
Stony Brook, NY 11794  
631-632-7119

U.S. EPA - Region II  
Records Room  
290 Broadway, 18th Floor  
New York, New York 10007  
212-637-4308

### **2.3.2 Community Involvement**

The community involvement activities conducted for the Waste Concentration Facility, beyond those associated with the original OU I Record of Decision, focused on periodic updates to the Community Advisory Council (CAC). Briefings to the CAC were held on May 28, 2014, March 12, 2015, September 10, 2015, and on June 9, 2016. Minutes from these meetings are available on the BNL Community Relations website, located at: <https://www.bnl.gov/stakeholder/CAC-meetings.php>.



### **3.0 CONSTRUCTION ACTIVITIES**

The objective of the Building 811 Project was to safely complete the D&D of Buildings 810 and 811, as well as to characterize and remove any associated contaminated soil in accordance with the project specific plans. Following the D&D of Buildings 810 and 811, the remaining section of waste transfer lines and contaminated soil were removed, and an FSS and a dose assessment were performed. The FSS was independently verified by ORISE. This work is further discussed in Section 3.2. The FSS was completed using the *Multi-Agency Radiological Survey and Site Investigation Manual (MARSSIM)* guidelines (EPA, 2000).

A Demolition Plan, FSP/QAPP, Excavation Plan, Job Safety Analysis (JSAs), Radiological Work Permits (RWPs), and project-specific work procedures were developed to address hazards and work steps associated with the project. The information presented in the project plans was reviewed by the site workers prior to initiating the project work activities. Copies of project plans were available onsite at all times for site workers to thoroughly review.

The FSP/QAPP (PWGC, 2015) detailed the data quality objectives (DQOs) and quality assurance (QA) requirements for the FSS. The plan also presented the field screening level (21,500 counts per minute [cpm]) with an unshielded sodium iodide detector) to be used in guiding the excavation and in determining when the excavation was completed.

Completion of the Building 811 Project was accomplished without any worker injuries categorized as lost time accidents.

#### **3.1 Building D&D**

The project was divided into two work phases. The first phase took place between July 2014 and February 2016 and included isolation of utilities, the D&D of Building 810, concrete supports for the previously removed 20,000 and 25,000 gallon ASTs, and Building 811. The second phase took place between March 2016 and July 2016 and included the survey and excavation of contaminated soil, removal of remaining waste transfer lines, and completion of a FSS.

FSS and IVS activities were performed upon completion of soil excavation, as described further in Section 3.2. All pre-construction tasks for each work phase were completed prior to beginning D&D and characterization activities within the associated work area, including equipment mobilization, site inspections, and securing the general work area.

In addition, radiological and non-radiological hazards were either removed or stabilized prior to building demolition. This included the removal of contaminated equipment, partial decontamination of concrete surfaces, and the abatement of asbestos-containing material (ACM) (i.e., pipe insulation, tiles and calking).

The D&D of Building 811, as well as removal of the waste transfer lines and contaminated soil, were performed in accordance with the Demolition Plan (BNL, 2015). An excavator equipped with hydraulic shears was the primary tool used to dismantle the buildings. As further discussed in Section 3.3, demolition debris, ducts and piping were size reduced in order to meet the disposal facility's waste acceptance criteria (WAC). Building 810 was released from radiological controls prior to demolition.

### **3.1.1 Building 810**

The above grade portion of Building 810 was free released and removed from the site in June 2015.

Utilities were isolated prior to building demolition; and equipment and materials were removed prior to demolition as described below:

- Fluorescent lighting was removed and turned over to BNL F&O for onsite recycling.
- Electrical equipment (e.g., switch gears, transformers, breakers, switches, etc.) were removed and turned over to BNL F&O for onsite recycling.

The above grade portion of Building 810 was surveyed and released in accordance with BNL procedures. Results of the release survey satisfied the requirements of the BNL Radiological Control Manual, specifically the requirements of FS-SOP-1005, *Radiological Surveys Required for Release of Materials from Areas Controlled for Radiological Purposes* (BNL, 2014). The above grade portion of Building 810 was recycled as scrap metal.

The remaining building foundation was demolished and removed as low level radioactive waste (LLRW).



Photograph 3 – Demolition of Building 810



Photograph 4 – Demolition of Building 810 Foundation

### 3.1.2 Building 811

The D&D of Building 811 and the removal of the associated piping, subsurface foundation, and soil were completed between August 2015 and June 2016. Beginning in 2014, utilities were isolated prior to building demolition; and equipment and materials were removed prior to demolition as described below:

- The sole source of electric power for Building 811 was supplied via a 350 MCM overhead line fed from disconnect switch FU-FDR811 in Building 924 and was connected to the 480V Main Switchgear located on the building mezzanine. Prior to commencement of demolition activities, this electrical source was locked out at disconnect switch FU-FDR81 in Building 924, and the 350 MCM overhead line between Building 811 and Building 924 was removed.
- ACM was removed, packaged and shipped offsite for disposal as described in Section 3.3,
- Lighting fixtures considered suspect PCB containing material were removed, packaged and shipped offsite for disposal as described in Section 3.3.
- Fluorescent lighting was removed and turned over to BNL F&O for onsite recycling.
- Electrical equipment (e.g., switch gears, transformers, breakers, switches, etc.) were removed and turned over to BNL F&O for onsite recycling.



Photograph 5 – Demolition of Building 811



### 3.1.3 Aboveground/Underground Structures and Soil Removal

The building foundations, AST concrete supports, and underground piping were exposed using standard excavation methods. The concrete was rubblelized using excavator mounted tools. Soil handling (i.e., transport, stockpiling and erosion control) and soil excavation activities were performed in accordance with the Demolition Plan (BNL, 2015) and the Excavation Plan (BNL, 2015)

Overburden above the waste transfer lines was removed, stockpiled, surveyed and sampled in accordance with the requirements detailed in the FSP/QAPP (PWGC, 2015). Approximately 400 cubic yards of overburden soil was stockpiled, surveyed and sampled. None of the overburden soil surveyed contained activity greater than 21,500 cpm, or Cs-137 concentrations  $< 11.5$  pCi/g, the limits established in the FSP/QAPP (PWGC, 2015). Once the survey and sampling of the overburden was completed, it was stockpiled for use as backfill. The sampling results of the overburden sampling are summarized in Table 3-1.

All concrete associated with the AST supports and the foundations of Buildings 810 and 811 were removed. The remaining section of waste transfer line between Buildings 810 and 811 was removed and the concrete associated with the steam pit where the waste transfer lines transitioned from below grade to above grade was excavated. The Building 811 sanitary line was removed to a point approximately 30 feet south of its junction with a manhole (previously abandoned by filling with concrete) located in the Collider Accelerator Department metal storage yard.



Photograph 6 – Demolition of AST Concrete Supports

Table 3-1 - Building 811 Project – ISOCS Overburden Soil Sampling Results

| GRID | CS-137 (pCi/g) | GRID | CS-137 (pCi/g) | GRID | CS-137 (pCi/g) | GRID | CS-137 (pCi/g) |
|------|----------------|------|----------------|------|----------------|------|----------------|
| G1   | 0.200          | G16R | 0.306          | G32  | 0.257          | G47R | ND             |
| G1R  | 0.261          | G17  | ND             | G32R | 0.161          | G48  | ND             |
| G2   | 0.252          | G17R | 0.232          | G33  | 0.306          | G48R | ND             |
| G2R  | 0.185          | G18  | 0.439          | G33R | 0.122          | G49  | ND             |
| G3   | 0.314          | G18R | 0.265          | G34  | 0.346          | G49R | 0.357          |
| G3R  | 0.341          | G19  | 0.233          | G34R | 0.154          | G50  | 0.444          |
| G4   | 0.284          | G19R | 0.242          | G35  | 0.453          | G50R | ND             |
| G4R  | ND             | G20  | 0.489          | G35R | 0.525          | G51  | 0.385          |
| G5   | 0.432          | G20R | 0.223          | G36  | 0.29           | G51R | 0.188          |
| G5R  | 0.326          | G21  | 0.449          | G36R | 0.359          | G52  | 0.407          |
| G6   | 0.276          | G21R | 0.245          | G37  | 0.303          | G52R | ND             |
| G6R  | 0.277          | G22  | 0.393          | G37R | 0.195          | G53  | 0.691          |
| G7   | 0.350          | G22R | 0.387          | G38  | ND             | G53R | 0.49           |
| G7R  | 0.338          | G23  | 0.441          | G38R | ND             | G54  | ND             |
| G8   | 4.911          | G23R | 0.400          | G39  | ND             | G54R | ND             |
| G8R  | 0.446          | G24  | 2.380          | G39R | ND             | G55  | 0.315          |
| G9   | 0.395          | G24R | 0.253          | G40  | ND             | G55R | 0.176          |
| G9R  | 0.297          | G25  | 0.698          | G40R | ND             |      |                |
| G10  | 0.260          | G25R | 1.340          | G41  | ND             |      |                |
| G10R | 0.256          | G26  | 0.484          | G41R | ND             |      |                |
| G11  | 0.364          | G26R | 0.188          | G42  | ND             |      |                |
| G11R | 0.298          | G27  | 0.125          | G42R | ND             |      |                |
| G12  | 0.193          | G27R | ND             | G43  | 0.099          |      |                |
| G12R | 0.226          | G28  | 0.579          | G43R | 0.222          |      |                |
| G13  | 0.331          | G28R | 0.49           | G44  | ND             |      |                |
| G13R | 0.222          | G29  | ND             | G44R | 0.288          |      |                |
| G14  | 0.297          | G29R | ND             | G45  | 0.489          |      |                |
| G14R | 0.196          | G30  | 0.403          | G45R | ND             |      |                |
| G15  | 0.370          | G30R | 0.251          | G46  | ND             |      |                |
| G15R | 0.360          | G31  | 0.391          | G46R | ND             |      |                |
| G16  | 0.279          | G31R | 0.3            | G47  | ND             |      |                |

Note:

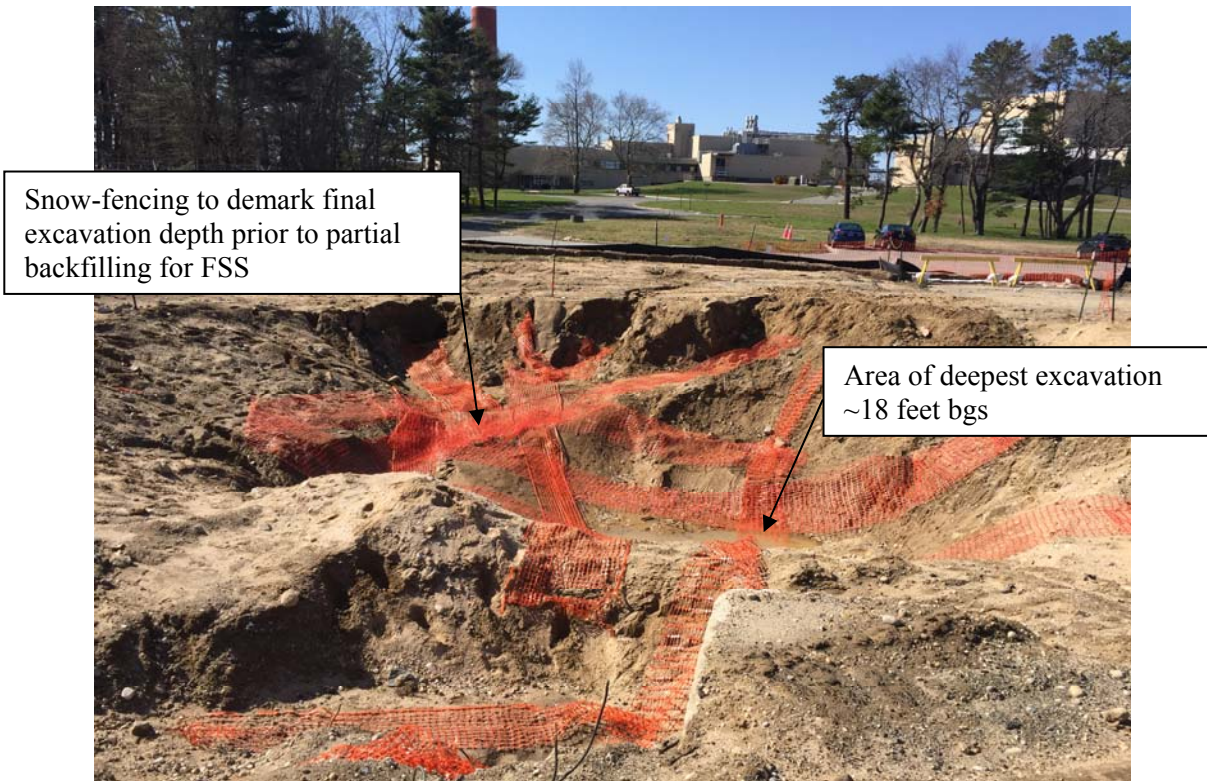
R = Sample from grid area with highest NAI reading



Photograph 7 – Waste Transfer Lines Removal

Once the building foundations, associated concrete structures, and waste transfer lines were removed and packaged, preliminary radiological walkover surveys and sampling were performed. Areas with count rates above the action level of 21,500 cpm with an uncollimated 2 x 2 sodium iodide (NaI) detector were excavated and packaged for off-site disposal. Excavation continued until field measurements were below 21,500 cpm. There were three exceptions:

- An area adjacent to and south-southwest of the concrete vault for the A/B waste tanks was excavated to approximately 6 feet to 8 feet bgs with field measurements between 25,000 – 35,000 cpm remaining. Sampling of this area indicated Cs-137 concentrations of 30.8 pCi/g (Location SS001 on Figure 3-1). This area coincides with one of the areas of contamination identified and left in-place during the 2005 FSS of the A/B Waste Storage Tanks.
- The area beneath the footprint of Building 811 was excavated to approximately 18 feet bgs. Access to this portion of the excavation to conduct radiological surveys was not possible due to the depth of the excavation. Samples were collected from the base of this portion of the excavation using long-handled hand augers and/or the excavator. After excavation of soil to 18 feet bgs, the detected Cs-137 concentration was 46.6 pCi/g (Location SS003 on Figure 3-1). At this point the limits of the excavation equipment had been reached. Photograph 8 shows the final excavation prior to partial backfill to allow for radiological surveys to be performed.



Photograph 8 – Completed Building 811 Excavation, Looking South (prior to partial backfill of the deepest portion and grading of side slopes)



- An area of elevated activity was identified along the fence line between the Collider Accelerator Department metal storage area and AOC 10 and surrounding area. The area of elevated activity straddles the fenceline and is further discussed in Section 7.0 and shown on Figure 7-1.

Preliminary walkover survey and excavation sampling results prior to beginning the FSS are provided on Figure 3-1. The two areas in red ( $>21,500$  cpm) on the north side of SU-1 were removed prior to beginning the FSS.

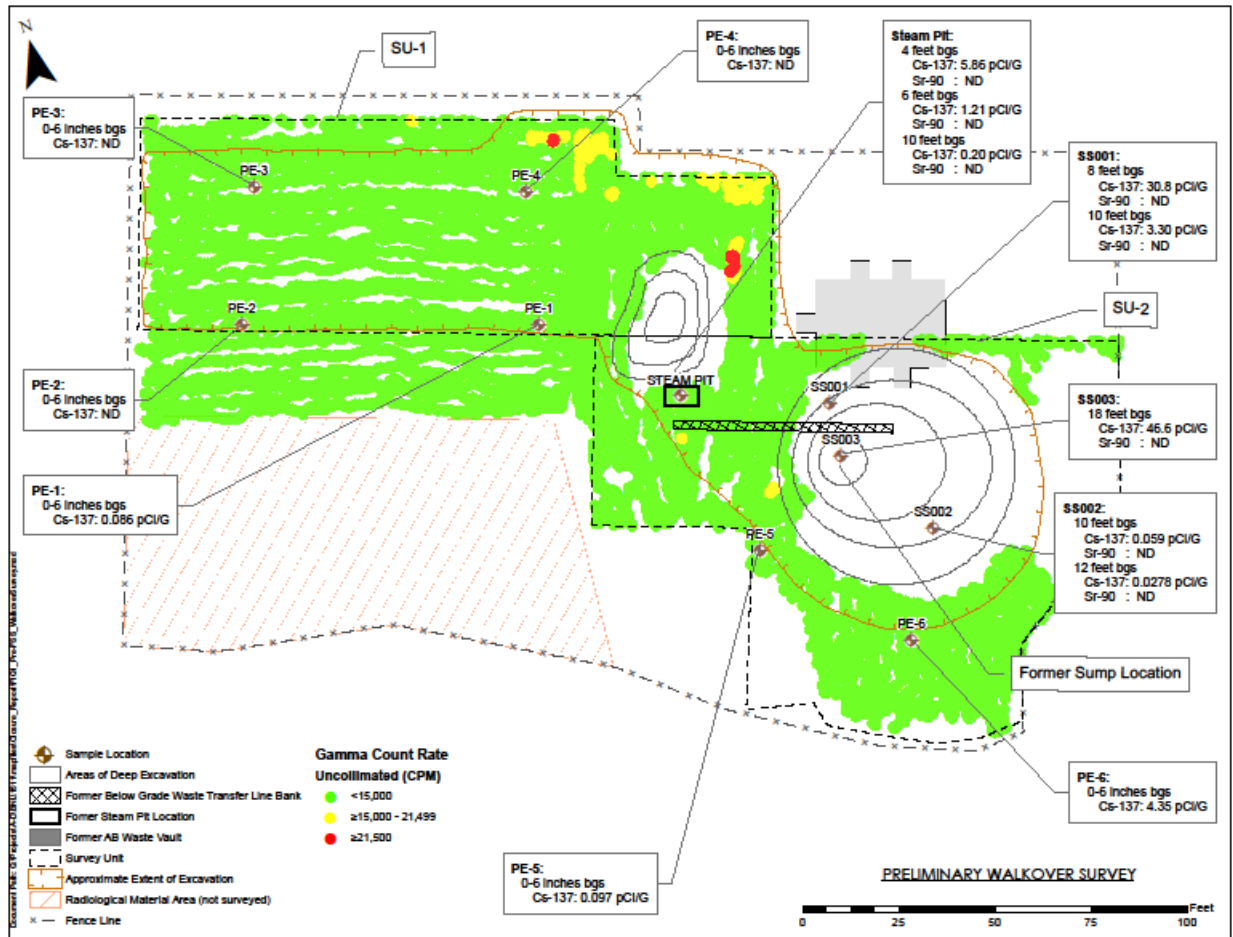


Figure 3-1 – Preliminary Walkover Survey Data and Sampling Results

### 3.2 Final Status Survey and Sampling

After completion of the building demolitions, debris removal, preliminary radiological surveys, and contaminated soil removal, an FSS was performed in May 2016 to confirm that the as-left conditions met the Building 811 Project cleanup criteria.



The excavation depths within survey units SU-1 and SU-2 varied. In general all the areas within the two survey units were excavated to some degree. Survey unit SU-1 excavation depths ranged from ground surface at the western boundary to 6.0 feet bgs at the southeastern corner of the survey unit. In SU-2, the deepest excavation extended to 18.0 feet bgs. The extent of the site excavation is provided on Figure 3-1.

As discussed in Section 2.1, the primary radionuclides of concern, based on exposure potential, were Cs-137, Ra-226, and Sr-90. Although less likely to be present, certain other radionuclides were monitored and include tritium, gamma emitters (i.e., Co-60 and Eu-152), and alpha emitters (isotopes of uranium and plutonium).



Photograph 9 – Performing Radiological Walkover Survey in SU-1

### 3.2.1 Final Status Survey Design

The FSS was divided into two survey units (SU-1 and SU-2). SU-1 (10,500 ft<sup>2</sup>) included the former AST area and footprint of Building 810, SU-2 (9,000 ft<sup>2</sup>) included the footprint of Building 811 and areas immediately adjacent, including the area of the former transfer lines and steam pit. Modifications were made to the areas of the survey units from their initial description in the FSP/QAPP (PWGC, 2015). The area of SU-1 was decreased slightly, removing approximately 5 feet from the fence line with the Collider Accelerator Department metal storage yard to the north. The area of SU-2 was increased to include excavated areas adjacent to Building 811.

For SU-1 and SU-2, a two-step approach to cleanup confirmation for radiological soil contamination was followed using the MARSSIM approach. The first step consisted of a global positioning system (GPS)-based gamma scintillation walkover survey using a 2-inch by 2-inch NaI detector in conjunction with a Ludlum Model 2221 scaler/ratemeters and a PRO XR Satellite Receiver Trimble model TSCe Data Logger (Trimble Unit). The second step involved the collection of soil samples, in accordance with BNL Environmental Management (EM) SOPs, for offsite analysis to verify that residual radiological contamination levels were sufficiently low to meet the cleanup goal established for the site. Fixed point one-minute measurements with the uncollimated 2 x 2 NaI detector were measured at each of the sample points prior to sample collection.

Core samples were taken from SU-1 and SU-2 to determine if there was residual contamination at depth, core samples were analyzed by gamma spectroscopy and Sr-90. Composites of the surface samples were analyzed for gamma emitters, alpha emitters, Sr-90, and tritium.

The survey unit boundaries and sample locations for SU-1 and SU-2 are shown in Figure 3-2.

### **3.2.2 Final Status Survey and Sampling Results**

The results of the FSS are presented below. Laboratory Reports for the FSS sampling data are provided in Appendix A.

#### **1. SU-1 and SU-2 Gamma Scans**

As specified in the FSP/QAPP (PWGC, 2015), the value of the 21,500 cpm count rate was determined to approximate a Cs-137 concentration of 15 pCi/g in soil at the ground surface, or two-thirds of the cleanup value for Cs-137 in soil when using the uncollimated NaI gamma scintillation detector. The scan Minimum Detectable Concentration (MDC) is 4.4 - 7.5 pCi/g, based on typical to high background levels. This scan MDC is described in the FSP/QAPP (PWGC, 2015), in Appendix A, and the development of the value of 21,500 cpm per 15 pCi/g is described in Appendix B of the same document.

Results of the final status radiological walkover survey for SU-1 and SU-2 exhibited count rates below 21,500 cpm using the uncollimated probe for all areas, except as described below and in Section 3.1.3.

As shown in Figure 3-3, three areas with readings greater than 21,500 cpm were identified during the FSS (i.e., Hotspot #1, #2, and #3). Hotspots #1 and #2 were remediated, sampled and resurveyed. Results of the sampling are provided on Table 3-2. When comparing Figure 3-4 to Figure 3-3, it can be seen that the gamma count rate levels have decreased following hotspot remediation.

Figure 3-3 indicates the area designated as "Hot Spot 3", which remains in place at an approximate depth below the final backfilled ground surface of between 4 feet and 8

feet in the northern portion and deeper than 18 feet at the southern end of the hotspot. This is the same area of elevated activity described previously in Section 3.1.3.

Table 3-2 - Hotspot Sampling Summary

| Date      | Sample Name        | Sample Depth<br>from excavation<br>grade (ft) | Sample Depth<br>from original<br>Grade | Cesium 137 (pCi/g) |   | Radium 226 (pCi/g) |   | Strontium 90 (pCi/g) |   |
|-----------|--------------------|-----------------------------------------------|----------------------------------------|--------------------|---|--------------------|---|----------------------|---|
|           |                    |                                               |                                        | Grab<br>Samples    | Q | Grab<br>Samples    | Q | Grab<br>Samples      | Q |
| 5/20/2016 | B811-PE-Hotspot 1  | 0-0.5                                         | 2                                      | 3.550              |   | 0.437              |   | 0.0353               | U |
| 5/20/2016 | B811-PE-Hotspot 2  | 0-0.5                                         | 2                                      | 20.000             |   | 0.336              |   | 15.9                 |   |
| 7/20/2016 | B811-PE-Hotspot 2a | 1.5-2.0                                       | 4                                      | NR                 |   | NR                 |   | 0.888                | U |

## 2. SU-1 and SU-2 Surface Soil Samples

Surface soil samples were collected at 32 locations. All sample results (including composite samples) were below the site cleanup values for Cs-137, Sr-90 and Ra-226, with the exception of sample location, SU-1-16, which exceeded the site cleanup value for Cs-137 (30.6 pCi/g). Samples were collected in accordance with the FSP/QAPP (PWGC, 2015). A summary of the soil sample results is provided in Table 3-3, and the individual sample results (including composite samples) are shown in Table 3-4. The six composite samples indicated no detection of tritium or Sr-90. Uranium-238 (U-238) was the only alpha-emitting isotope detected above Minimum Detectable Concentration (MDC) for the alpha-emitting isotopes reported. The maximum reported concentration of U-238 was 0.606 pCi/g. Table 3-5 shows the results including the uncertainty (95% confidence level) and the minimum detectable concentration for each surface sample. Table 3-6 provides the same information for the composite samples hard-to-detect radionuclides (Pu-238, Pu-239/240, U-235, U-238, and tritium).

For the six composite samples, the sample increments were as follows:

1. Composite 1: SU-1-1 through SU-1-5 (5 increments)
2. Composite 2: SU-1-6 through SU-1-11 (6 increments)
3. Composite 3: SU-1-12 through SU-1-16 (5 increments)
4. Composite 4: SU-2-1 through SU-2-5 (5 increments)
5. Composite 5: SU-2-6 through SU-2-11 (6 increments)
6. Composite 6: SU-2-12 through SU-2-16 (5 increments)

There were a maximum of six increments per composite. A modified investigation level (MIL) is determined by taking the DCGL and dividing by the square root of the number of increments. This MIL is then compared to the MDC for each radionuclide to ensure that the level of detection is acceptable. In Table 3-7 below, for each contaminant analyzed in the composite samples, the MDC is less than the MIL.

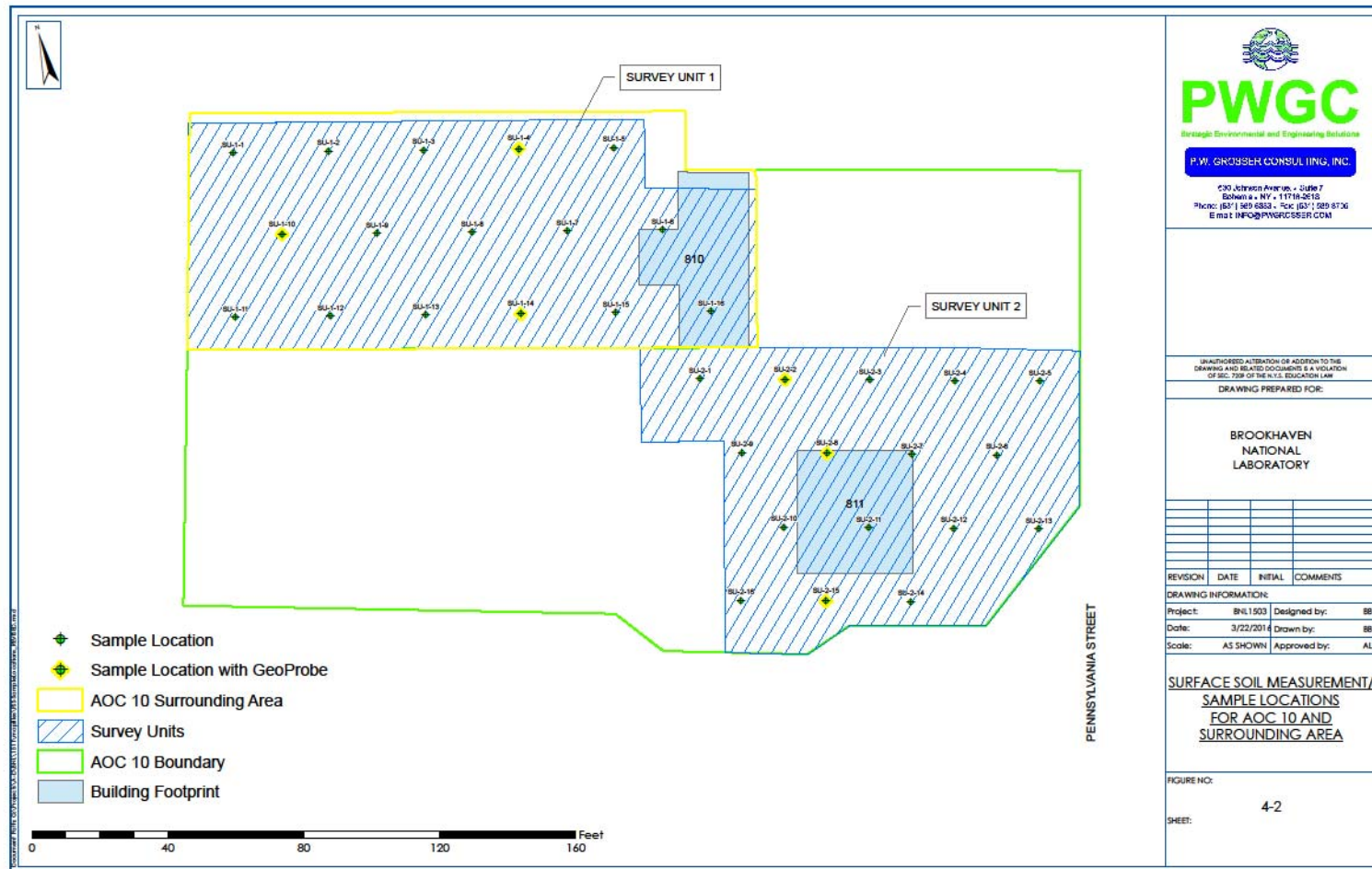


Figure 3-2 – AOC 10 and Surrounding Area Survey Units and Sampling Locations

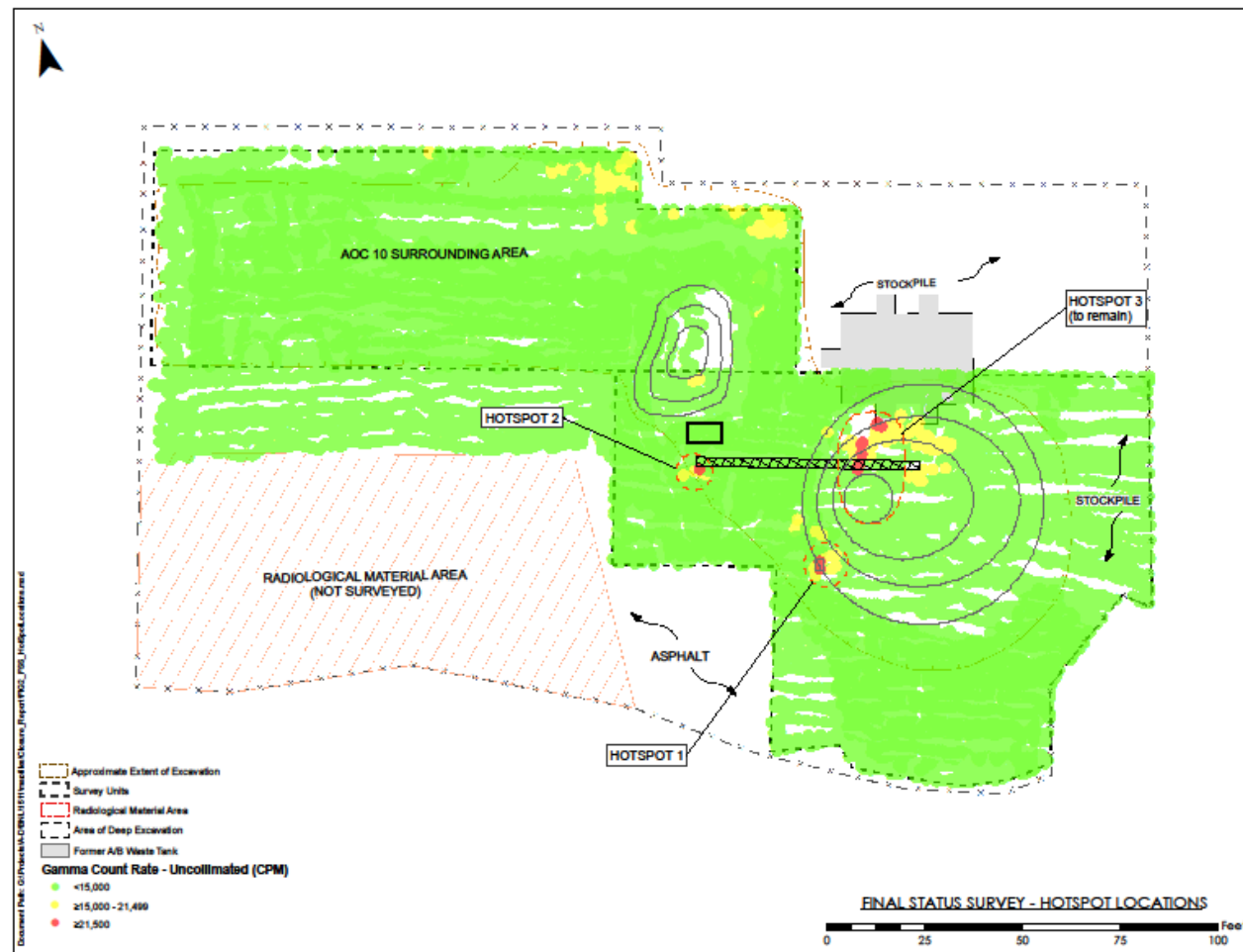


Figure 3-3 – SU-1 and SU-2 FSS Gamma Walkover Survey Results Showing Hotspots (Un-collimated Probe)

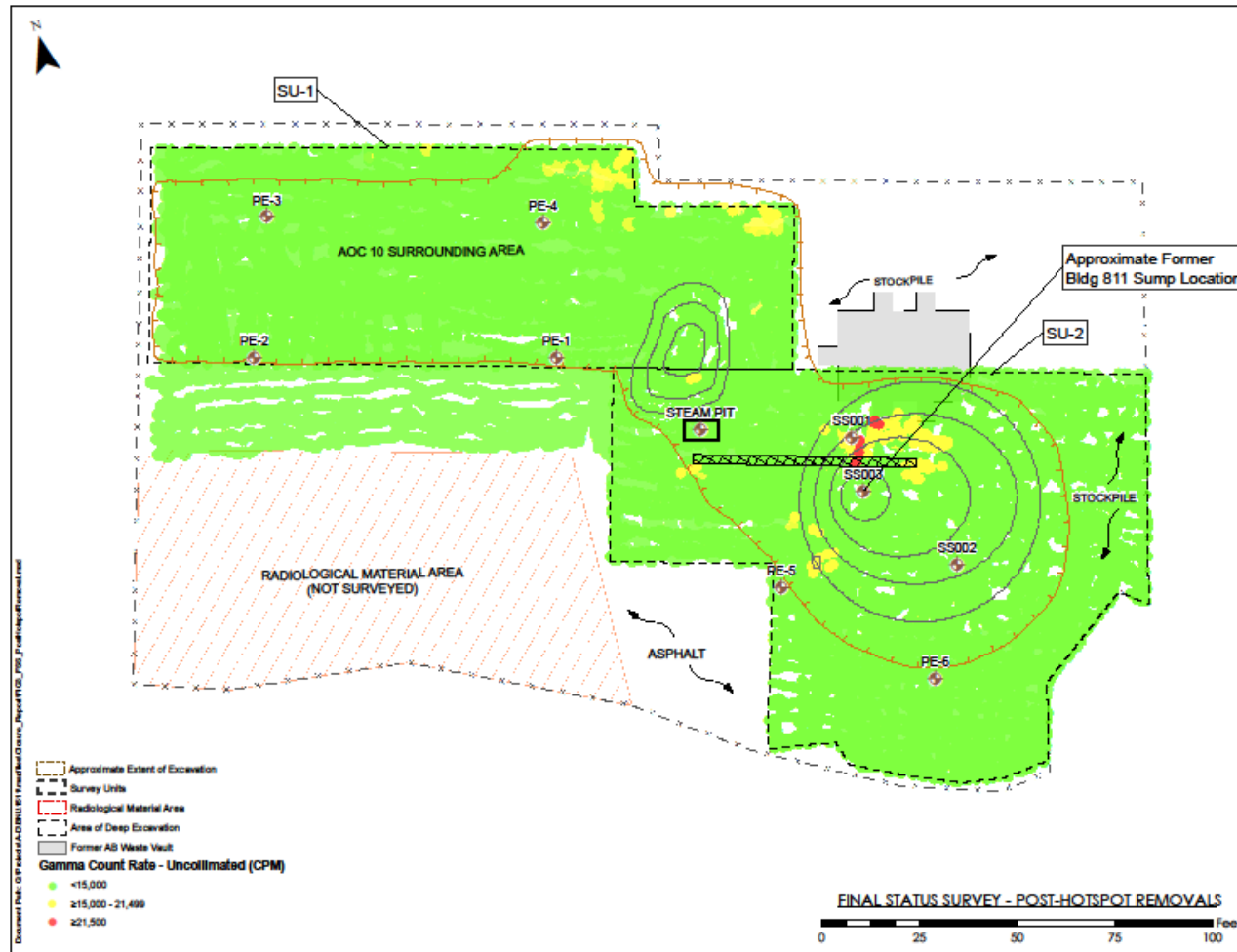


Figure 3-4 – SU-1 and SU-2 FSS Gamma Walkover Survey Results after Hotspot Remediation (Un-collimated Probe)

Table 3-3 - Summary of SU-1 &amp; SU-2 Surface Soil Sample Results for Radionuclides

|               | Cs-137 (pCi/g)                                  | Sr-90 (pCi/g)                          | Ra-226 (pCi/g) | U-238 (pCi/g) |
|---------------|-------------------------------------------------|----------------------------------------|----------------|---------------|
| Cleanup Value | 23                                              | 15                                     | 5              | N/A*          |
| Average       | 3.85 (average including results from Table 3-2) | 0.214                                  | 0.496          | 0.447         |
| Maximum       | 30.6                                            | No samples indicated detectable values | 0.846          | 0.606**       |

\* U-238 is not listed in the ROD; however, a RESRAD evaluation shows a derived value of 4.7 pCi/g as detailed in Table 2-1

\*\* The composite sample for SU-2 indicated U-238 at an "estimated" value (J Qualifier) of 0.606 pCi/g

-Composite and Core samples not included in the Cs-137, Ra-226 or Sr-90 averages

In addition, individual 1-minute fixed-point measurements were taken with the NaI probe at each of the 32 fixed sample points. The results ranged from 5,707 to 15,078 cpm, which are below the 21,500 cpm field screening level. The gamma fixed-point readings are provided in Table 3-4.

Radiological results for offsite soil sample analyses are provided in Appendix A.

### 3. SU-1 and SU-2 Core Sample Results

Core samples were collected at six locations identified on Figure 3-2 in two foot intervals from 0.5 feet to 8.0 feet below excavation grade. One of the 24 samples collected exceeded the cleanup value for Cs-137. Concentrations of Cs-137, detected above MDC, ranged from 0.027 pCi/g (GP-SU-2-15, 4-6 feet) to 50.5 pCi/g (GP-SU-2-2, 2-4 feet). Sr-90 was not reported above detection limits. Results of the core sampling are summarized on Table 3-8.



Table 3-4 - SU-1 &amp; SU-2 Surface Soil Sample Results for Radionuclides

| Survey Unit 1  |                                         |                                              |                                                      |                    |   |                    |    |                      |   |                     |   |
|----------------|-----------------------------------------|----------------------------------------------|------------------------------------------------------|--------------------|---|--------------------|----|----------------------|---|---------------------|---|
| Sample Name    | Sample Depth from Excavation Grade (ft) | Approximate Sample Depth from Original Grade | One Minute Fixed Gamma Count Rate Uncollimated (CPM) | Cesium 137 (pCi/g) |   | Radium 226 (pCi/g) |    | Strontium 90 (pCi/g) |   | Uranium 238 (pCi/g) |   |
|                |                                         |                                              |                                                      | Result             | Q | Result             | Q  | Result               | Q | Results             | Q |
| SU-1-1         | 0.0-0.5                                 | 0.0-0.5                                      | 7,788                                                | 0.201              |   | 0.472              |    | 0.369                | U | NR                  |   |
| SU-1-2         | 0.0-0.5                                 | 0.0-0.5                                      | 6,230                                                | 0.312              |   | 0.334              | UI | 0.724                | U | NR                  |   |
| SU-1-3         | 0.0-0.5                                 | 0.0-0.5                                      | 5,707                                                | 0.668              |   | 0.373              |    | 0.0135               | U | NR                  |   |
| SU-1-4         | 0.0-0.5                                 | 2.0-2.5                                      | 10,518                                               | 7.330              |   | 0.542              |    | -0.58                | U | NR                  |   |
| SU-1-5         | 0.0-0.5                                 | 2.0-2.5                                      | 12,505                                               | 5.140              |   | 0.590              |    | 0.196                | U | NR                  |   |
| SU-1-6         | 0.0-0.5                                 | 0.5-1.0                                      | 9,134                                                | 2.470              |   | 0.658              |    | -0.137               | U | NR                  |   |
| SU-1-7         | 0.0-0.5                                 | 0.5-1.0                                      | 6,777                                                | 0.414              |   | 0.466              |    | 1                    | U | NR                  |   |
| SU-1-8         | 0.0-0.5                                 | 0.5-1.0                                      | 6,497                                                | 0.255              |   | 0.319              |    | -0.212               | U | NR                  |   |
| SU-1-9         | 0.0-0.5                                 | 0.5-1.0                                      | 6,740                                                | 0.347              |   | 0.313              |    | 0.233                | U | NR                  |   |
| SU-1-10        | 0.0-0.5                                 | 0.5-1.0                                      | 6,650                                                | 0.066              | U | 0.389              |    | -0.388               | U | NR                  |   |
| SU-1-11        | 0.0-0.5                                 | 0.5-1.0                                      | 6,963                                                | 0.359              |   | 0.234              |    | -0.37                | U | NR                  |   |
| SU-1-12        | 0.0-0.5                                 | 0.5-1.0                                      | 7,345                                                | 0.937              |   | 0.323              |    | -0.0624              | U | NR                  |   |
| SU-1-13        | 0.0-0.5                                 | 0.5-1.0                                      | 6,802                                                | 0.510              |   | 0.439              |    | 0.603                | U | NR                  |   |
| SU-1-14        | 0.0-0.5                                 | 0.5-1.0                                      | 6,298                                                | 0.726              |   | 0.470              |    | 0.315                | U | NR                  |   |
| SU-1-15        | 0.0-0.5                                 | 0.5-1.0                                      | 8,928                                                | 3.020              |   | 0.279              |    | 0.678                | U | NR                  |   |
| SU-1-16        | 0.0-0.5                                 | 2.0-2.5                                      | 10,275                                               | 30.600             |   | 0.552              |    | 0.915                | U | NR                  |   |
| Composite 1    | NA                                      | NA                                           | NA                                                   | 2.610              |   | 0.436              |    | -0.178               | U | 0.511               | J |
| Composite 2    | NA                                      | NA                                           | NA                                                   | 0.461              |   | 0.285              |    | 1.09                 | U | 0.328               | U |
| Composite 3    | NA                                      | NA                                           | NA                                                   | 1.750              |   | 0.585              | UI | 0.19                 | U | 0.290               |   |
| Survey Unit 2  |                                         |                                              |                                                      |                    |   |                    |    |                      |   |                     |   |
| SU-2-1         | 0.0-0.5                                 | 2.0-2.5                                      | 13,627                                               | 7.800              |   | 0.590              |    | 1.16                 | U | NR                  |   |
| SU-2-2         | 0.0-0.5                                 | 2.0-2.5                                      | 10,532                                               | 3.930              |   | 0.709              |    | 0.963                | U | NR                  |   |
| SU-2-3         | 0.0-0.5                                 | 7.5-8.0                                      | 15,078                                               | 9.220              |   | 0.696              |    | 0.297                | U | NR                  |   |
| SU-2-4         | 0.0-0.5                                 | 0.5-1.0                                      | 8,292                                                | 1.210              |   | 0.599              |    | -0.298               | U | NR                  |   |
| SU-2-5         | 0.0-0.5                                 | 0.0-0.5                                      | 8,331                                                | 3.100              |   | 0.435              |    | -0.151               | U | NR                  |   |
| SU-2-6         | 0.0-0.5                                 | 0.5-1.0                                      | 8,894                                                | 2.710              |   | 0.534              |    | 0.655                | U | NR                  |   |
| SU-2-7         | 0.0-0.5                                 | 6.0-6.5                                      | 10,003                                               | 1.850              |   | 0.527              |    | -0.511               | U | NR                  |   |
| SU-2-8         | 0.0-0.5                                 | 6.0-6.5                                      | 9,802                                                | 3.000              |   | 0.376              |    | -0.355               | U | NR                  |   |
| SU-2-9         | 0.0-0.5                                 | 2.0-2.5                                      | 10,368                                               | 4.540              |   | 0.456              |    | 0.275                | U | NR                  |   |
| SU-2-10        | 0.0-0.5                                 | 0.5-1.0                                      | 8,980                                                | 2.890              |   | 0.460              |    | -0.119               | U | NR                  |   |
| SU-2-11        | 0.0-0.5                                 | 2.0-2.5                                      | 8,337                                                | 2.400              |   | 0.583              |    | 0.704                | U | NR                  |   |
| SU-2-12        | 0.0-0.5                                 | 2.0-2.5                                      | 8,606                                                | 2.450              |   | 0.846              |    | -0.379               | U | NR                  |   |
| SU-2-13        | 0.0-0.5                                 | 0.0-0.5                                      | 8,363                                                | 1.450              |   | 0.584              |    | -0.649               | U | NR                  |   |
| SU-2-14        | 0.0-0.5                                 | 0.0-0.5                                      | 8,343                                                | 2.250              |   | 0.485              |    | 0.619                | U | NR                  |   |
| SU-2-15        | 0.0-0.5                                 | 0.0-0.5                                      | 8,086                                                | 0.206              |   | 0.582              |    | -0.114               | U | NR                  |   |
| SU-2-16        | 0.0-0.5                                 | 0.0-0.5                                      | 6,094                                                | 5.110              |   | 0.644              |    | 0.971                | U | NR                  |   |
| Composite 4    | NA                                      | NA                                           | NA                                                   | 3.700              |   | 0.552              |    | -0.0802              | U | 0.563               | U |
| Composite 5    | NA                                      | NA                                           | NA                                                   | 2.860              |   | 0.521              |    | -0.645               | U | 0.385               | U |
| Composite 6    | NA                                      | NA                                           | NA                                                   | 1.620              |   | 0.601              |    | -0.82                | U | 0.606               | J |
| Average Result |                                         |                                              |                                                      | 3.170              |   | 0.496              |    | 0.156                |   | 0.447               |   |

Notes:

U - Analyte was analyzed for, but not detected above the MDL, MDA, LOD.

J - Value is estimated.

Denotes GeoProbe Sample Location

Q- Qualifier

NA-Not Applicable

NR-Not Reported

Table 3-5 - SU-1 and SU-2 Surface Sample Results with MDC

| Sample Name | Cs-137 (pCi/g)  | MDC (pCi/g) | Ra-226 (pCi/g) | MDC (pCi/g) | Sr-90 (pCi/g)   | MDC (pCi/g) |
|-------------|-----------------|-------------|----------------|-------------|-----------------|-------------|
| SU-1-1      | 0.201 ± 0.047   | 0.0475      | 0.472 ± 0.118  | 0.0996      | 0.369 ± 0.716   | 1.28        |
| SU-1-2      | 0.312 ± 0.0935  | 0.0729      | 0.334 ± 0.124  | 0.239       | 0.724 ± 0.809   | 1.35        |
| SU-1-3      | 0.668 ± 0.0977  | 0.0572      | 0.373 ± 0.122  | 0.121       | 0.0135 ± 0.805  | 1.54        |
| SU-1-4      | 7.33 ± 0.272    | 0.0593      | 0.542 ± 0.155  | 0.159       | (0.58) ± 0.805  | 1.61        |
| SU-1-5      | 5.14 ± 0.263    | 0.0869      | 0.590 ± 0.215  | 0.195       | 0.196 ± 0.598   | 1.11        |
| SU-1-6      | 2.47 ± 0.227    | 0.0879      | 0.658 ± 0.236  | 0.232       | (0.137) ± 0.567 | 1.18        |
| SU-1-7      | 0.414 ± 0.0884  | 0.0625      | 0.466 ± 0.103  | 0.100       | 1.00 ± 0.881    | 1.41        |
| SU-1-8      | 0.255 ± 0.0726  | 0.0517      | 0.319 ± 0.125  | 0.129       | (0.212) ± 0.600 | 1.31        |
| SU-1-9      | 0.347 ± 0.0756  | 0.0612      | 0.313 ± 0.142  | 0.120       | 0.233 ± 0.634   | 1.16        |
| SU-1-10     | 0.0664 ± 0.0768 | 0.0905      | 0.389 ± 0.229  | 0.150       | (0.388) ± 0.998 | 1.90        |
| SU-1-11     | 0.359 ± 0.0829  | 0.0668      | 0.234 ± 0.190  | 0.153       | (0.37) ± 0.421  | 0.98        |
| SU-1-12     | 0.937 ± 0.0954  | 0.0507      | 0.323 ± 0.119  | 0.122       | (0.0624) ± 1.05 | 1.94        |
| SU-1-13     | 0.510 ± 0.0885  | 0.0669      | 0.439 ± 0.132  | 0.128       | 0.603 ± 0.865   | 1.49        |
| SU-1-14     | 0.726 ± 0.105   | 0.0663      | 0.470 ± 0.150  | 0.136       | 0.315 ± 0.707   | 1.26        |
| SU-1-15     | 3.02 ± 0.165    | 0.0646      | 0.279 ± 0.111  | 0.111       | 0.678 ± 0.571   | 0.90        |
| SU-1-16     | 30.6 ± 0.544    | 0.0911      | 0.552 ± 0.164  | 0.192       | 0.915 ± 0.800   | 1.27        |
| SU-2-1      | 7.80 ± 0.315    | 0.0756      | 0.590 ± 0.141  | 0.136       | 1.16 ± 0.883    | 1.39        |
| SU-2-2      | 3.93 ± 0.229    | 0.0746      | 0.709 ± 0.178  | 0.182       | 0.963 ± 1.11    | 1.87        |
| SU-2-3      | 9.22 ± 0.338    | 0.0875      | 0.696 ± 0.220  | 0.190       | 0.297 ± 0.792   | 1.42        |
| SU-2-4      | 1.21 ± 0.127    | 0.0617      | 0.599 ± 0.138  | 0.130       | (0.298) ± 0.658 | 1.41        |
| SU-2-5      | 3.10 ± 0.239    | 0.1020      | 0.435 ± 0.202  | 0.215       | (0.151) ± 0.691 | 1.38        |
| SU-2-6      | 2.71 ± 0.199    | 0.0824      | 0.534 ± 0.208  | 0.170       | 0.655 ± 0.755   | 1.27        |
| SU-2-7      | 1.85 ± 0.164    | 0.0714      | 0.527 ± 0.197  | 0.132       | (0.511) ± 0.728 | 1.52        |
| SU-2-8      | 3.00 ± 0.192    | 0.0735      | 0.376 ± 0.170  | 0.150       | (0.355) ± 0.642 | 1.32        |
| SU-2-9      | 4.54 ± 0.215    | 0.0723      | 0.456 ± 0.136  | 0.142       | 0.275 ± 0.521   | 0.93        |
| SU-2-10     | 2.89 ± 0.199    | 0.0910      | 0.460 ± 0.162  | 0.161       | (0.119) ± 0.627 | 1.26        |
| SU-2-11     | 2.40 ± 0.203    | 0.0763      | 0.583 ± 0.166  | 0.141       | 0.704 ± 0.729   | 1.20        |
| SU-2-12     | 2.45 ± 0.199    | 0.0785      | 0.846 ± 0.168  | 0.137       | (0.379) ± 0.431 | 1.02        |
| SU-2-13     | 1.45 ± 0.128    | 0.0706      | 0.584 ± 0.135  | 0.112       | (0.649) ± 0.634 | 1.38        |
| SU-2-14     | 2.25 ± 0.161    | 0.0631      | 0.485 ± 0.131  | 0.135       | 0.619 ± 0.786   | 1.34        |
| SU-2-15     | 0.206 ± 0.081   | 0.0729      | 0.582 ± 0.132  | 0.132       | (0.114) ± 0.645 | 1.27        |
| SU-2-16     | 5.11 ± 0.250    | 0.0626      | 0.644 ± 0.179  | 0.161       | 0.971 ± 0.776   | 1.23        |

Table 3-6 - SU-1 and SU-2 Composite Sample Results with MDC

| Sample Name | Pu-238 (pCi/g)  | MDC (pCi/g) | Pu-239 (pCi/g)  | MDC (pCi/g) | U-235 (pCi/g)  | MDC (pCi/g) | U-238 (pCi/g) | MDC (pCi/g) | H-3 (pCi/g)   | MDC (pCi/g) |
|-------------|-----------------|-------------|-----------------|-------------|----------------|-------------|---------------|-------------|---------------|-------------|
| Compos. 1   | (.0328) ± 0.145 | 0.379       | 0.00 ± 0.138    | 0.205       | 0.179 ± 0.307  | 0.269       | 0.511 ± 0.433 | 0.478       | 19 ± 74.6     | 131         |
| Compos. 2   | (.0598) ± 0.181 | 0.507       | (.0797) ± 0.185 | 0.547       | 0.107 ± 0.300  | 0.320       | 0.328 ± 0.426 | 0.605       | 60.4 ± 104    | 178         |
| Compos. 3   | 0.00 ± 0.163    | 0.243       | (.0389) ± 0.172 | 0.449       | 0.00 ± 0.241   | 0.359       | 0.290 ± 0.382 | 0.290       | 16.2 ± 70.9   | 124         |
| Compos. 4   | (.0604) ± 0.182 | 0.513       | (.0604) ± 0.182 | 0.512       | (.105) ± 0.199 | 0.614       | 0.563 ± 0.542 | 0.795       | (18.2) ± 64.9 | 118         |
| Compos. 5   | (.0832) ± 0.158 | 0.486       | (.0665) ± 0.154 | 0.456       | 0.00 ± 0.211   | 0.313       | 0.385 ± 0.451 | 0.625       | 31.6 ± 60.9   | 105         |
| Compos. 6   | (.0203) ± 0.175 | 0.406       | (.0779) ± 0.263 | 0.684       | 0.0966 ± 0.272 | 0.290       | 0.606 ± 0.462 | 0.375       | 8.55 ± 86.5   | 153         |

Table 3-7 - Modified Investigation Level for Composite Samples

| Contaminant | DCGL <sub>w</sub> (pCi/g) | MDC (pCi/g) | MIL (pCi/g) | Ratio of MDC to MIL |
|-------------|---------------------------|-------------|-------------|---------------------|
| H-3         | 1010                      | 178         | 412.3       | 0.43                |
| U-235       | 4.6                       | 0.51        | 1.9         | 0.27                |
| U-238       | 4.7                       | 0.26        | 1.9         | 0.14                |
| Pu-238      | 57                        | 0.66        | 23.3        | 0.03                |
| Pu-239      | 35                        | 0.37        | 14.3        | 0.03                |

### 3.2.3 Sign Test and Elevated Measurement Comparison

In survey unit SU-1, one sample exceeded the cleanup criteria, and the survey unit was tested using the sign test and Elevated Measurement Comparison (EMC). The sign test checks whether a sufficient number of sample locations are less than the cleanup criteria. Using all of the 16 surface samples taken, the MARSSIM Table I.3 is used to determine the number of acceptable values. In the sign test method, a sample point that has a positive value is below the cleanup criteria. During the initial selection of sampling points, as described in Appendix C of the FSP/QAPP, the Type I decision error (alpha) and Type II decision error (beta) were both set at 0.05. From Table I.3 of MARSSIM, for 16 sample points and alpha = 0.05, at least 11 values of the sign test must be positive. Since there are 15 positive values, this survey unit passes the sign test. Survey Unit 1 sample results and the sign test statistic are shown in Table 3-9.

The one sample location that exceeded the sum of the fractions limit is considered in the EMC. As described in Appendix B of the FSP/QAPP (PWGC, 2015), area factors have been developed for various sized areas down to 1 m<sup>2</sup>. The area of contamination was small, and was conservatively estimated at < 2 m<sup>2</sup>, and the Area Factor for 2 m<sup>2</sup> is 5.7. The comparison is shown in Table 3-10, and the results indicate a sum of the fractions of 0.57. This is less than 1.0, and the survey unit passes the EMC.

Table 3-8 - SU-1 &amp; SU-2 Geoprobe Soil Sample Results for Radionuclides

| Date           | Sample Name     | Sample Depth from excavation grade (ft) | Sample Depth from original Grade | Cesium 137 (pCi/g) |      | Radium 226 (pCi/g) |      | Strontium 90 (pCi/g) |   |
|----------------|-----------------|-----------------------------------------|----------------------------------|--------------------|------|--------------------|------|----------------------|---|
|                |                 |                                         |                                  | Grab Samples       | Q    | Grab Samples       | Q    | Grab Samples         | Q |
| 5/17/2016      | B811-GP-SU-1-4  | 0.5-2                                   | 2.5-4.0                          | 1.420              | J    | 0.533              | J    | 0.0924               | U |
| 5/17/2016      | B811-GP-SU-1-4  | 2-4                                     | 4.0-6.0                          | -0.002             | U    | 0.383              | J    | -0.598               | U |
| 5/17/2016      | B811-GP-SU-1-4  | 4-6                                     | 6.0-8.0                          | 0.001              | U    | 0.498              | J    | 0.419                | U |
| 5/17/2016      | B811-GP-SU-1-4  | 6-8                                     | 8.0-10.0                         | 0.002              | U    | 0.297              | J    | -0.241               | U |
| 5/17/2016      | B811-GP-SU-1-10 | 0.5-2                                   | 1.0-2.5                          | 0.232              | J    | 0.265              | J    | -0.431               | U |
| 5/17/2016      | B811-GP-SU-1-10 | 2-4                                     | 2.5-4.5                          | 0.346              | J    | 0.435              | J    | -0.678               | U |
| 5/17/2016      | B811-GP-SU-1-10 | 4-6                                     | 4.5-6.5                          | 0.005              | U    | 0.504              | J    | 0.124                | U |
| 5/17/2016      | B811-GP-SU-1-10 | 6-8                                     | 6.5-8.5                          | 0.002              | U    | 0.258              | J    | 0.766                | U |
| 5/17/2016      | B811-GP-SU-1-14 | 0.5-2                                   | 1.0-2.5                          | 0.292              | J    | NR                 |      | 0.047                | U |
| 5/17/2016      | B811-GP-SU-1-14 | 2-4                                     | 2.5-4.5                          | 0.000              | U    | 0.865              | J    | 0.306                | U |
| 5/17/2016      | B811-GP-SU-1-14 | 4-6                                     | 4.5-6.5                          | 0.011              | U    | 0.434              | J    | -0.19                | U |
| 5/17/2016      | B811-GP-SU-1-14 | 6-8                                     | 6.5-8.5                          | -0.001             | U    | 0.423              | J    | 0.194                | U |
| 5/17/2016      | B811-GP-SU-2-2  | 0.5-2                                   | 2.5-4.0                          | 10.900             |      | 0.487              | J    | 0.181                | U |
| 5/17/2016      | B811-GP-SU-2-2  | 2-4                                     | 4.0-6.0                          | 50.500             |      | 0.421              | J    | -0.096               | U |
| 5/17/2016      | B811-GP-SU-2-2  | 4-6                                     | 6.0-8.0                          | 6.910              |      | NR                 |      | 1.21                 | U |
| 5/17/2016      | B811-GP-SU-2-2  | 6-8                                     | 8.0-10.0                         | 0.025              | J-UI | 0.238              | J    | -0.155               | U |
| 5/17/2016      | B811-GP-SU-2-8  | 8-10                                    | 14-16                            | 15.000             |      | 0.080              | U    | -0.164               | U |
| 5/17/2016      | B811-GP-SU-2-8  | 10-12                                   | 16-18                            | 0.004              | U    | 0.286              | J-UI | -0.125               | U |
| 5/17/2016      | B811-GP-SU-2-8  | 12-14                                   | 18-20                            | 0.031              | J    | 0.336              | J    | 0.251                | U |
| 5/17/2016      | B811-GP-SU-2-8  | 14-16                                   | 22-24                            | -0.019             | U    | 0.170              | J    | -0.516               | U |
| 5/17/2016      | B811-GP-SU-2-15 | 0.5-2                                   | 0.5-2                            | 0.037              | J    | 0.589              | J    | 0.332                | U |
| 5/17/2016      | B811-GP-SU-2-15 | 2-4                                     | 2-4                              | -0.002             | U    | 0.472              | J    | -0.509               | U |
| 5/17/2016      | B811-GP-SU-2-15 | 4-6                                     | 4-6                              | 0.027              | J    | 0.351              | J    | 0.0659               | U |
| 5/17/2016      | B811-GP-SU-2-15 | 6-8                                     | 6.0-8.0                          | 0.002              | U    | 0.372              | J    | -0.0838              | U |
| Average Result |                 |                                         |                                  | 3.572              |      | 0.395              |      | 0.008                |   |

## Notes:

U - Analyte was analyzed for, but not detected above the MDL, MDA, LOD.

J - Value is estimated.

Q- Qualifier

NA-Not Applicable

NR-Not Reported

SU-2 was also tested using the sign test, although the results indicated no sample locations that exceeded the sum of the fractions. Therefore, no EMC test was required. The results of the SU-2 sign test are shown in Table 3-11.

### 3.2.4 Post Remediation Dose Assessment

A dose assessment was conducted to evaluate radiological dose impacts from residual radioactive materials remaining following the completion of the Building 811 Project. The dose assessment was conducted using RESRAD-ONSITE for Windows, Version 7.2, July 2016, (Argonne National Laboratory (ANL), 2016).

Table 3-9 - Sign Test for SU-1

| Location<br>(BNL<br>Sample No.) | Cs-137<br>(pCi/g) | Fraction of<br>Limit for<br>Cs-137 | Ra-226<br>(pCi/g) | Fraction of<br>Limit for<br>Ra-226 | Sr-90<br>(pCi/g) | Fraction of<br>Limit for<br>Sr-90 | Sum of<br>Fractions | DCGL (1.0) -<br>Sum of<br>Fractions |
|---------------------------------|-------------------|------------------------------------|-------------------|------------------------------------|------------------|-----------------------------------|---------------------|-------------------------------------|
| SU-1-1                          | 0.20              | 0.01                               | 0.47              | 0.09                               | 0.37             | 0.02                              | 0.13                | 0.87                                |
| SU-1-2                          | 0.31              | 0.01                               | 0.33              | 0.07                               | 0.72             | 0.05                              | 0.13                | 0.87                                |
| SU-1-3                          | 0.67              | 0.03                               | 0.37              | 0.07                               | 0.01             | 0.00                              | 0.10                | 0.90                                |
| SU-1-4                          | 7.33              | 0.32                               | 0.54              | 0.11                               | -0.58            | -0.04                             | 0.39                | 0.61                                |
| SU-1-5                          | 5.14              | 0.22                               | 0.59              | 0.12                               | 0.20             | 0.01                              | 0.35                | 0.65                                |
| SU-1-6                          | 2.47              | 0.11                               | 0.66              | 0.13                               | -0.14            | -0.01                             | 0.23                | 0.77                                |
| SU-1-7                          | 0.41              | 0.02                               | 0.47              | 0.09                               | 1.00             | 0.07                              | 0.18                | 0.82                                |
| SU-1-8                          | 0.26              | 0.01                               | 0.32              | 0.06                               | -0.21            | -0.01                             | 0.06                | 0.94                                |
| SU-1-9                          | 0.35              | 0.02                               | 0.31              | 0.06                               | 0.23             | 0.02                              | 0.09                | 0.91                                |
| SU-1-10                         | 0.07              | 0.00                               | 0.39              | 0.08                               | -0.39            | -0.03                             | 0.05                | 0.95                                |
| SU-1-11                         | 0.36              | 0.02                               | 0.23              | 0.05                               | -0.37            | -0.02                             | 0.04                | 0.96                                |
| SU-1-12                         | 0.94              | 0.04                               | 0.32              | 0.06                               | -0.06            | 0.00                              | 0.10                | 0.90                                |
| SU-1-13                         | 0.51              | 0.02                               | 0.44              | 0.09                               | 0.60             | 0.04                              | 0.15                | 0.85                                |
| SU-1-14                         | 0.73              | 0.03                               | 0.47              | 0.09                               | 0.32             | 0.02                              | 0.15                | 0.85                                |
| SU-1-15                         | 3.02              | 0.13                               | 0.28              | 0.06                               | 0.68             | 0.05                              | 0.23                | 0.77                                |
| SU-1-16                         | 30.60             | 1.33                               | 0.55              | 0.11                               | 0.92             | 0.06                              | 1.50                | -0.50                               |

Note that Ra-226 does not have the site background of 0.56 pCi/g subtracted from the values used in this table; therefore, the table provides a conservative estimate of the sign test statistic.

Table 3-10 - Elevated Measurement Comparison for SU-1

| Nuclide             | DCGL <sub>w</sub> | Avg in<br>SU | Fraction<br>in SU | Area<br>factor for<br>2 m <sup>2</sup> (a) | Elevated<br>Criteria<br>Limit<br>(pCi/g) | SU-1-16<br>Result<br>(pCi/g) | Adjusted<br>SU-1-6<br>Result<br>(pCi/g) (b) | Adjusted<br>SU-1-16<br>Fraction (c) | Sum of<br>Fractions |
|---------------------|-------------------|--------------|-------------------|--------------------------------------------|------------------------------------------|------------------------------|---------------------------------------------|-------------------------------------|---------------------|
| Cs-137              | 23                | 3.34         | 0.145             | 5.7                                        | 131                                      | 30.6                         | 27.3                                        | 0.208                               | 0.35                |
| Sr-90               | 15                | 0.42         | 0.028             | 1.0                                        | 15                                       | 0.55                         | 0.1                                         | 0.009                               | 0.04                |
| Ra-226 (d)          | 5                 | 0.21         | 0.041             | 1.0                                        | 5                                        | 0.92                         | 0.7                                         | 0.142                               | 0.18                |
| Sum of<br>Fractions | N/A               | N/A          | 0.214             | N/A                                        | N/A                                      | N/A                          | N/A                                         | 0.358                               | <b>0.57</b>         |

(a) Area of contamination was found to be small, and a conservative value was selected as 2 m<sup>2</sup>. Area Factors for Sr-90 and Ra-226 are not used, so the factors are listed as 1.0.

(b) In EMC calculations, the sample result is adjusted to equal the amount that it exceeds the average level in the SU.

(c) Adjusted Fraction is the adjusted result divided by the DCGL<sub>EMC</sub>

(d) Ra-226 is conservatively listed in this table without the BNL Ra-226 background of 0.56 pCi/g subtracted.

To determine if the SU passes, the values for sum of the fractions for the overall survey unit must be added to those from elevated locations.

Since the result is 0.57, and this is less than 1.0, the survey unit passes the Elevated Measurement Comparison.

The average concentration for each radionuclide from SU-1 and SU-2 were used as inputs to the model in order to determine the projected dose. The average concentrations (see Table 3-4) are as follows:

- Cs-137: 3.85 pCi/g, one of the 34 samples used in the average was below the MDC for Cs-137 (Average includes results from Table 3-2).
- Ra-226: 0.496 pCi/g, one of the 32 samples used in the average was below the MDC for Ra-226. As explained below, the average Ra-226 concentration was below the previously established background for Ra-226 (0.56 pCi/g), so the value used for RESRAD was 0.0 pCi/g.
- Sr-90: 0.214 pCi/g, all of the 34 samples used in the average were below the MDC for Sr-90. However, the average of the concentrations reported (0.214 pCi/g) was used in the RESRAD evaluation (Average includes results from Table 3-2).
- U-238: 0.447 pCi/g, three of the six composite samples were below the MDC for U-238, two of the six composites were estimated (i.e., above the MDC but below the required detection limit for U-238), and one of the six composites was above the MDC for U-238. The average of all six composite samples for U-238 (0.447 pCi/g) was used in the RESRAD evaluation.

Table 3-11 - Sign Test for SU-2

| Location<br>(BNL<br>Sample No.) | Cs-137<br>(pCi/g) | Fraction of<br>Limit for<br>Cs-137 | Ra-226<br>(pCi/g) | Fraction of<br>Limit for<br>Ra-226 | Sr-90<br>(pCi/g) | Fraction of<br>Limit for<br>Sr-90 | Sum of<br>Fractions | DCGL (1.0) -<br>Sum of<br>Fractions |
|---------------------------------|-------------------|------------------------------------|-------------------|------------------------------------|------------------|-----------------------------------|---------------------|-------------------------------------|
| SU-2-1                          | 7.80              | 0.34                               | 0.59              | 0.12                               | 1.16             | 0.08                              | 0.53                | 0.47                                |
| SU-2-2                          | 3.93              | 0.17                               | 0.71              | 0.14                               | 0.96             | 0.06                              | 0.38                | 0.62                                |
| SU-2-3                          | 9.22              | 0.40                               | 0.70              | 0.14                               | 0.30             | 0.02                              | 0.56                | 0.44                                |
| SU-2-4                          | 1.21              | 0.05                               | 0.60              | 0.12                               | -0.30            | -0.02                             | 0.15                | 0.85                                |
| SU-2-5                          | 3.10              | 0.13                               | 0.44              | 0.09                               | -0.15            | -0.01                             | 0.21                | 0.79                                |
| SU-2-6                          | 2.71              | 0.12                               | 0.53              | 0.11                               | 0.66             | 0.04                              | 0.27                | 0.73                                |
| SU-2-7                          | 1.85              | 0.08                               | 0.53              | 0.11                               | -0.51            | -0.03                             | 0.15                | 0.85                                |
| SU-2-8                          | 3.00              | 0.13                               | 0.38              | 0.08                               | -0.36            | -0.02                             | 0.18                | 0.82                                |
| SU-2-9                          | 4.54              | 0.20                               | 0.46              | 0.09                               | 0.28             | 0.02                              | 0.31                | 0.69                                |
| SU-2-10                         | 2.89              | 0.13                               | 0.46              | 0.09                               | -0.12            | -0.01                             | 0.21                | 0.79                                |
| SU-2-11                         | 2.40              | 0.10                               | 0.58              | 0.12                               | 0.70             | 0.05                              | 0.27                | 0.73                                |
| SU-2-12                         | 2.45              | 0.11                               | 0.85              | 0.17                               | -0.38            | -0.03                             | 0.25                | 0.75                                |
| SU-2-13                         | 1.45              | 0.06                               | 0.58              | 0.12                               | -0.65            | -0.04                             | 0.14                | 0.86                                |
| SU-2-14                         | 2.25              | 0.10                               | 0.49              | 0.10                               | 0.62             | 0.04                              | 0.24                | 0.76                                |
| SU-2-15                         | 0.21              | 0.01                               | 0.58              | 0.12                               | -0.11            | -0.01                             | 0.12                | 0.88                                |
| SU-2-16                         | 5.11              | 0.22                               | 0.64              | 0.13                               | 0.97             | 0.06                              | 0.42                | 0.58                                |

Note that Ra-226 does not have the site background of 0.56 pCi/g subtracted from the values used in this table; therefore, the table provides a conservative estimate of the sign test statistic.

As anticipated, Ra-226 was not detected above its cleanup value during the FSS; however, it is included in the dose assessment as it is specified as a radionuclide of concern in the OU I ROD. The cleanup value of 5 pCi/g was selected for Ra-226 based on *DOE Order 458.1, Administrative Change 3, Radiation Protection of the Public and the Environment*, (DOE, 2013). The average Ra-226 background concentration on BNL property had previously been established at approximately 0.56 pCi/g (CDM, 1996). Therefore, the average Ra-226 value of 0.496 pCi/g from the FSS results is below established background. However, when performing the post-remediation dose assessment using RESRAD, background is subtracted to obtain a more accurate result of the dose above background. In this case, Ra-226 was 0.0 pCi/g after subtracting for background.

Potential radiological dose scenarios were evaluated following remediation. The first assessment considered the radiation dose to a hypothetical future resident (non-farmer) assuming 50 years of institutional control. The second assessment considered the radiation dose to a current industrial worker (no decay). The parameters and pathways used in this dose assessment for SU-1 and SU-2 are shown in the RESRAD summary Table 3-12. The RESRAD inputs are shown in a table in Appendix B, along with the RESRAD output reports from each scenario shown in Table 3-12.

In addition to the residential and industrial scenarios described above, additional residential and industrial scenarios were performed using the results of the Geoprobe samples, which included one result for Cs-137 above 23 pCi/g (50.5 pCi/g at location GP-SU-2-2, 2-4 feet bgs). These additional calculations assumed that the maximum Cs-137 concentration detected (50.5 pCi/g) is present from 2 feet (0.6 meters) to 28.2 feet (8.6 meters) over the entire area of both survey units. This conservatively “double counts” the contamination, because the surface calculation assumed a 0.0 -16.4 feet bgs depth, and the deep calculation assumed a 2.0 - 28.2 feet bgs depth, it also overestimates the observed extent of the contamination both vertically and horizontally.

The results of the dose assessment are shown in Table 3-12 below. The maximum projected dose to a resident in year 50 or later (3.9 mrem/year) would be below the dose objective (non-farmer) of 15 mrem/year. In addition, the maximum projected dose to an industrial worker at year 0 or later (2.2 mrem/year) is less than 15 mrem/year. The results also indicate that the NYSDEC TAGM 4003 guideline of 10 mrem/yr would be met under each of the scenarios described above.



Table 3-12 - Summary of Post-Remediation Dose Assessment Results

| Scenario                 | RESRAD Run | Dose at 50 yr (mrem) | Dose at 0 yr (mrem) | Dose at max time (mrem)* | Time for max dose | Cs-137 (pCi/g) | Ra-226 (pCi/g) | Sr-90 (pCi/g) | U-238 (pCi/g) |
|--------------------------|------------|----------------------|---------------------|--------------------------|-------------------|----------------|----------------|---------------|---------------|
| Residential              | B          | 2.7                  | 8.5                 | 2.7                      | 0                 | 3.854          | 0              | 0.214         | 0.447         |
| Industrial               | D          | 0.73                 | 2.2                 | 0.73                     | 0                 | 3.854          | 0              | 0.214         | 0.447         |
| Residential - deep layer | F          | 1.2                  | 3.1                 | 1.2                      | 0 yr              | 50.5           | 0              | 0.214         | 0.447         |
| Industrial - deep layer  | H          | 0.06                 | 0.02                | 0.10                     | 16 yr             | 50.5           | 0              | 0.214         | 0.447         |
| <b>Total Residential</b> | B+F        | 3.9                  | 11.5                | 3.9                      |                   |                |                |               |               |
| <b>Total Industrial</b>  | D+H        | 0.8                  | 2.2                 | 0.8                      |                   |                |                |               |               |

\* For residential scenario, refers to max dose at  $\geq 50$  yr.  
 For industrial scenario, refers to max dose for time  $\geq 0$  yr.

### 3.2.5 Final Status Survey Conclusions

The results of the FSS and sampling following the completion of the demolition of Building 810 and Building 811, as well as the removal of the associated subsurface structures and piping, demonstrate conformance to the site cleanup goal established for the Building 811 Project.

### 3.2.6 Final Status Survey Independent Verification

The Type A Independent Verification (IV) of the Building 811 Project was performed by ORISE. ORISE concluded that the remediation was sufficient to satisfy the cleanup goal specified for the project.

The results of the IV are documented in the *Independent Review of the Brookhaven National Laboratory Building 811 Draft Closure Report*, (DCN: 5098-LT-03-0, ORISE, October 20, 2016), provided in Appendix C.

## 3.3 Waste Management

### 3.3.1 Waste Characterization, Handling and Disposal

The waste management strategy, waste characterization, packaging, handling, and storage were performed in accordance with the *Waste Management Plan Bldg. 811 Demolition* (BNL, 2015c) and BNL Standards Based Management System (SBMS) waste management procedures. Waste generated during the Building 811 Project was characterized as LLRW waste and included soil, concrete, brick, metal, and ACM. Oversized waste was size-reduced to meet the disposal facility's WAC prior to being packaged for disposal. Debris and soil characterization data collected during remedial activities were used to characterize project waste. The waste shipped met the WAC of the disposal facilities specified below. Waste verification results were submitted to BNL's Waste Management Program. LLRW was shipped via rail to Waste Control

Specialists (WCS) of Texas and via truck to Energy Solutions of Utah. The metal superstructure of Building 810 was recycled by Crestwood Metal Corporation of Holbrook, New York.

Waste loading and shipping was initiated in February 2016 and was completed in August 2016. Several truck shipments to Energy Solutions will be completed in FY 2017. MHF Services and ICE Service Group provided shipping containers and MHF Services provided railcars for transportation of project waste by rail. Hittman Transport Services, Inc. and RSB Trucking, Inc. provided waste shipment services for LLRW shipped by truck. Total volume of LLRW transported for disposal was approximately 1,660 cubic yards. A project waste summary is provided below in Table 3-13.



Photograph 10 – Shipping project waste via rail.

Table 3-13 - Project Waste Summary (Revised January 2017)

| Manifest/BOL                       | # Ship | Destination      | Mode  | Volume (cu ft.) | PSO         | Comments/Description                                                                                                                             | BHSO App. Req'd | SC-3 Notif. Req'd | Actual Ship Date | Actual Arrival Date                                                                                                                                                                          |
|------------------------------------|--------|------------------|-------|-----------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WP-019888-0001<br>WP-0198880012    | 12     | WCS              | Rail  | 27,771          | WM          | Soil, Concrete & Rubble from Bldg. 811 Demo Project                                                                                              | No              | No                | 2/13/2016        | 3/1/2016                                                                                                                                                                                     |
| W-7314-03-0035<br>& W-7314-08-0008 | 2      | Energy Solutions | Truck | 1,304           | LS, WM, CAD | B25 - Piping, PPE, Metal, Paper & Plastic / Connex - PPE, Solidified Liquid, Asbestos Pipe Insulation & Wood / B12 - PPE, Glass, Paper & Plastic | No              | No                | 3/23/2016        | 3/28/2016                                                                                                                                                                                    |
| WP-019888-0013<br>WP-019888-0018   | 6      | WCS              | Rail  | 13,885          | WM          | Soil, Concrete & Rubble from Bldg. 811 Demo Project                                                                                              | No              | No                | 5/21/2016        | 06/10/2016 - (WP-019888-013)<br>06/14/2016 - (WP-019888-014)<br>06/13/2016 - (WP-019888-015)<br>06/20/2016 - (WP-019888-016)<br>06/20/2016 - (WP-019888-017)<br>06/13/2016 - (WP-019888-018) |
| 9521-04-0008 & 7314-03-0062        | 1      | Energy Solutions | Truck | 542             | WM          | 811 Intermodal,                                                                                                                                  | No              | No                | 8/18/2016        | 8/22/2016                                                                                                                                                                                    |
| 7314-03-0060                       | 1      | Energy Solutions | Truck | 542             | WM          | Intermodal - Bulk Waste                                                                                                                          | No              | No                | 8/24/2016        | 8/29/2016                                                                                                                                                                                    |
| 7314-03-0061 & 9521-04-0009        | 1      | Energy Solutions | Truck | 789             | WM          | 811 Intermodal, (811 Pipes / 811 Super Sack / Misc. Debris)                                                                                      | No              | No                | 8/25/2016        | 8/30/2016                                                                                                                                                                                    |
| Total (cu ft)                      |        |                  |       | 44,833          |             |                                                                                                                                                  |                 |                   |                  |                                                                                                                                                                                              |
| Total (cu yds)                     |        |                  |       | 1,660           |             |                                                                                                                                                  |                 |                   |                  |                                                                                                                                                                                              |

### **3.3.2 Pollution Prevention and Waste Minimization Opportunities**

Waste minimization and pollution prevention methods employed during the Project included the judicious use of consumables (Personal Protection Equipment) as well the survey, free release and recycling of approximately 23,000 pounds of metal; and the recycling of fluorescent lighting. In addition, overburden soil was segregated and characterized for reuse as backfill during site restoration activities. Characterization data is summarized in Appendix D.

### **3.4 Site Restoration**

Site restoration was performed in accordance with the Excavation Plan (BNL, 2015b). Excavation areas were backfilled to original grade and the area re-seeded with native grass. The backfill material was a combination of overburden generated from the Building 811 Project and material from the construction of the National Synchrotron Light Source. Representative samples of the backfill material met the requirements of the NYS Part 375 Table 6.8(b) Residential Use Soil Cleanup Objectives. Backfill soil analytical results are included in Appendix E.

Site restoration activities were completed in September 2016. Future site controls are discussed in Section 7.0.



Photograph 11 – Placing clean fill at previous location of Building 811.

## 4.0 CHRONOLOGY OF EVENTS

Table 4-1 lists a chronology of the main remedial events associated with AOC 10:

Table 4-1 - Chronology of Remedial Events for AOC 10 and Surrounding Area

| Date                      | Remedial Event                                                                                 |
|---------------------------|------------------------------------------------------------------------------------------------|
| 1995                      | 100,000 gallon D-tanks removed                                                                 |
| August 1999               | OU I ROD finalized                                                                             |
| 2004                      | A/B Waste Storage Tank Closure and AOC 10 FSS                                                  |
| 2007-2010                 | 25,000 (2) and 22,000 (2) D-Waste ASTs removed                                                 |
| 2014                      | Building 811 utilities were isolated                                                           |
| May 2015                  | Building 811 Demolition Plan and Waste Management Plans finalized                              |
| August 2015               | FSP/QAPP for AOC 10 and Surrounding Area finalized                                             |
| June 2015 March 2016      | D&D of Building 810 and 811, removal of waste transfer lines and contaminated soil             |
| March 2016 – October 2016 | FSS and IV were performed, Waste Disposal, Site Restoration, Draft Completion Report prepared. |

## 5.0 PERFORMANCE STANDARDS & QUALITY CONTROL

As discussed in Section 3.2.4, the calculated radiological doses from all radioisotopes were below the levels stipulated in the OU I ROD (BNL, 1999).

Physical and radiological inspections were conducted on both incoming and outgoing intermodal containers. Inspections were also conducted on excavations and storm water control measures during excavation operations. Field sampling procedures were reviewed periodically.

QA/quality control (QC) samples were collected in accordance with the FSP/QAPP (PWGC, 2015). Field duplicates were collected at a frequency of one per twenty soil samples and analyzed for the radiological contaminants of concern. QA/QC results are summarized with the FSS results provided in Appendix A.

Data validation was performed for a minimum of 5% of the end-point sampling data. The data results obtained from the contract analytical laboratory (GEL Laboratories LLC) underwent a systematic data validation performed by BNL to provide assurance that the data is adequate for its intended use (i.e., in assessing the effectiveness of remedial activities). The validation was performed by personnel who have had appropriate training and/or experience in performing data validation for the radiological analyses.

Validation was performed in accordance with BNL EM-SOP-204, *Radiochemical Data Verification*, EM-SOP-209, *Radiochemical Data Validation*, and EM-SOP-210, *Radiochemical Data Usability*. The validation checklists are provided in Appendix F.

The conclusion of the data validation was that the sample data is sufficient for the intended use.

## **6.0 FINAL INSPECTION AND CERTIFICATIONS**

As described in Section 3.3.6, IV was performed by ORISE upon the completion of the FSS performed by BNL EPD. Based on the results of the FSS, an evaluation of the dose from the remaining activity in the project area was performed using RESRAD; results were within the design criteria described in Section 2.2.

There was strict adherence to industrial safety and radiological safety precautions during the Project. Work was performed under written and approved procedures, and any potentially hazardous steps were highlighted in the procedure to ensure understanding and compliance. JSAs were developed and approved for the work. Radiological safety and oversight was provided by Radiological Control Technicians (RCTs), and all work was performed under a RWP. Completion of the Project was accomplished without any worker injuries categorized as lost time accidents.

### **6.1 Industrial Hygiene Oversight & Monitoring**

Industrial hygiene (IH) oversight and monitoring was conducted by BNL personnel and contractors in accordance with OSHA or NIOSH sampling and analysis methods. BNL workers followed JSAs, which identified hazards associated with each of the tasks identified and specified the required controls for each hazard. Contractors followed their respective Health and Safety Plans and Phased Hazard Analyses. A designated Site Health and Safety Officer was onsite during cleanup activities to ensure controls were in place as specified in work plans and JSAs, including the use of safety equipment, safe work practices, excavation safety and asbestos controls. IH monitoring included heat stress, asbestos, and silica monitoring. Each contractor was responsible for performing IH monitoring on their own employees. The asbestos sampling was conducted by Enviroscience Consultants for both area and personnel monitoring. Results are on file with BNL Safety and Health Services Division.

### **6.2 Radiological Oversight & Monitoring**

Radiological oversight and monitoring for the Project was conducted by BNL RCTs in accordance with the project RWP - 106WMP15. Thermoluminescent dosimeters (TLDs) were worn by each individual entering the posted Controlled Area, Soil Contamination Areas and Contamination Areas. The radiation exposure estimate for the project was 10 mrem, far less than the BNL administrative control level dose value of 100 mrem. The actual total radiation exposure for the project was 0 mrem.

Radiological monitoring included air sampling as specified by the RWPs and the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) Assessment. All general area air sample results were detection limits for radionuclides, except for radon

and its progeny. Workers entering the posted contamination areas were also required to have a whole body count prior to and upon completion of work on the Project.

Portions of Building 810 were radiologically surveyed and free released. Results of the release survey satisfied the requirements of the BNL Radiological Control Manual, specifically Table 2-6 and the requirements of FS-SOP-1005, Revision No. 5 (BNL, 2014).

Equipment used during the Project was also monitored for radiological contamination. All equipment released from the work zone was surveyed in accordance with the requirements of FS-SOP-1005, Revision No. 5 (BNL, 2014).



## **7.0 OPERATION AND MAINTENANCE ACTIVITIES**

The BNL Land Use Controls Fact Sheet will be updated and the BNL site utility maps revised to reflect the as-left site conditions.

Brookhaven Science Associates (BSA) will perform surveillance and maintenance activities. In addition to maintaining institutional controls for the area, BSA will ensure that routine monitoring/inspections are performed. DOE will ensure enforcement of all institutional controls.

Radiological contamination was identified along the fence line between the Collider Accelerator Department metal storage area and AOC 10 and surrounding area. Based on preliminary surveys and limited excavation activities along the fence line, the contaminated soil appears to be shallow (up to 2 feet bgs). Samples collected from the areas of elevated activity along the fence line indicate that the primary radionuclide is Cs-137. One of the samples however did contain detectable concentrations of Co-60. This area will remain under radiological control.

This area will be placed under institutional controls, added to the LUIC contaminated soil map and be remediated as funds become available in the future. Appropriate LUIC postings will be installed at locations where permanent fencing was removed. The as-left survey of the fence line is provided in Figure 7-1.

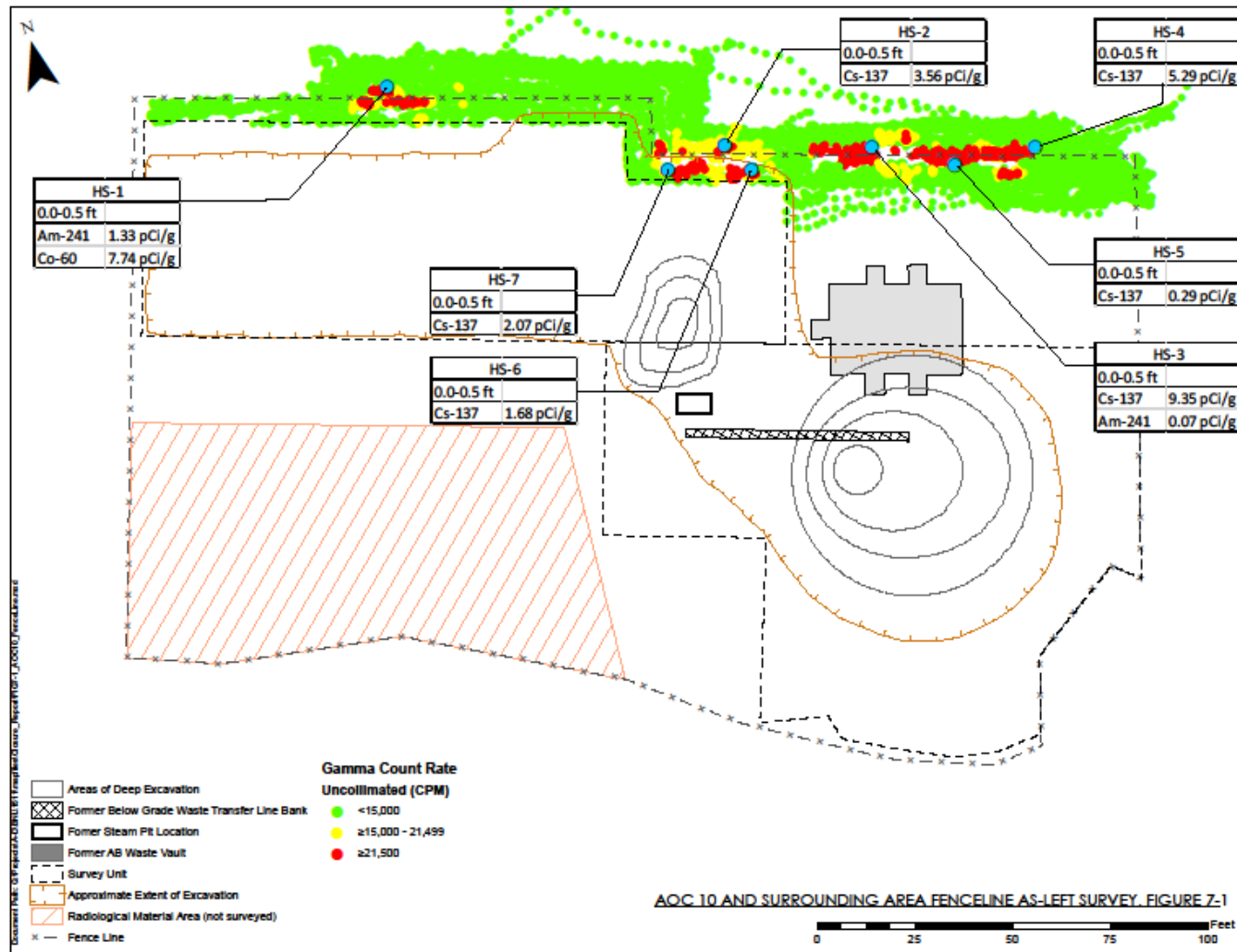


Figure 7-1 – As-Left Fence Line Survey and ISOCs Soil Sample Results

## 8.0 SUMMARY OF PROJECT COSTS

The Building 811 Project cost was approximately \$5,100,000 to complete. The original estimate cost for the Project was \$4,400,000. The additional cost was associated with the asbestos removals and additional waste volumes.

The costs for the Building 811 Project included the following:

|                                    |              |
|------------------------------------|--------------|
| Engineering and planning           | \$ 550,000   |
| D&D/Remediation & Site Restoration | \$ 3,000,000 |
| Independent Verification (ORISE)   | \$ 10,000    |
| Waste Transportation and Disposal  | \$ 1,500,000 |
| Project Closeout                   | \$ 30,000    |
| Total Cost                         | \$ 5,100,000 |

## 9.0 OBSERVATIONS AND LESSONS LEARNED

The following is a summary of the observations and lessons learned from this project and the corrective actions for future projects:

- Reloading of intermodals on ABC flatcars – Intermodals containing waste generated from the Building 811 Project were loaded onto flatcars in an orientation calculated based upon gross weight limits. When the details of the loaded flatcars were transmitted to New York and Atlantic Railway the cars were not approved for shipping because the center of gravity did not conform to acceptable limits. This resulted in the intermodals having to be reloaded in a configuration that provided an acceptable center of gravity. Corrective actions to be implemented include:
  - Ensuring future railcar loading is performed using the New York and Atlantic Railway calculation for center of gravity. WM Procedure WM-SOP-578, Shipping Low-Level Radioactive and Mixed Waste will be modified to include this requirement.
- The Asbestos Survey performed for Building 811 did not include a determination of ACM on electrical wiring within the building. Prior to demolition but after abatement of known ACM was completed, the electrical wiring within the building was determined to be ACM. This required personnel to have appropriate asbestos training, as well as additional IH monitoring and controls that would have not been necessary had the wiring been removed during ACM abatement. Corrective actions to be implemented include:
  - Perform evaluation of ACM on electrical wiring during the planning stages of future building demolitions.

## **10.0 PROTECTIVENESS**

The work performed during the Building 811 Project is protective of human health and the environment. These actions have removed the majority of radioactivity from the site and minimized the potential for the migration of contaminants into the underlying groundwater.

## **11.0 FIVE YEAR REVIEW**

Five-year reviews will be conducted to determine whether the remedy implemented continues to be protective of human health and the environment. These reviews will be performed in accordance with the *Comprehensive Five-Year Review Guidance*, OSWER No. 9355.7-03B-P (EPA, 2001). Remedy implementation at AOC 10, including D&D of Buildings 810 and 811, was discussed in the *Five Year Review Report for Brookhaven National Laboratory Superfund Site* (BNL, 2016). AOC 10 will be included in the next sitewide five year review in 2021.

*This page intentionally blank*



## REFERENCES

ANL, 2016. *RESRAD-ONSITE for Windows, Version 7.2*, Argonne National Laboratory, July 2016.

BNL, 1992. Interagency Agreement, May 1992.

BNL, 1999. *Record of Decision, Operable Unit I and Radiologically Contaminated Soils*, August 1999.

BNL, 2015. *Demolition Plan, Building 811 and Associated Structures*, May 2015.

BNL, 2015b. *Excavation Plan for Building 811 and Surrounding Area*, September 2015.

BNL, 2015c. *Waste Management Plan Bldg 811 Demolition*, May 2015.

BNL, 2014. FS-SOP-1005, Rev 5, *Radiological Surveys Required for Release of Materials from Areas Controlled for Radiological Purposes*, June 2014.

BNL, 2016. *Five Year Review Report for Brookhaven National Laboratory Superfund Site*, June 2016.

BNL, 2016b. WM-SOP-578, Rev. 31, *Shipping Low-Level Radioactive and Mixed Waste*, August 2016

BNL, *Brookhaven National Laboratory Radiological Control Manual*, (as revised).

CDM, 1996. *Final Remedial Investigation and Risk Assessment Report for Operable Unit I/VI*, 1996.

CDM, 1999. *Final Feasibility Study Report for Operable Unit I Radiologically Contaminated Soils*, 1999.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Title 42, U.S. Code, Sec. 9620 et seq.

Dames and Moore, 1993. *Engineering Evaluation/Cost Assessment for the D Tanks Removal Action*, 1993.

Department of Energy, DOE 458.1- Administrative Change 3, *Radiation Protection of the Public and the Environment*, January 15, 2013.

EPA, 2000b. *Multi-Agency Radiological Survey and Site Investigation Manual*, Revision 1, August 2000.

EPA, 2001. *Comprehensive Five-Year Review Guidance* (OSWER Directive 9355.7-03B-P), June 2001.

IT Corp, 1993. OU II/VII RI Report, 1993.

IT Corp, 1995. *Closeout Report for Brookhaven National Laboratory “D” Tanks Removal Action*, 1995.

NYSDEC, 1993. *New York State Department of Environmental Conservation TAGM 4003: Cleanup Guideline for Soils Contaminated with Radioactive Materials*, September, 1993.

ORISE, 2011. *Final Report - Independent Verification of the Waste Concentration Facility (AOC 10) and Surrounding Area*, September 2015.

PWGC, 2015. *Field Sampling Plan/Quality Assurance Project Plan Waste Concentration Facility (AOC 10) and Surrounding Area*, August 2015.

URS Corp, 2001. *Closeout Report, Removal Treatment, and Disposal of Radioactive and Mixed Waste Sludge from Building 811 Tanks*, October 2001.

Weston Solutions, 2005. *Closeout Report, Brookhaven National Laboratory, Operable Unit I, Area of Concern 10 (AOC 10), Waste Concentration Facility*, September 2005.

## Figures



**PWGC**

Strategic Environmental and Engineering Solutions

P.W. GROSSER CONSULTING, INC.

630 Johnson Avenue. • Suite 7  
Bohemia • NY • 11716-2618  
Phone: (631) 589-6353 • Fax: (631) 589-8705  
E-mail: [INFO@PWGROSSER.COM](mailto:INFO@PWGROSSER.COM)

UNAUTHORIZED ALTERATION OR ADDITION TO THIS  
DRAWING AND RELATED DOCUMENTS IS A VIOLATION  
OF SEC. 7209 OF THE N.Y.S. EDUCATION LAW

DRAWING PREPARED FOR:

BROOKHAVEN  
NATIONAL  
LABORATORY

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

| REVISION | DATE | INITIAL | COMMENTS |
|----------|------|---------|----------|
|----------|------|---------|----------|

|                      |           |              |    |
|----------------------|-----------|--------------|----|
| DRAWING INFORMATION: |           |              |    |
| Project:             | BNL1503   | Designed by: | BB |
| Date:                | 4/24/2015 | Drawn by:    | BB |
| Scale:               | AS SHOWN  | Approved by: | AL |

AOC 10 BOUNDARY  
AND CURRENT CONDITIONS

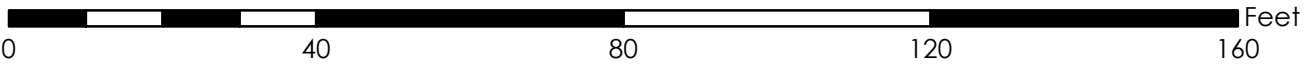
FIGURE NO:  
  
1-3

SHEET:



PENNSYLVANIA ST

-  AOC 10 Boundary
-  Building Footprint







FORMER 25,000-GALLON  
ABOVE GROUND D-TANKS

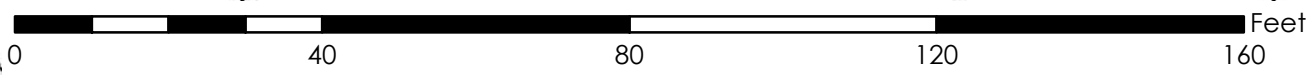
FORMER 22,000-GALLON  
ABOVE GROUND D-TANKS

FORMER 8,000-GALLON  
BELOW GRADE A/B  
WASTE TANKS

FORMER 100,000-GALLON  
ABOVE GROUND D-TANKS

FORMER A/B  
WASTE LINES

AOC 10 Boundary



**PWGC**

Strategic Environmental and Engineering Solutions

P.W. GROSSER CONSULTING, INC.

630 Johnson Avenue, • Suite 7  
Bohemia, NY • 11716-2618  
Phone: (631) 589-6353 • Fax: (631) 589-8705  
E-mail: INFO@PWGROSSER.COM

UNAUTHORIZED ALTERATION OR ADDITION TO THIS  
DRAWING AND RELATED DOCUMENTS IS A VIOLATION  
OF SEC. 7209 OF THE N.Y.S. EDUCATION LAW

DRAWING PREPARED FOR:

BROOKHAVEN  
NATIONAL  
LABORATORY

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

| REVISION | DATE | INITIAL | COMMENTS |
|----------|------|---------|----------|
|----------|------|---------|----------|

DRAWING INFORMATION:

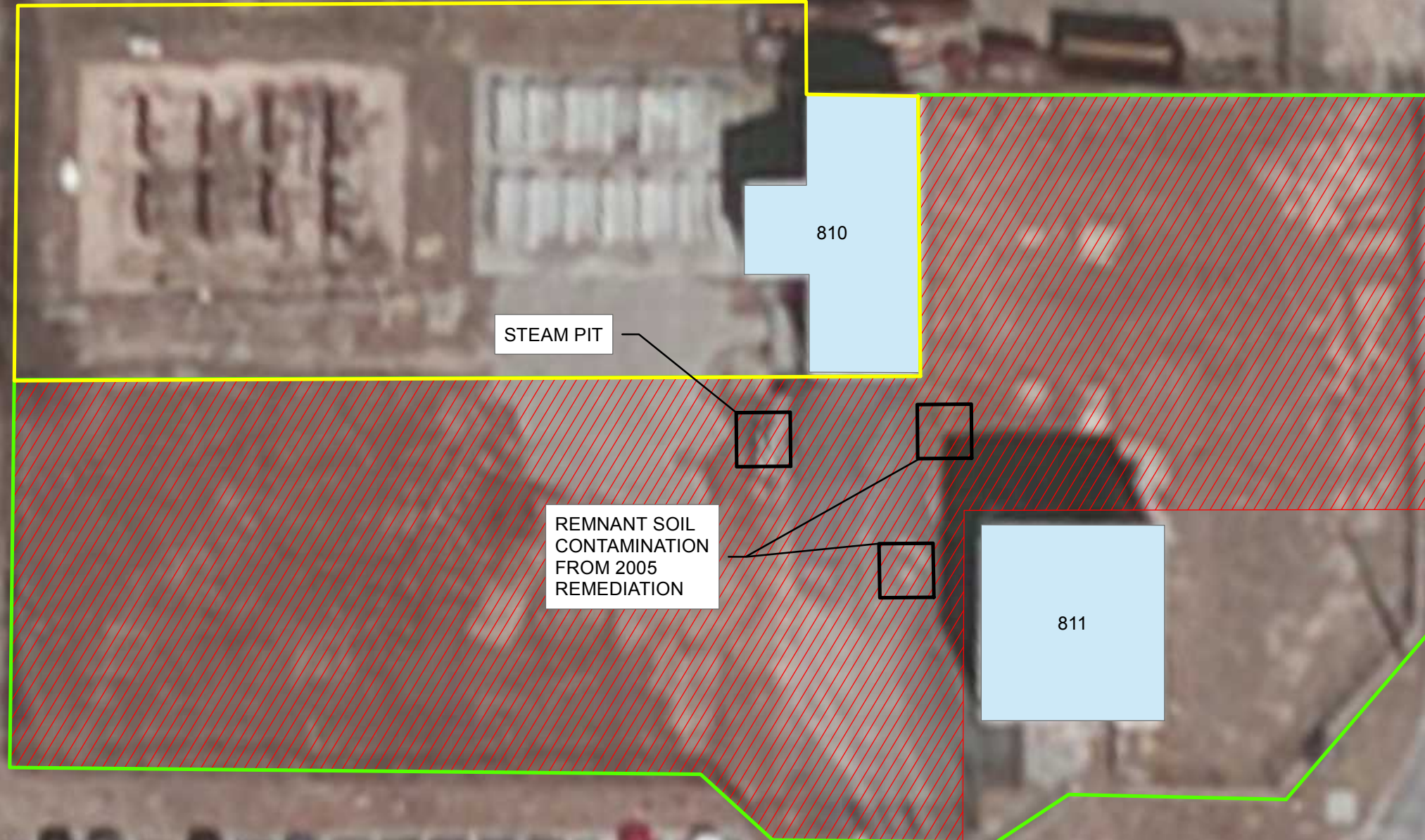
|          |           |              |    |
|----------|-----------|--------------|----|
| Project: | BNL1503   | Designed by: | BB |
| Date:    | 6/12/2015 | Drawn by:    | BB |
| Scale:   | AS SHOWN  | Approved by: | AL |

AOC 10 - FORMER WASTE  
STORAGE FACILITIES AND  
TRANSFER LINES

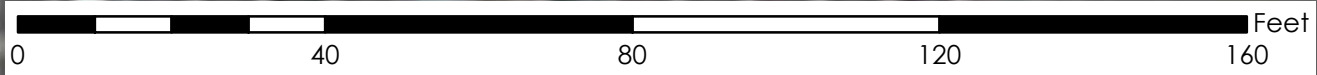
FIGURE NO:  
  
1-4

SHEET:





-  Areas with known/suspected Cs-137 concentrations in excess of 23 pci/g
-  Area Included in 2005 Final Status Survey
-  AOC 10 Surrounding Area
-  AOC 10 Boundary
-  Building Footprint



**PWGC**

Strategic Environmental and Engineering Solutions

P.W. GROSSER CONSULTING, INC.

630 Johnson Avenue, • Suite 7  
Bohemia • NY • 11716-2618  
Phone: (631) 589-6353 • Fax: (631) 589-8705  
E-mail: INFO@PWGROSSER.COM

UNAUTHORIZED ALTERATION OR ADDITION TO THIS  
DRAWING AND RELATED DOCUMENTS IS A VIOLATION  
OF SEC. 7209 OF THE N.Y.S. EDUCATION LAW

DRAWING PREPARED FOR:

BROOKHAVEN  
NATIONAL  
LABORATORY

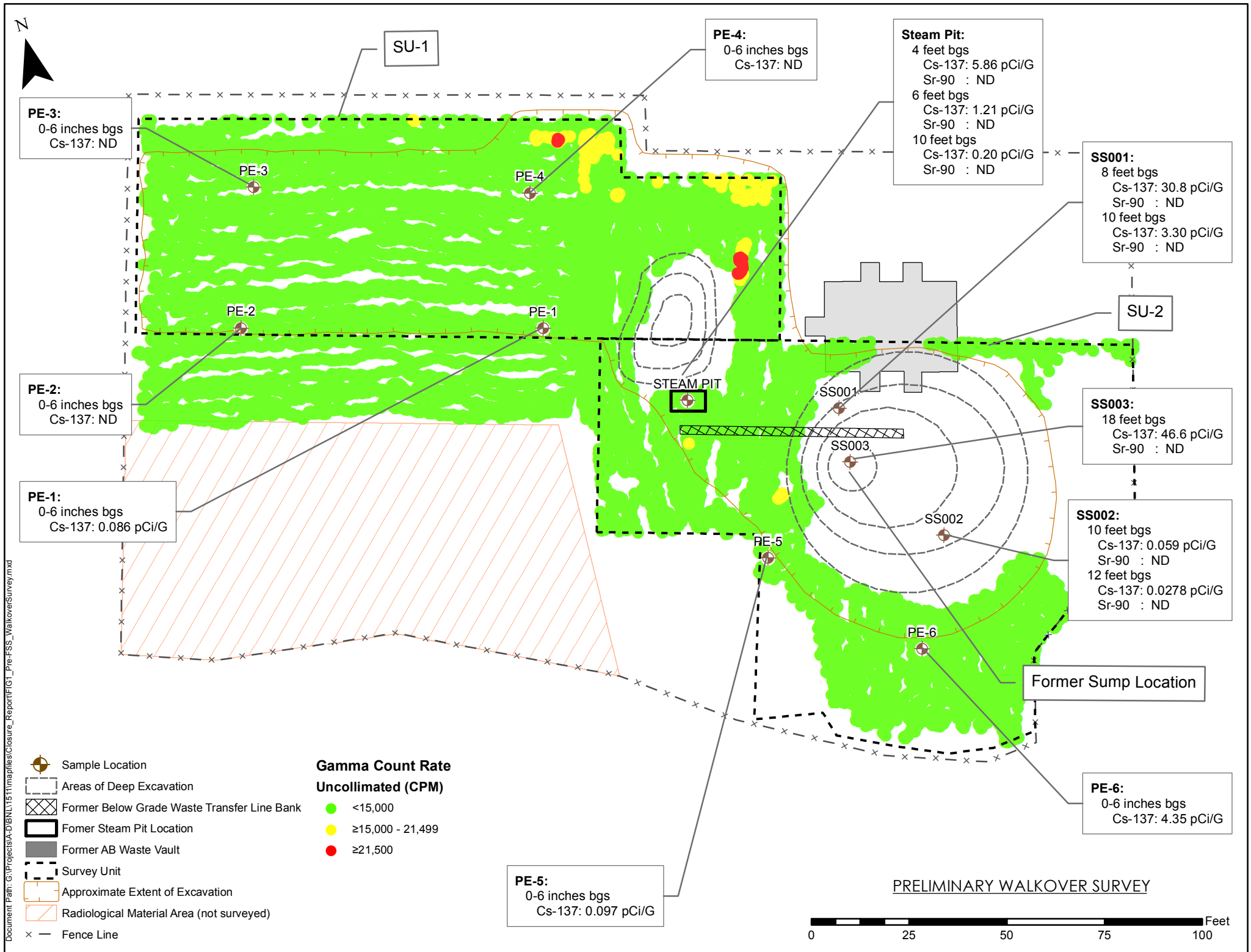
|          |      |         |          |
|----------|------|---------|----------|
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |
| REVISION | DATE | INITIAL | COMMENTS |

|                      |           |              |    |
|----------------------|-----------|--------------|----|
| DRAWING INFORMATION: |           |              |    |
| Project:             | BNL 1503  | Designed by: | BB |
| Date:                | 6/12/2015 | Drawn by:    | BB |
| Scale:               | AS SHOWN  | Approved by: | AL |

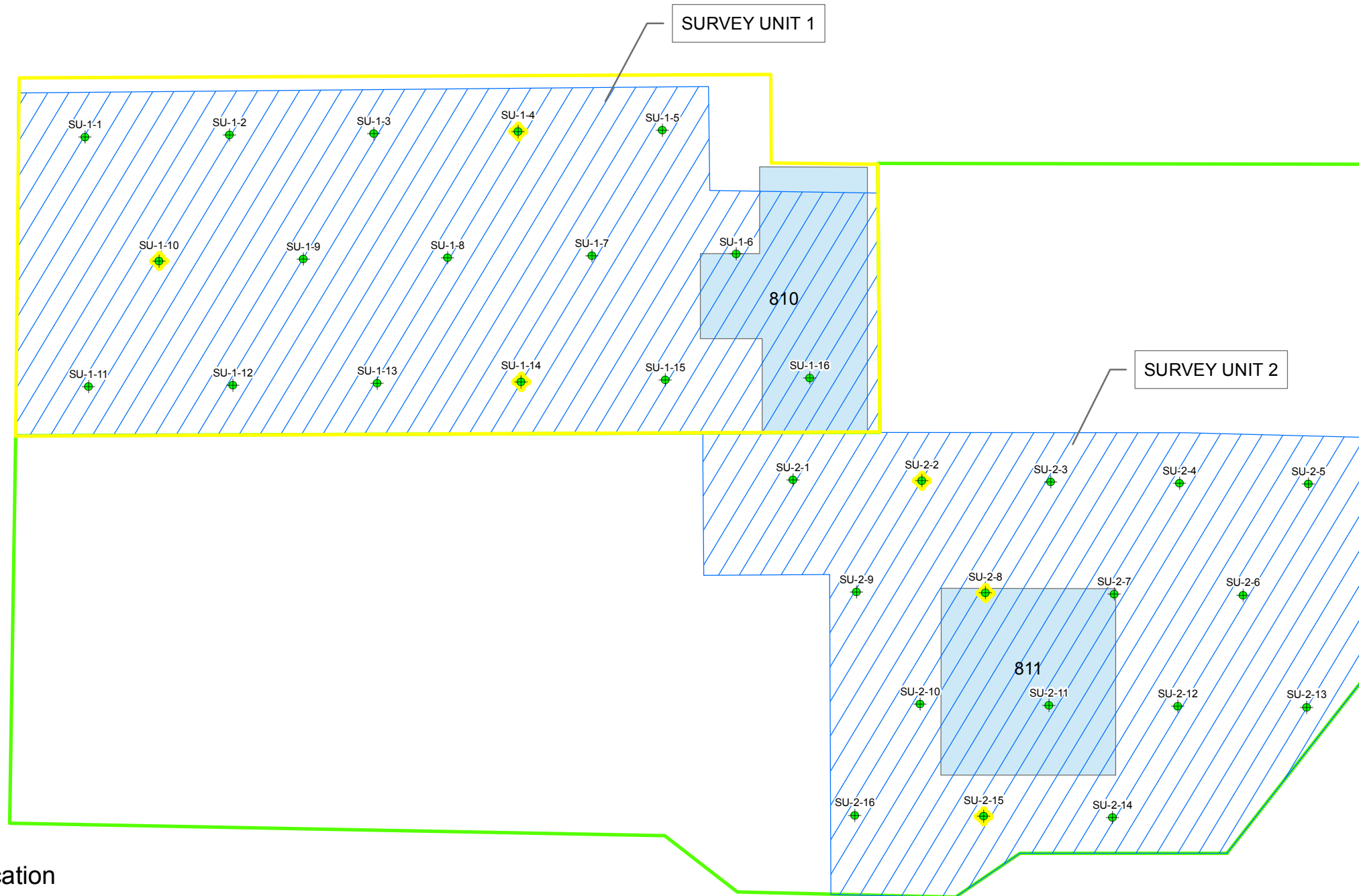
2005 FINAL STATUS  
SURVEY AREA

FIGURE NO:  
  
1-5

SHEET:







- Sample Location
- Sample Location with GeoProbe
- AOC 10 Surrounding Area
- Survey Units
- AOC 10 Boundary
- Building Footprint



**PWGC**

Strategic Environmental and Engineering Solutions

P.W. GROSSER CONSULTING, INC.

630 Johnson Avenue, • Suite 7  
Bohemia • NY • 11716-2618  
Phone: (631) 589-6353 • Fax: (631) 589-8705  
E-mail: INFO@PWGROSSER.COM

UNAUTHORIZED ALTERATION OR ADDITION TO THIS  
DRAWING AND RELATED DOCUMENTS IS A VIOLATION  
OF SEC. 7209 OF THE N.Y.S. EDUCATION LAW

DRAWING PREPARED FOR:

BROOKHAVEN  
NATIONAL  
LABORATORY

| REVISION | DATE | INITIAL | COMMENTS |
|----------|------|---------|----------|
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |
|          |      |         |          |

DRAWING INFORMATION:

|          |           |              |    |
|----------|-----------|--------------|----|
| Project: | BNL1503   | Designed by: | BB |
| Date:    | 3/22/2016 | Drawn by:    | BB |
| Scale:   | AS SHOWN  | Approved by: | AL |

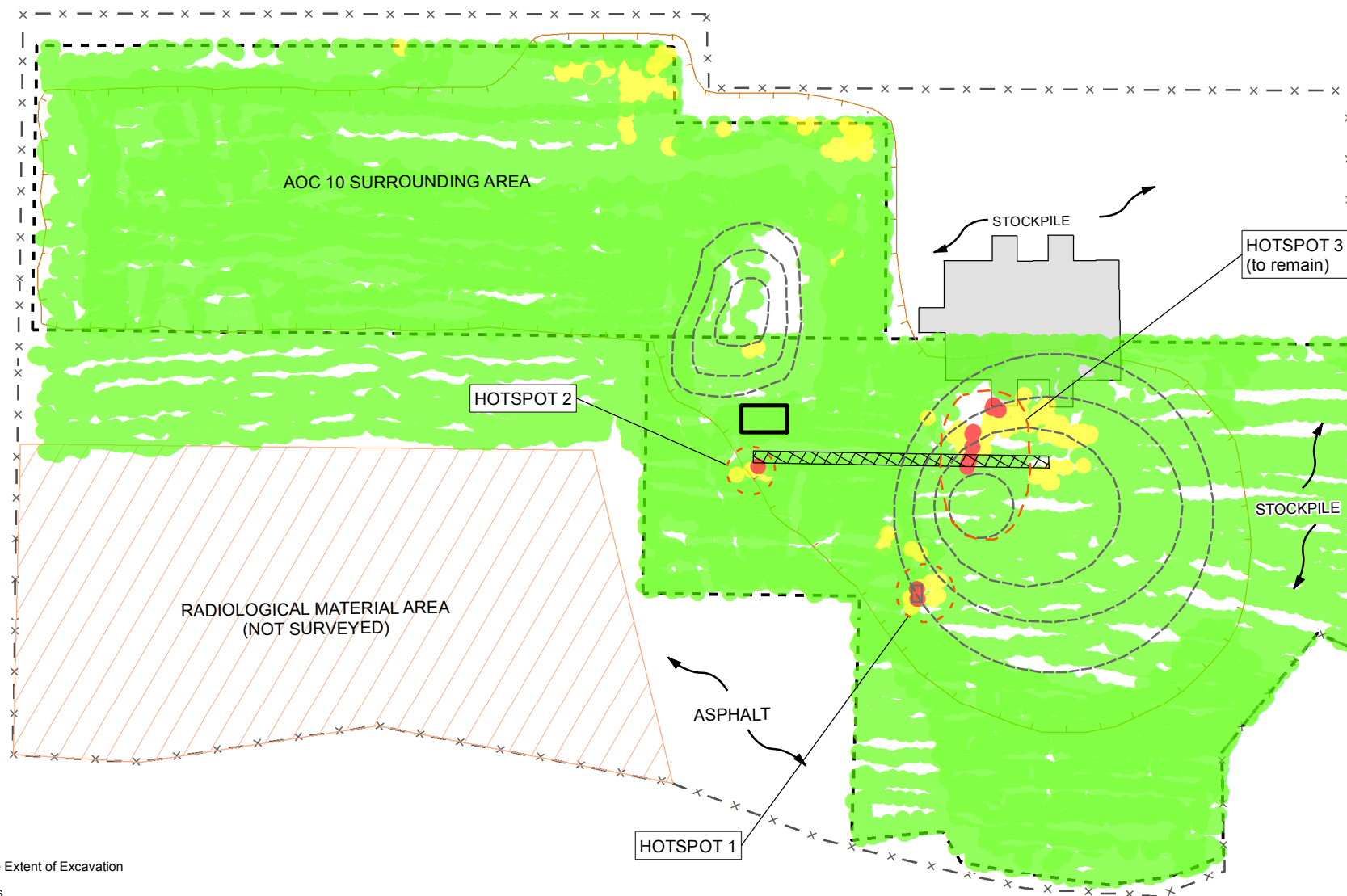
SURFACE SOIL MEASUREMENT/  
SAMPLE LOCATIONS  
FOR AOC 10 AND  
SURROUNDING AREA

FIGURE NO:

4-2

SHEET:



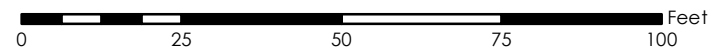


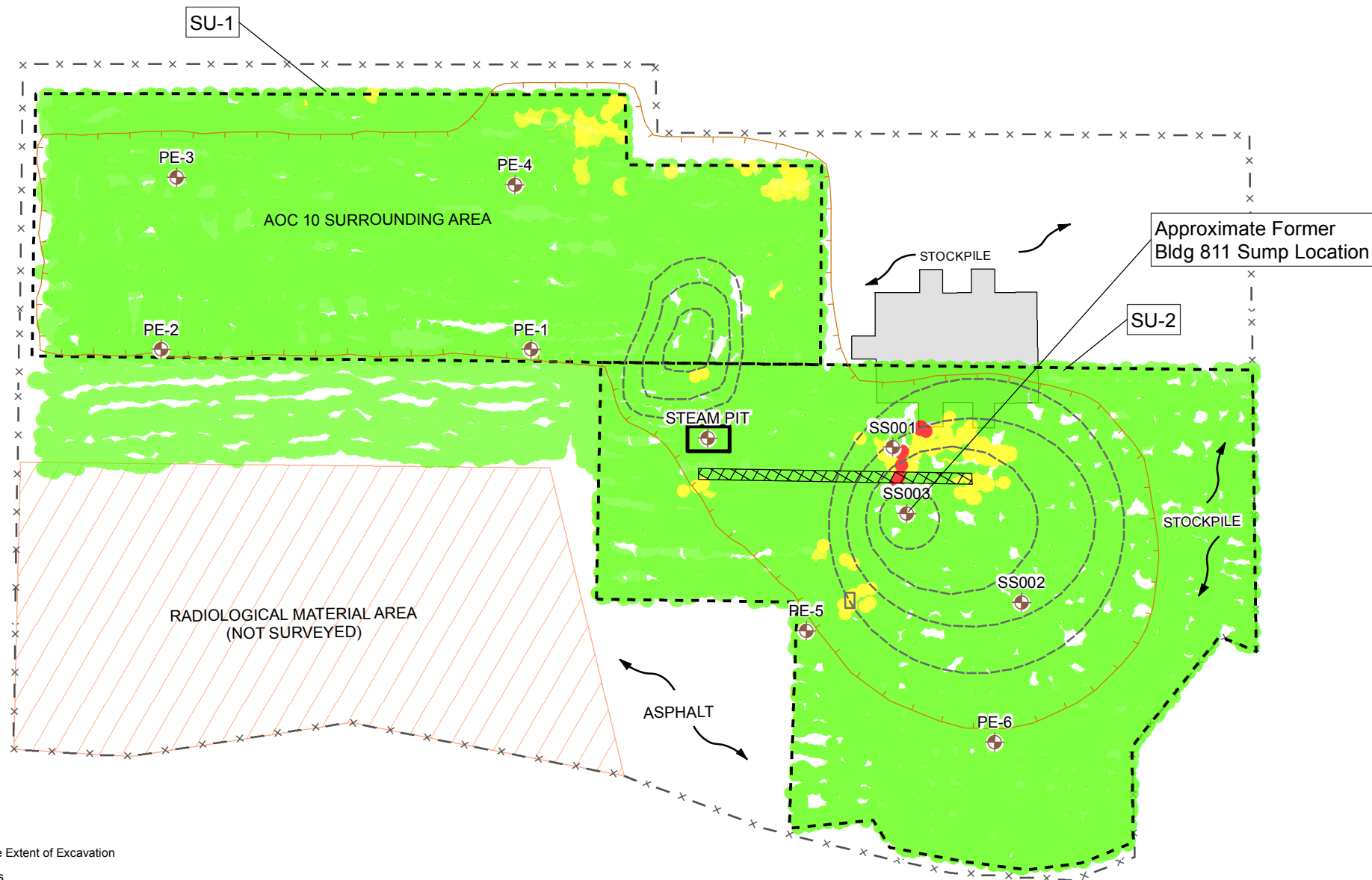
- Approximate Extent of Excavation
- Survey Units
- Radiological Material Area
- Area of Deep Excavation
- Former A/B Waste Tank

**Gamma Count Rate - Uncollimated (CPM)**

- <15,000
- ≥15,000 - 21,499
- ≥21,500

**FINAL STATUS SURVEY - HOTSPOT LOCATIONS**



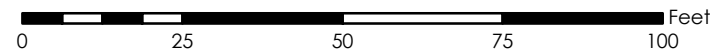


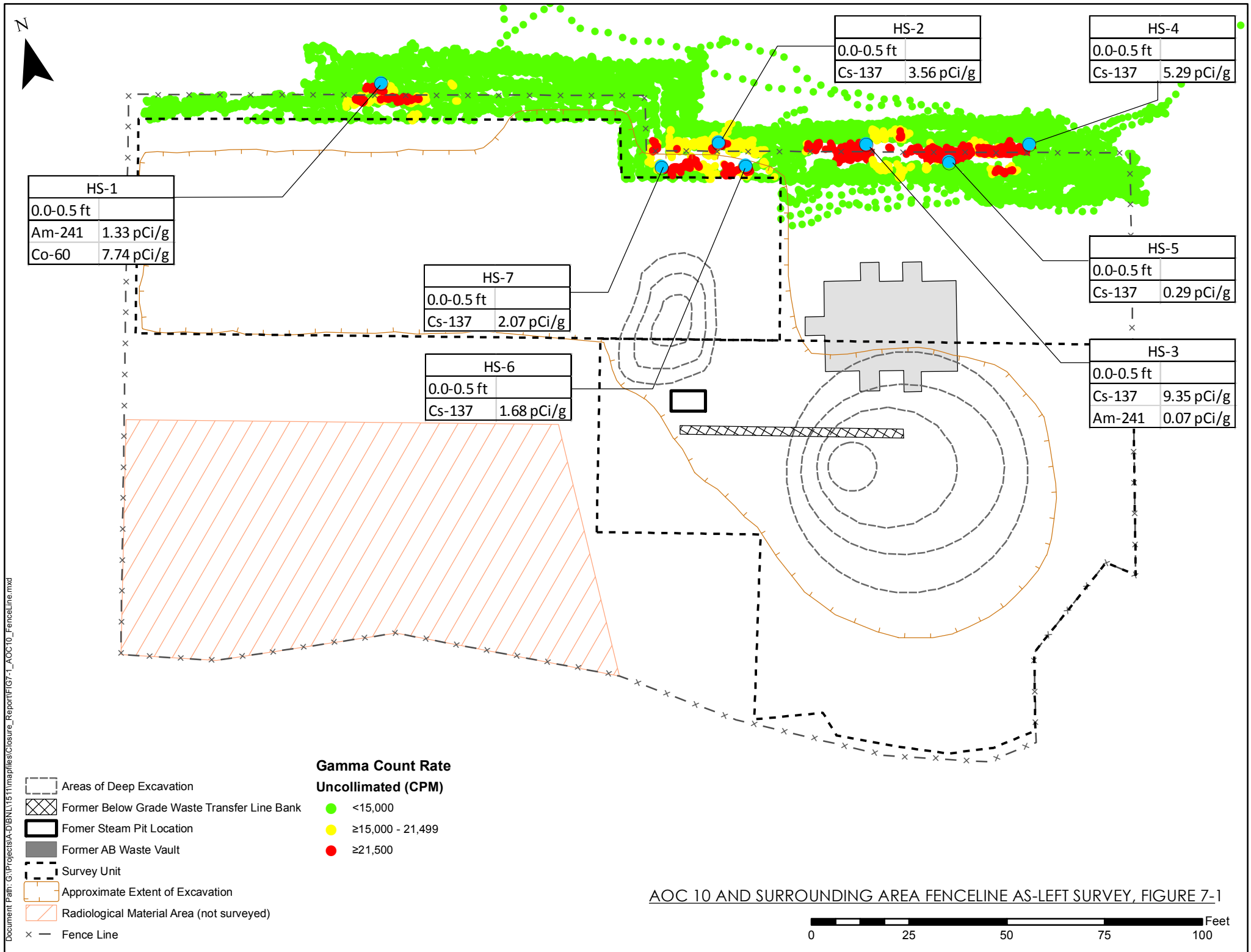
- Approximate Extent of Excavation
- Survey Units
- Radiological Material Area
- Area of Deep Excavation
- Former AB Waste Vault

**Gamma Count Rate - Uncollimated (CPM)**

- <15,000
- ≥15,000 - 21,499
- ≥21,500

FINAL STATUS SURVEY - POST-HOTSPOT REMOVALS





Document Path: G:\Projects\AOC10\11\mapfiles\Closure\_Report\Fig7-1\_AOC10\_Fenceline.mxd

AOC 10 AND SURROUNDING AREA FENCELINE AS-LEFT SURVEY, FIGURE 7-1

Appendix B  
Building 811 Project RESRAD Summary Reports

## RESRAD Input Parameters and Results Comparison

### RESRAD Analysis Inputs – Building 811 Soil Area

The RESRAD computer code (RESRAD for Windows, Version 7.2, 2016, Argonne National Laboratory) is used to determine whether a remediated area has met the criteria of 15 millirem per year, with an ALARA goal of 10 millirem per year (NYSDEC TAGM 4003, 1993).

For the Building 811 Soil Areas, a residential scenario with a decay time of 50 years after the time of remediation will be used, along with an industrial scenario with no decay time. The information in this input analysis refers to the residential scenario. The parameters used for RESRAD are a combination of default parameters and site specific parameters. The input parameters are based on the following document: “Final Remedial Investigation/ Risk Assessment Report, OU I/VI, June 14, 1996, CDM Federal Programs Corp.” The attached table provides the details of the input parameters used for the original CDM Report, and for the current RESRAD run for the Building 811 Soil Area. Yellow shaded areas indicate parameters used for the current project that differ from the RESRAD default parameters. The gray shaded areas are for nuclides that are not applicable.

|                                 |               |                    | Reference:    | Final RI/RA OU I/VI June 1996, CDM Document |                        | Building 811 Soil Area Resrad Eval. @ 50 years |
|---------------------------------|---------------|--------------------|---------------|---------------------------------------------|------------------------|------------------------------------------------|
| Resrad Parameter                | Menu-Name     | Units              | Default Value | Industrial User Input                       | Residential User Input | Residential User Input                         |
| Area of Contaminated Zone       | R011 - AREA   | m <sup>2</sup>     | 1.00E+04      | 5.20E+04                                    | 5.20E+04               | 1.86 E+3                                       |
| Thickness of Contaminated Zone  | R011- THICK0  | m                  | 2.00E+00      | 5.00E+00                                    | 5.00E+00               | 5.00E+00                                       |
| Length Parallel to Aquifer Flow | R011 - LCZPAQ | m                  | 1.00E+02      | 2.50E+02                                    | 2.50E+02               | 7.60 E+01                                      |
| Unsaturated Zone Thickness      | R015- H (1)   | m                  | 4.00E+00      | 0.00E+00                                    | 0.00E+00               | 0.00E+00                                       |
| Inhalation Rate                 | R017 – INHALR | m <sup>3</sup> /yr | 8.40E+03      | 7.30E+03                                    | 7.30E+03               | 7.30E+03                                       |

## RESRAD Input Parameters and Results Comparison

|                                          |               |                  | Reference:    | Final RI/RA OU I/VI June 1996, CDM Document |                        | Building 811 Soil Area Resrad Eval. @ 50 years |
|------------------------------------------|---------------|------------------|---------------|---------------------------------------------|------------------------|------------------------------------------------|
| Resrad Parameter                         | Menu-Name     | Units            | Default Value | Industrial User Input                       | Residential User Input | Residential User Input                         |
| Mass Loading for Inhalation              | R017 – MLINH  | g/m <sup>3</sup> | 1.00E-04      | 1.00E-04                                    | 1.00E-04               | 1.00E-04                                       |
| Exposure Duration                        | R017 – ED     | yr               | 3.00E+01      | 2.50E+01                                    | 3.00E+01               | 3.00E+01                                       |
| Shielding Factor, Inhalation             | R017 – SHF3   | unitless         | 4.00E-01      | 4.00E-01                                    | 4.00E-01               | 4.00E-01                                       |
| Shielding Factor, External Gamma         | R017 – SHF1   | unitless         | 7.00E-01      | 8.00E-01                                    | 8.00E-01               | 8.00E-01                                       |
| Fraction of Time Spent Indoors           | R017 – FIND   | unitless         | 5.00E-01      | 1.70E-01                                    | 5.00E-01               | 5.00E-01                                       |
| Fraction of Time Spent Outdoors (onsite) | R017 – FOTD   | unitless         | 2.50E-01      | 6.00E-02                                    | 2.50E-01               | 2.50E-01                                       |
| Shape Factor, External Gamma             | R017 – FS     | unitless         | 1.00E+00      | 1.00E+00                                    | 1.00E+00               | 1.00E+00                                       |
| Depth of Cover Material                  | R013 – COVER0 | m                | 0.00E+00      | 0.00E+00                                    | 0.00E+00               | 0.00E+00                                       |
| Density of Cover Material                | R013 – DENSCV | g/cc             | 1.50E+00      | not used, no cover                          | not used, no cover     | not used, no cover                             |
| Contaminated Zone Total Porosity         | R013 – TPCZ   | unitless         | 4.00E-01      | 3.30E-01                                    | 3.30E-01               | 3.30E-01                                       |

### RESRAD Input Parameters and Results Comparison

|                                          |               |                  | Reference:    | Final RI/RA OU I/VI June 1996, CDM Document |                        | Building 811 Soil Area Resrad Eval. @ 50 years |
|------------------------------------------|---------------|------------------|---------------|---------------------------------------------|------------------------|------------------------------------------------|
| Resrad Parameter                         | Menu-Name     | Units            | Default Value | Industrial User Input                       | Residential User Input | Residential User Input                         |
| Contaminated Zone Field Capacity         | R013 – FCCZ   | unitless         | 2.00E-01      | 2.40E-01                                    | 2.40E-01               | 2.40E-01                                       |
| Contaminated Zone Hydraulic Conductivity | R013 – HCCZ   | m/yr             | 1.00E+01      | 5.00E+03                                    | 5.00E+03               | 5.00E+03                                       |
| Contaminated Zone b Parameter            | R013 – BCZ    | unitless         | 5.30E+00      | 4.90E+00                                    | 4.90E+00               | 4.90E+00                                       |
| Contaminated Zone Erosion Rate           | R013 - VCZ    | m/yr             | 1.00E-03      | 1.00E-03                                    | 1.00E-03               | 1.00E-03                                       |
| Humidity in Air                          | R013 - HUMID  | g/m <sup>3</sup> | 8.00E+00      | 6.60E+00                                    | 6.60E+00               | 8.00E+00                                       |
| Evapotranspiration Coefficient           | R013 – EVAPTR | unitless         | 5.00E-01      | 4.60E-01                                    | 4.60E-01               | 4.60E-01                                       |
| Precipitation                            | R013 – PRECIP | m/yr             | 1.00E+00      | 1.23E+00                                    | 1.23E+00               | 1.23E+00                                       |
| Average Annual Wind Speed                | R013 - WIND   | m/sec            | 2.00E+00      | 6.23E+00                                    | 6.23E+00               | 6.23E+00                                       |
| Density of Saturated Zone                | R014 – DENSAQ | g/cc             | 1.50E+00      | 1.66E+00                                    | 1.66E+00               | 1.66E+00                                       |
| Saturated Zone Total Porosity            | R014 – TPSZ   | unitless         | 4.00E-01      | 3.30E-01                                    | 3.30E-01               | 3.30E-01                                       |



### RESRAD Input Parameters and Results Comparison

|                                            |                   |                     | Reference:    | Final RI/RA OU I/VI June 1996, CDM Document |                        | Building 811 Soil Area Resrad Eval. @ 50 years |
|--------------------------------------------|-------------------|---------------------|---------------|---------------------------------------------|------------------------|------------------------------------------------|
| Resrad Parameter                           | Menu-Name         | Units               | Default Value | Industrial User Input                       | Residential User Input | Residential User Input                         |
| Saturated Zone Effective Porosity          | R014 – EPSZ       | unitless            | 2.00E-01      | 2.40E-01                                    | 2.40E-01               | 2.40E-01                                       |
| Saturated Zone Hydraulic Conductivity      | R014 – HCSZ       | m/yr                | 1.00E+02      | 2.00E+04                                    | 2.00E+04               | 2.00E+04                                       |
| Saturated Zone Hydraulic Gradient          | R014 – HGWT       | unitless            | 2.00E-02      | 4.80E-03                                    | 4.80E-03               | 4.80E-03                                       |
| Saturated Zone b Parameter                 | R014 – BSZ        | unitless            | 5.30E+00      | 4.90E+00                                    | 4.90E+00               | 4.90E+00                                       |
| Well Pump Intake Depth                     | R014 – DW1BWT     | m below water table | 1.00E+01      | 1.80E+01                                    | 1.80E+01               | 1.80E+01                                       |
| Well Pumping Rate                          | R014 – UW         | m <sup>3</sup> /yr  | 2.50E+02      | 2.50E+02                                    | 2.50E+02               | 2.50E+02                                       |
| Unsaturated Zone thickness                 | R015 - H (1)      | m                   | 4.00 E+00     |                                             |                        | 0.00 E+00                                      |
| Unsaturated Zone Soil Density              | R015 – DENSUZ (1) | g/cc                | 1.50E+00      | 1.66E+00                                    | 1.66E+00               | 1.66E+00                                       |
| Unsaturated Zone Total Porosity            | R015 – TPUZ (1)   | unitless            | 4.00E-01      | 3.30E-01                                    | 3.30E-01               | 3.30E-01                                       |
| Unsaturated Zone Effective Porosity        | R015 – EPUZ (1)   | unitless            | 2.00E-01      | 2.40E-01                                    | 2.40E-01               | 2.40E-01                                       |
| Unsaturated Zone Soil-Specific b Parameter | R015 – BUZ (1)    | unitless            | 5.30E+00      | 4.90E+00                                    | 4.90E+00               | 4.90E+00                                       |

### RESRAD Input Parameters and Results Comparison

|                                         |                 |                  | Reference:    | Final RI/RA OU I/VI June 1996, CDM Document |                        | Building 811 Soil Area Resrad Eval. @ 50 years |
|-----------------------------------------|-----------------|------------------|---------------|---------------------------------------------|------------------------|------------------------------------------------|
| Resrad Parameter                        | Menu-Name       | Units            | Default Value | Industrial User Input                       | Residential User Input | Residential User Input                         |
| Unsaturated Zone Hydraulic Conductivity | R015 – HCUZ (1) | m/yr             | 1.00E+01      | 5.00E+03                                    | 5.00E+03               | 5.00E+03                                       |
| Fruit, Vegetable and Grain Consumption  | R018 - DIET(1)  | kg/yr            | 1.60E+02      | N/A                                         | 1.60E+02               | 1.60E+02                                       |
| Leafy Vegetable Consumption             | R018 - DIET(2)  | kg/yr            | 1.40E+01      | N/A                                         | 1.40E+01               | 1.40E+01                                       |
| Soil Ingestion Rate                     | R018 - SOIL     | g/yr             | 3.65E+01      | 3.65E+01                                    | 4.38E+01               | 4.38E+01                                       |
| Drinking Water Intake                   | R018 - DWI      | L/yr             | 5.10E+02      | 3.50E+02                                    | 7.00E+02               | 7.00E+02                                       |
| Household Water Fraction                | R018 - FDW      | unitless         | 1.00E+00      | 1.00E+00                                    | 1.00E+00               | 1.00E+00                                       |
| Mass Loading for Foliar Deposition      | R019 - MLFD     | g/m <sup>3</sup> | 1.00E-04      | 1.00E-05                                    | 1.00E-05               | 1.00E-05                                       |
| Building Depth below Ground Level       | R021 - DMFL     | m                | -1.00E+00     | N/A                                         | -1.00E+00              | no radon pathway – not used -1.00E+00          |
| Emanating Power of Rn-222 gas           | EMANA(1)        | unitless         | 2.50E-01      | N/A                                         | 2.50E-01               | no radon pathway – not used 2.50E-01           |
| Emanating Power of Rn-220 gas           | EMANA(2)        | unitless         | 1.50E-01      | N/A                                         | 1.50E-01               | no radon pathway – not used 1.50E-01           |

## RESRAD Input Parameters and Results Comparison

|                                 |                   |       | Reference:    | Final RI/RA OU I/VI June 1996, CDM Document |                        | Building 811 Soil Area Resrad Eval. @ 50 years |
|---------------------------------|-------------------|-------|---------------|---------------------------------------------|------------------------|------------------------------------------------|
| Resrad Parameter                | Menu-Name         | Units | Default Value | Industrial User Input                       | Residential User Input | Residential User Input                         |
| Am-241 Distribution Coefficient | R016 – DCNUCC (1) | cc/g  | 2.00E+01      | 1.90E+03                                    | 1.90E+03               | 1.90E+03                                       |
| Am-241 Results for 15 mrem/yr   |                   | pCi/g |               | 1.59E+02                                    | 1.59E+02               | 1.41 E+2                                       |
| Co-60 Distribution Coefficient  | R016 – DCNUCC (2) | cc/g  | 1.00E+03      | 6.00E+01                                    | 6.00E+01               | 6.00E+01                                       |
| Co-60 Results for 15 mrem/yr    |                   | pCi/g |               | 3.33E+03                                    | 3.33E+03               | 1.26E+03                                       |
| Cs-137 Distribution Coefficient | R016 – DCNUCC (3) | cc/g  | 1.00E+03      | 2.80E+02                                    | 2.80E+02               | 2.80E+02                                       |
| Cs-137 Results for 15 mrem/yr @ |                   | pCi/g |               |                                             | 21.9                   | 22.6                                           |
| Eu-152 Distribution Coefficient | R016 – DCNUCC (4) | cc/g  | -1.00E+00     | N/A                                         | N/A                    | 2.40E+02                                       |
| Eu-152 Results for 15 mrem/yr   |                   | pCi/g |               | N/A                                         | N/A                    | 5.10E+01                                       |
| Eu-154 Distribution Coefficient | R016 – DCNUCC (5) | cc/g  | -1.00E+00     | N/A                                         | N/A                    | 2.40E+02                                       |
| Eu-154 Results for 15 mrem/yr   |                   | pCi/g |               | N/A                                         | N/A                    | 1.80E+02                                       |

## RESRAD Input Parameters and Results Comparison

|                                 |                    |       | Reference:    | Final RI/RA OU I/VI June 1996, CDM Document |                        | Building 811 Soil Area Resrad Eval. @ 50 years |
|---------------------------------|--------------------|-------|---------------|---------------------------------------------|------------------------|------------------------------------------------|
| Resrad Parameter                | Menu-Name          | Units | Default Value | Industrial User Input                       | Residential User Input | Residential User Input                         |
| H-3 Distribution Coefficient    | R016 – DCNUCC (6)  | cc/g  | 0.00E+00      | 0.00E+00                                    | 0.00E+00               | 0.00E+00                                       |
| H-3 Results for 15 mrem/yr      |                    | pCi/g |               | 9.59E+15                                    | 9.59E+15               | Very High - N/A                                |
| Pu-238 Distribution Coefficient | R016 – DCNUCC (7)  | cc/g  | 2.00E+03      | 5.50E+02                                    | 5.50E+02               | 5.50E+02                                       |
| Pu-238 Results for 15 mrem/yr   |                    | pCi/g |               | 2.74E+02                                    | 2.74E+02               | 2.20 E+02                                      |
| Pu-239 Distribution Coefficient | R016 – DCNUCC (8)  | cc/g  | 2.00E+03      | 5.50E+02                                    | 5.50E+02               | 5.50E+02                                       |
| Pu-239 Results for 15 mrem/yr   |                    | pCi/g |               | 1.68E+02                                    | 1.68E+02               | 1.34 E+02                                      |
| Ra-226 Distribution Coefficient | R016 – DCNUCC (9)  | cc/g  | 7.00E+01      | 5.00E+02                                    | 5.00E+02               | 5.00E+02                                       |
| Ra-226 Results for 15 mrem/yr   |                    | pCi/g |               | Not Used                                    | Not calculated         | 1.0                                            |
| Sr-90 Distribution Coefficient  | R016 – DCNUCC (10) | cc/g  | 3.00E+01      | 3.00E+00                                    | 3.00E+00               | 3.00E+00                                       |
| Sr-90 Results for 15 mrem/yr    |                    | pCi/g |               |                                             | 32.7                   | 31.3                                           |

## RESRAD Input Parameters and Results Comparison

|                                |                    |       | Reference:    | Final RI/RA OU I/VI June 1996, CDM Document |                        | Building 811 Soil Area Resrad Eval. @ 50 years        |
|--------------------------------|--------------------|-------|---------------|---------------------------------------------|------------------------|-------------------------------------------------------|
| Resrad Parameter               | Menu-Name          | Units | Default Value | Industrial User Input                       | Residential User Input | Residential User Input                                |
| U-235 Distribution Coefficient | R016 – DCNUCC (11) | cc/g  | 5.00E+01      | 1.70E+01                                    | 1.70E+01               | 1.70E+01                                              |
| U-235 Results for 15 mrem/yr   |                    | pCi/g |               | 31 pCi/g (15 mrem); 8.2 pCi/g (4 mrem)      | 3.06E+01               | 15 pCi/g (15 mrem); 6.7 pCi/g (4 mrem water pathways) |
| U-238 Distribution Coefficient | R016 – DCNUCC (12) | cc/g  | 5.00E+01      | 1.70E+01                                    | 1.70E+01               | 1.70E+01                                              |
| U-238 Results for 15 mrem/yr   |                    | pCi/g |               | 39 pCi/g (15 mrem); 10.5 pCi/g (4 mrem)     | 3.92E+01               | 21 pCi/g (15 mrem); 6.6 pCi/g (4 mrem water pathways) |
| Inhalation Pathway             |                    |       |               | Active                                      | Active                 | Active                                                |
| Plant Ingestion Pathway        |                    |       |               | Suppressed                                  | Active                 | Active                                                |
| Meat Ingestion Pathway         |                    |       |               | Suppressed                                  | Suppressed             | Suppressed                                            |
| Milk Ingestion Pathway         |                    |       |               | Suppressed                                  | Suppressed             | Suppressed                                            |
| Aquatic Foods Pathway          |                    |       |               | Suppressed                                  | Suppressed             | Suppressed                                            |
| Drinking Water Pathway         |                    |       |               | Active                                      | Active                 | Active                                                |
| Soil Ingestion Pathway         |                    |       |               | Active                                      | Active                 | Active                                                |
| Radon Pathway                  |                    |       |               | Active                                      | Active                 | Suppressed (no buildings)                             |

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

|                                                            |    |
|------------------------------------------------------------|----|
| Dose Conversion Factor (and Related) Parameter Summary ... | 2  |
| Site-Specific Parameter Summary .....                      | 5  |
| Summary of Pathway Selections .....                        | 10 |
| Contaminated Zone and Total Dose Summary .....             | 11 |
| Total Dose Components                                      |    |
| Time = 0.000E+00 .....                                     | 12 |
| Time = 1.000E+00 .....                                     | 13 |
| Time = 5.000E+00 .....                                     | 14 |
| Time = 1.000E+01 .....                                     | 15 |
| Time = 5.000E+01 .....                                     | 16 |
| Time = 1.000E+02 .....                                     | 17 |
| Time = 5.000E+02 .....                                     | 18 |
| Time = 1.000E+03 .....                                     | 19 |
| Dose/Source Ratios Summed Over All Pathways .....          | 20 |
| Single Radionuclide Soil Guidelines .....                  | 20 |
| Dose Per Nuclide Summed Over All Pathways .....            | 21 |
| Soil Concentration Per Nuclide .....                       | 21 |

Dose Conversion Factor (and Related) Parameter Summary  
Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| A-1  | DCF's for external ground radiation, (mrem/yr)/(pCi/g)   |                |            |                |
| A-1  | At-218 (Source: DCFPAK3.02)                              | 5.567E-05      | 5.567E-05  | DCF1( 1)       |
| A-1  | Ba-137m (Source: DCFPAK3.02)                             | 3.381E+00      | 3.381E+00  | DCF1( 2)       |
| A-1  | Bi-210 (Source: DCFPAK3.02)                              | 5.473E-03      | 5.473E-03  | DCF1( 3)       |
| A-1  | Bi-214 (Source: DCFPAK3.02)                              | 9.135E+00      | 9.135E+00  | DCF1( 4)       |
| A-1  | Cs-137 (Source: DCFPAK3.02)                              | 8.686E-04      | 8.686E-04  | DCF1( 5)       |
| A-1  | Hg-206 (Source: DCFPAK3.02)                              | 6.127E-01      | 6.127E-01  | DCF1( 6)       |
| A-1  | Pa-234 (Source: DCFPAK3.02)                              | 8.275E+00      | 8.275E+00  | DCF1( 7)       |
| A-1  | Pa-234m (Source: DCFPAK3.02)                             | 1.257E-01      | 1.257E-01  | DCF1( 8)       |
| A-1  | Pb-210 (Source: DCFPAK3.02)                              | 2.092E-03      | 2.092E-03  | DCF1( 9)       |
| A-1  | Pb-214 (Source: DCFPAK3.02)                              | 1.257E+00      | 1.257E+00  | DCF1( 10)      |
| A-1  | Po-210 (Source: DCFPAK3.02)                              | 5.641E-05      | 5.641E-05  | DCF1( 11)      |
| A-1  | Po-214 (Source: DCFPAK3.02)                              | 4.801E-04      | 4.801E-04  | DCF1( 12)      |
| A-1  | Po-218 (Source: DCFPAK3.02)                              | 9.228E-09      | 9.228E-09  | DCF1( 13)      |
| A-1  | Ra-226 (Source: DCFPAK3.02)                              | 3.176E-02      | 3.176E-02  | DCF1( 14)      |
| A-1  | Rn-218 (Source: DCFPAK3.02)                              | 4.259E-03      | 4.259E-03  | DCF1( 15)      |
| A-1  | Rn-222 (Source: DCFPAK3.02)                              | 2.130E-03      | 2.130E-03  | DCF1( 16)      |
| A-1  | Sr-90 (Source: DCFPAK3.02)                               | 6.463E-04      | 6.463E-04  | DCF1( 17)      |
| A-1  | Th-230 (Source: DCFPAK3.02)                              | 1.106E-03      | 1.106E-03  | DCF1( 18)      |
| A-1  | Th-234 (Source: DCFPAK3.02)                              | 2.316E-02      | 2.316E-02  | DCF1( 19)      |
| A-1  | Tl-206 (Source: DCFPAK3.02)                              | 1.278E-02      | 1.278E-02  | DCF1( 20)      |
| A-1  | Tl-210 (Source: DCFPAK3.02)                              | 1.677E+01      | 1.677E+01  | DCF1( 21)      |
| A-1  | U-234 (Source: DCFPAK3.02)                               | 3.456E-04      | 3.456E-04  | DCF1( 22)      |
| A-1  | U-238 (Source: DCFPAK3.02)                               | 1.713E-04      | 1.713E-04  | DCF1( 23)      |
| A-1  | Y-90 (Source: DCFPAK3.02)                                | 4.016E-02      | 4.016E-02  | DCF1( 24)      |
|      |                                                          |                |            |                |
| B-1  | Dose conversion factors for inhalation, mrem/pCi:        |                |            |                |
| B-1  | Cs-137+D                                                 | 1.457E-04      | 1.457E-04  | DCF2( 1)       |
| B-1  | Pb-210+D                                                 | 3.708E-02      | 2.077E-02  | DCF2( 2)       |
| B-1  | Ra-226+D                                                 | 3.528E-02      | 3.517E-02  | DCF2( 3)       |
| B-1  | Sr-90+D                                                  | 5.841E-04      | 5.786E-04  | DCF2( 4)       |
| B-1  | Th-230                                                   | 3.759E-01      | 3.759E-01  | DCF2( 5)       |
| B-1  | U-234                                                    | 3.479E-02      | 3.479E-02  | DCF2( 6)       |
| B-1  | U-238                                                    | 2.973E-02      | 2.973E-02  | DCF2( 7)       |
| B-1  | U-238+D                                                  | 2.976E-02      | 2.973E-02  | DCF2( 8)       |
|      |                                                          |                |            |                |
| D-1  | Dose conversion factors for ingestion, mrem/pCi:         |                |            |                |
| D-1  | Cs-137+D                                                 | 5.032E-05      | 5.032E-05  | DCF3( 1)       |
| D-1  | Pb-210+D                                                 | 7.057E-03      | 2.575E-03  | DCF3( 2)       |
| D-1  | Ra-226+D                                                 | 1.037E-03      | 1.036E-03  | DCF3( 3)       |
| D-1  | Sr-90+D                                                  | 1.120E-04      | 1.021E-04  | DCF3( 4)       |
| D-1  | Th-230                                                   | 7.918E-04      | 7.918E-04  | DCF3( 5)       |
| D-1  | U-234                                                    | 1.831E-04      | 1.831E-04  | DCF3( 6)       |
| D-1  | U-238                                                    | 1.650E-04      | 1.650E-04  | DCF3( 7)       |
| D-1  | U-238+D                                                  | 1.776E-04      | 1.650E-04  | DCF3( 8)       |
|      |                                                          |                |            |                |
| D-34 | Food transfer factors:                                   |                |            |                |
| D-34 | Cs-137+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 1,1)      |
| D-34 | Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.000E-02      | 3.000E-02  | RTF( 1,2)      |
| D-34 | Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 1,3)      |



Summary : 811 area-Resident-surface-Bkgd subtract-B

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKG SUBTR-B.RAD

## Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| D-34 | Pb-210+D , plant/soil concentration ratio, dimensionless | 1.000E-02      | 1.000E-02  | RTF( 2,1)      |
| D-34 | Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-04      | 8.000E-04  | RTF( 2,2)      |
| D-34 | Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 3.000E-04      | 3.000E-04  | RTF( 2,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Ra-226+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 3,1)      |
| D-34 | Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-03      | 1.000E-03  | RTF( 3,2)      |
| D-34 | Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 1.000E-03      | 1.000E-03  | RTF( 3,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Sr-90+D , plant/soil concentration ratio, dimensionless  | 3.000E-01      | 3.000E-01  | RTF( 4,1)      |
| D-34 | Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 4,2)      |
| D-34 | Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 2.000E-03      | 2.000E-03  | RTF( 4,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Th-230 , plant/soil concentration ratio, dimensionless   | 1.000E-03      | 1.000E-03  | RTF( 5,1)      |
| D-34 | Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 1.000E-04      | 1.000E-04  | RTF( 5,2)      |
| D-34 | Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06      | 5.000E-06  | RTF( 5,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-234 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 6,1)      |
| D-34 | U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 6,2)      |
| D-34 | U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 6,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 7,1)      |
| D-34 | U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 7,2)      |
| D-34 | U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 7,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238+D , plant/soil concentration ratio, dimensionless  | 2.500E-03      | 2.500E-03  | RTF( 8,1)      |
| D-34 | U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04      | 3.400E-04  | RTF( 8,2)      |
| D-34 | U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04      | 6.000E-04  | RTF( 8,3)      |
| D-5  |                                                          |                |            |                |
| D-5  | Bioaccumulation factors, fresh water, L/kg:              |                |            |                |
| D-5  | Cs-137+D , fish                                          | 2.000E+03      | 2.000E+03  | BIOFAC( 1,1)   |
| D-5  | Cs-137+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 1,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Pb-210+D , fish                                          | 3.000E+02      | 3.000E+02  | BIOFAC( 2,1)   |
| D-5  | Pb-210+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 2,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Ra-226+D , fish                                          | 5.000E+01      | 5.000E+01  | BIOFAC( 3,1)   |
| D-5  | Ra-226+D , crustacea and mollusks                        | 2.500E+02      | 2.500E+02  | BIOFAC( 3,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Sr-90+D , fish                                           | 6.000E+01      | 6.000E+01  | BIOFAC( 4,1)   |
| D-5  | Sr-90+D , crustacea and mollusks                         | 1.000E+02      | 1.000E+02  | BIOFAC( 4,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Th-230 , fish                                            | 1.000E+02      | 1.000E+02  | BIOFAC( 5,1)   |
| D-5  | Th-230 , crustacea and mollusks                          | 5.000E+02      | 5.000E+02  | BIOFAC( 5,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-234 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 6,1)   |
| D-5  | U-234 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 6,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-238 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 7,1)   |
| D-5  | U-238 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 7,2)   |
| D-5  |                                                          |                |            |                |

Summary : 811 area-Resident-surface-Bkdg subtract-B

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKG SUBTR-B.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                        | Current   | Base      | Parameter    |
|------|----------------------------------|-----------|-----------|--------------|
|      |                                  | Value#    | Case*     | Name         |
| D-5  | U-238+D , fish                   | 1.000E+01 | 1.000E+01 | BIOFAC( 8,1) |
| D-5  | U-238+D , crustacea and mollusks | 6.000E+01 | 6.000E+01 | BIOFAC( 8,2) |

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.

\*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : 811 area-Resident-surface-Bkgd subtract-B

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKG SUBTR-B.RAD

## Site-Specific Parameter Summary

| Menu | Parameter                                       | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|-------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R011 | Area of contaminated zone (m**2)                | 1.860E+03  | 1.000E+04 | ---                                              | AREA           |
| R011 | Thickness of contaminated zone (m)              | 5.000E+00  | 2.000E+00 | ---                                              | THICK0         |
| R011 | Fraction of contamination that is submerged     | 0.000E+00  | 0.000E+00 | ---                                              | SUBMFRACT      |
| R011 | Length parallel to aquifer flow (m)             | 7.600E+01  | 1.000E+02 | ---                                              | LCZPAQ         |
| R011 | Basic radiation dose limit (mrem/yr)            | 1.500E+01  | 3.000E+01 | ---                                              | BRDL           |
| R011 | Time since placement of material (yr)           | 0.000E+00  | 0.000E+00 | ---                                              | TI             |
| R011 | Times for calculations (yr)                     | 1.000E+00  | 1.000E+00 | ---                                              | T ( 2)         |
| R011 | Times for calculations (yr)                     | 5.000E+00  | 3.000E+00 | ---                                              | T ( 3)         |
| R011 | Times for calculations (yr)                     | 1.000E+01  | 1.000E+01 | ---                                              | T ( 4)         |
| R011 | Times for calculations (yr)                     | 5.000E+01  | 3.000E+01 | ---                                              | T ( 5)         |
| R011 | Times for calculations (yr)                     | 1.000E+02  | 1.000E+02 | ---                                              | T ( 6)         |
| R011 | Times for calculations (yr)                     | 5.000E+02  | 3.000E+02 | ---                                              | T ( 7)         |
| R011 | Times for calculations (yr)                     | 1.000E+03  | 1.000E+03 | ---                                              | T ( 8)         |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T ( 9)         |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T(10)          |
|      |                                                 |            |           |                                                  |                |
| R012 | Initial principal radionuclide (pCi/g): Cs-137  | 3.854E+00  | 0.000E+00 | ---                                              | S1(1)          |
| R012 | Initial principal radionuclide (pCi/g): Sr-90   | 2.140E-01  | 0.000E+00 | ---                                              | S1(4)          |
| R012 | Initial principal radionuclide (pCi/g): U-238   | 4.470E-01  | 0.000E+00 | ---                                              | S1(7)          |
| R012 | Concentration in groundwater (pCi/L): Cs-137    | not used   | 0.000E+00 | ---                                              | W1( 1)         |
| R012 | Concentration in groundwater (pCi/L): Sr-90     | not used   | 0.000E+00 | ---                                              | W1( 4)         |
| R012 | Concentration in groundwater (pCi/L): U-238     | not used   | 0.000E+00 | ---                                              | W1( 7)         |
|      |                                                 |            |           |                                                  |                |
| R013 | Cover depth (m)                                 | 0.000E+00  | 0.000E+00 | ---                                              | COVER0         |
| R013 | Density of cover material (g/cm**3)             | not used   | 1.500E+00 | ---                                              | DENSCV         |
| R013 | Cover depth erosion rate (m/yr)                 | not used   | 1.000E-03 | ---                                              | VCV            |
| R013 | Density of contaminated zone (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSCZ         |
| R013 | Contaminated zone erosion rate (m/yr)           | 1.000E-03  | 1.000E-03 | ---                                              | VCZ            |
| R013 | Contaminated zone total porosity                | 3.300E-01  | 4.000E-01 | ---                                              | TPCZ           |
| R013 | Contaminated zone field capacity                | 2.400E-01  | 2.000E-01 | ---                                              | FCCZ           |
| R013 | Contaminated zone hydraulic conductivity (m/yr) | 5.000E+03  | 1.000E+01 | ---                                              | HCCZ           |
| R013 | Contaminated zone b parameter                   | 4.900E+00  | 5.300E+00 | ---                                              | BCZ            |
| R013 | Average annual wind speed (m/sec)               | 6.230E+00  | 2.000E+00 | ---                                              | WIND           |
| R013 | Humidity in air (g/m**3)                        | not used   | 8.000E+00 | ---                                              | HUMID          |
| R013 | Evapotranspiration coefficient                  | 4.600E-01  | 5.000E-01 | ---                                              | EVAPTR         |
| R013 | Precipitation (m/yr)                            | 1.230E+00  | 1.000E+00 | ---                                              | PRECIP         |
| R013 | Irrigation (m/yr)                               | 2.600E-01  | 2.000E-01 | ---                                              | RI             |
| R013 | Irrigation mode                                 | overhead   | overhead  | ---                                              | IDITCH         |
| R013 | Runoff coefficient                              | 2.000E-01  | 2.000E-01 | ---                                              | RUNOFF         |
| R013 | Watershed area for nearby stream or pond (m**2) | 1.000E+06  | 1.000E+06 | ---                                              | WAREA          |
| R013 | Accuracy for water/soil computations            | 1.000E-03  | 1.000E-03 | ---                                              | EPS            |
|      |                                                 |            |           |                                                  |                |
| R014 | Density of saturated zone (g/cm**3)             | 1.660E+00  | 1.500E+00 | ---                                              | DENSAQ         |
| R014 | Saturated zone total porosity                   | 3.300E-01  | 4.000E-01 | ---                                              | TPSZ           |
| R014 | Saturated zone effective porosity               | 2.400E-01  | 2.000E-01 | ---                                              | EPSZ           |
| R014 | Saturated zone field capacity                   | 2.000E-01  | 2.000E-01 | ---                                              | FCSZ           |
| R014 | Saturated zone hydraulic conductivity (m/yr)    | 2.000E+04  | 1.000E+02 | ---                                              | HCSZ           |
| R014 | Saturated zone hydraulic gradient               | 4.800E-03  | 2.000E-02 | ---                                              | HGWT           |
| R014 | Saturated zone b parameter                      | 4.900E+00  | 5.300E+00 | ---                                              | BSZ            |
| R014 | Water table drop rate (m/yr)                    | 1.000E-03  | 1.000E-03 | ---                                              | VWT            |

Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|------|------------------------------------------------|---------------|-----------|--------------------------------------------------|-------------------|
| R014 | Well pump intake depth (m below water table)   | 1.800E+01     | 1.000E+01 | ---                                              | DWIBWT            |
| R014 | Model: Nondispersion (ND) or Mass-Balance (MB) | ND            | ND        | ---                                              | MODEL             |
| R014 | Well pumping rate (m**3/yr)                    | 2.500E+02     | 2.500E+02 | ---                                              | UW                |
|      |                                                |               |           |                                                  |                   |
| R015 | Number of unsaturated zone strata              | 1             | 1         | ---                                              | NS                |
| R015 | Unsat. zone 1, thickness (m)                   | 0.000E+00     | 4.000E+00 | ---                                              | H (1)             |
| R015 | Unsat. zone 1, soil density (g/cm**3)          | 1.660E+00     | 1.500E+00 | ---                                              | DENSUZ (1)        |
| R015 | Unsat. zone 1, total porosity                  | 3.300E-01     | 4.000E-01 | ---                                              | TPUZ (1)          |
| R015 | Unsat. zone 1, effective porosity              | 2.400E-01     | 2.000E-01 | ---                                              | EPUZ (1)          |
| R015 | Unsat. zone 1, field capacity                  | 2.000E-01     | 2.000E-01 | ---                                              | FCUZ (1)          |
| R015 | Unsat. zone 1, soil-specific b parameter       | 4.900E+00     | 5.300E+00 | ---                                              | BUZ (1)           |
| R015 | Unsat. zone 1, hydraulic conductivity (m/yr)   | 5.000E+03     | 1.000E+01 | ---                                              | HCUZ (1)          |
|      |                                                |               |           |                                                  |                   |
| R016 | Distribution coefficients for Cs-137           |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 2.800E+02     | 4.600E+03 | ---                                              | DCNUCC ( 1)       |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 2.800E+02     | 4.600E+03 | ---                                              | DCNUCU ( 1,1)     |
| R016 | Saturated zone (cm**3/g)                       | 2.800E+02     | 4.600E+03 | ---                                              | DCNUCS ( 1)       |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 2.889E-04                                        | ALEACH ( 1)       |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK ( 1)       |
|      |                                                |               |           |                                                  |                   |
| R016 | Distribution coefficients for Sr-90            |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 3.000E+01     | 3.000E+01 | ---                                              | DCNUCC ( 4)       |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 3.000E+01     | 3.000E+01 | ---                                              | DCNUCU ( 4,1)     |
| R016 | Saturated zone (cm**3/g)                       | 3.000E+01     | 3.000E+01 | ---                                              | DCNUCS ( 4)       |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 2.685E-03                                        | ALEACH ( 4)       |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK ( 4)       |
|      |                                                |               |           |                                                  |                   |
| R016 | Distribution coefficients for U-238            |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---                                              | DCNUCC ( 7)       |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01     | 5.000E+01 | ---                                              | DCNUCU ( 7,1)     |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+01     | 5.000E+01 | ---                                              | DCNUCS ( 7)       |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 1.614E-03                                        | ALEACH ( 7)       |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK ( 7)       |
|      |                                                |               |           |                                                  |                   |
| R016 | Distribution coefficients for daughter Pb-210  |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 1.000E+02     | 1.000E+02 | ---                                              | DCNUCC ( 2)       |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 1.000E+02     | 1.000E+02 | ---                                              | DCNUCU ( 2,1)     |
| R016 | Saturated zone (cm**3/g)                       | 1.000E+02     | 1.000E+02 | ---                                              | DCNUCS ( 2)       |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 8.082E-04                                        | ALEACH ( 2)       |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK ( 2)       |
|      |                                                |               |           |                                                  |                   |
| R016 | Distribution coefficients for daughter Ra-226  |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 7.000E+01     | 7.000E+01 | ---                                              | DCNUCC ( 3)       |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 7.000E+01     | 7.000E+01 | ---                                              | DCNUCU ( 3,1)     |
| R016 | Saturated zone (cm**3/g)                       | 7.000E+01     | 7.000E+01 | ---                                              | DCNUCS ( 3)       |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 1.154E-03                                        | ALEACH ( 3)       |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK ( 3)       |

Summary : 811 area-Resident-surface-Bkgd subtract-B

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKG SUBTR-B.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|------|------------------------------------------------|---------------|-----------|--------------------------------------------------|-------------------|
| R016 | Distribution coefficients for daughter Th-230  |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 6.000E+04     | 6.000E+04 | ---                                              | DCNUCC( 5)        |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 6.000E+04     | 6.000E+04 | ---                                              | DCNUCU( 5,1)      |
| R016 | Saturated zone (cm**3/g)                       | 6.000E+04     | 6.000E+04 | ---                                              | DCNUCS( 5)        |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 1.349E-06                                        | ALEACH( 5)        |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK( 5)        |
| R016 | Distribution coefficients for daughter U-234   |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---                                              | DCNUCC( 6)        |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01     | 5.000E+01 | ---                                              | DCNUCU( 6,1)      |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+01     | 5.000E+01 | ---                                              | DCNUCS( 6)        |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 1.614E-03                                        | ALEACH( 6)        |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK( 6)        |
| R017 | Inhalation rate (m**3/yr)                      | 7.300E+03     | 8.400E+03 | ---                                              | INHALR            |
| R017 | Mass loading for inhalation (g/m**3)           | 1.000E-04     | 1.000E-04 | ---                                              | MLINH             |
| R017 | Exposure duration                              | 3.000E+01     | 3.000E+01 | ---                                              | ED                |
| R017 | Shielding factor, inhalation                   | 4.000E-01     | 4.000E-01 | ---                                              | SHF3              |
| R017 | Shielding factor, external gamma               | 8.000E-01     | 7.000E-01 | ---                                              | SHF1              |
| R017 | Fraction of time spent indoors                 | 5.000E-01     | 5.000E-01 | ---                                              | FIND              |
| R017 | Fraction of time spent outdoors (on site)      | 2.500E-01     | 2.500E-01 | ---                                              | FOTD              |
| R017 | Shape factor flag, external gamma              | 1.000E+00     | 1.000E+00 | >0 shows circular AREA.                          | FS                |
| R017 | Radii of shape factor array (used if FS = -1): |               |           |                                                  |                   |
| R017 | Outer annular radius (m), ring 1:              | not used      | 5.000E+01 | ---                                              | RAD_SHAPE( 1)     |
| R017 | Outer annular radius (m), ring 2:              | not used      | 7.071E+01 | ---                                              | RAD_SHAPE( 2)     |
| R017 | Outer annular radius (m), ring 3:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 3)     |
| R017 | Outer annular radius (m), ring 4:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 4)     |
| R017 | Outer annular radius (m), ring 5:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 5)     |
| R017 | Outer annular radius (m), ring 6:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 6)     |
| R017 | Outer annular radius (m), ring 7:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 7)     |
| R017 | Outer annular radius (m), ring 8:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 8)     |
| R017 | Outer annular radius (m), ring 9:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 9)     |
| R017 | Outer annular radius (m), ring 10:             | not used      | 0.000E+00 | ---                                              | RAD_SHAPE(10)     |
| R017 | Outer annular radius (m), ring 11:             | not used      | 0.000E+00 | ---                                              | RAD_SHAPE(11)     |
| R017 | Outer annular radius (m), ring 12:             | not used      | 0.000E+00 | ---                                              | RAD_SHAPE(12)     |
| R017 | Fractions of annular areas within AREA:        |               |           |                                                  |                   |
| R017 | Ring 1                                         | not used      | 1.000E+00 | ---                                              | FRACA( 1)         |
| R017 | Ring 2                                         | not used      | 2.732E-01 | ---                                              | FRACA( 2)         |
| R017 | Ring 3                                         | not used      | 0.000E+00 | ---                                              | FRACA( 3)         |
| R017 | Ring 4                                         | not used      | 0.000E+00 | ---                                              | FRACA( 4)         |
| R017 | Ring 5                                         | not used      | 0.000E+00 | ---                                              | FRACA( 5)         |
| R017 | Ring 6                                         | not used      | 0.000E+00 | ---                                              | FRACA( 6)         |
| R017 | Ring 7                                         | not used      | 0.000E+00 | ---                                              | FRACA( 7)         |
| R017 | Ring 8                                         | not used      | 0.000E+00 | ---                                              | FRACA( 8)         |
| R017 | Ring 9                                         | not used      | 0.000E+00 | ---                                              | FRACA( 9)         |
| R017 | Ring 10                                        | not used      | 0.000E+00 | ---                                              | FRACA(10)         |
| R017 | Ring 11                                        | not used      | 0.000E+00 | ---                                              | FRACA(11)         |
| R017 | Ring 12                                        | not used      | 0.000E+00 | ---                                              | FRACA(12)         |

Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User      | Default   | Used by RESRAD                 | Parameter Name |
|------|--------------------------------------------------|-----------|-----------|--------------------------------|----------------|
|      |                                                  | Input     |           | (If different from user input) |                |
| R018 | Fruits, vegetables and grain consumption (kg/yr) | 1.600E+02 | 1.600E+02 | ---                            | DIET(1)        |
| R018 | Leafy vegetable consumption (kg/yr)              | 1.400E+01 | 1.400E+01 | ---                            | DIET(2)        |
| R018 | Milk consumption (L/yr)                          | not used  | 9.200E+01 | ---                            | DIET(3)        |
| R018 | Meat and poultry consumption (kg/yr)             | not used  | 6.300E+01 | ---                            | DIET(4)        |
| R018 | Fish consumption (kg/yr)                         | not used  | 5.400E+00 | ---                            | DIET(5)        |
| R018 | Other seafood consumption (kg/yr)                | not used  | 9.000E-01 | ---                            | DIET(6)        |
| R018 | Soil ingestion rate (g/yr)                       | 4.380E+01 | 3.650E+01 | ---                            | SOIL           |
| R018 | Drinking water intake (L/yr)                     | 7.000E+02 | 5.100E+02 | ---                            | DWI            |
| R018 | Contamination fraction of drinking water         | 1.000E+00 | 1.000E+00 | ---                            | FDW            |
| R018 | Contamination fraction of household water        | not used  | 1.000E+00 | ---                            | FHHW           |
| R018 | Contamination fraction of livestock water        | not used  | 1.000E+00 | ---                            | FLW            |
| R018 | Contamination fraction of irrigation water       | 1.000E+00 | 1.000E+00 | ---                            | FIRW           |
| R018 | Contamination fraction of aquatic food           | not used  | 5.000E-01 | ---                            | FR9            |
| R018 | Contamination fraction of plant food             | -1        | -1        | 0.500E+00                      | FPLANT         |
| R018 | Contamination fraction of meat                   | not used  | -1        | ---                            | FMEAT          |
| R018 | Contamination fraction of milk                   | not used  | -1        | ---                            | FMILK          |
|      |                                                  |           |           |                                |                |
| R019 | Livestock fodder intake for meat (kg/day)        | not used  | 6.800E+01 | ---                            | LFI5           |
| R019 | Livestock fodder intake for milk (kg/day)        | not used  | 5.500E+01 | ---                            | LFI6           |
| R019 | Livestock water intake for meat (L/day)          | not used  | 5.000E+01 | ---                            | LWI5           |
| R019 | Livestock water intake for milk (L/day)          | not used  | 1.600E+02 | ---                            | LWI6           |
| R019 | Livestock soil intake (kg/day)                   | not used  | 5.000E-01 | ---                            | LSI            |
| R019 | Mass loading for foliar deposition (g/m**3)      | 1.000E-05 | 1.000E-04 | ---                            | MLFD           |
| R019 | Depth of soil mixing layer (m)                   | 1.500E-01 | 1.500E-01 | ---                            | DM             |
| R019 | Depth of roots (m)                               | 9.000E-01 | 9.000E-01 | ---                            | DROOT          |
| R019 | Drinking water fraction from ground water        | 1.000E+00 | 1.000E+00 | ---                            | FGWDW          |
| R019 | Household water fraction from ground water       | not used  | 1.000E+00 | ---                            | FGWHH          |
| R019 | Livestock water fraction from ground water       | not used  | 1.000E+00 | ---                            | FGWLW          |
| R019 | Irrigation fraction from ground water            | 1.000E+00 | 1.000E+00 | ---                            | FGWIR          |
|      |                                                  |           |           |                                |                |
| R19B | Wet weight crop yield for Non-Leafy (kg/m**2)    | 7.000E-01 | 7.000E-01 | ---                            | YV(1)          |
| R19B | Wet weight crop yield for Leafy (kg/m**2)        | 1.500E+00 | 1.500E+00 | ---                            | YV(2)          |
| R19B | Wet weight crop yield for Fodder (kg/m**2)       | not used  | 1.100E+00 | ---                            | YV(3)          |
| R19B | Growing Season for Non-Leafy (years)             | 1.700E-01 | 1.700E-01 | ---                            | TE(1)          |
| R19B | Growing Season for Leafy (years)                 | 2.500E-01 | 2.500E-01 | ---                            | TE(2)          |
| R19B | Growing Season for Fodder (years)                | not used  | 8.000E-02 | ---                            | TE(3)          |
| R19B | Translocation Factor for Non-Leafy               | 1.000E-01 | 1.000E-01 | ---                            | TIV(1)         |
| R19B | Translocation Factor for Leafy                   | 1.000E+00 | 1.000E+00 | ---                            | TIV(2)         |
| R19B | Translocation Factor for Fodder                  | not used  | 1.000E+00 | ---                            | TIV(3)         |
| R19B | Dry Foliar Interception Fraction for Non-Leafy   | 2.500E-01 | 2.500E-01 | ---                            | RDRY(1)        |
| R19B | Dry Foliar Interception Fraction for Leafy       | 2.500E-01 | 2.500E-01 | ---                            | RDRY(2)        |
| R19B | Dry Foliar Interception Fraction for Fodder      | not used  | 2.500E-01 | ---                            | RDRY(3)        |
| R19B | Wet Foliar Interception Fraction for Non-Leafy   | 2.500E-01 | 2.500E-01 | ---                            | RWET(1)        |
| R19B | Wet Foliar Interception Fraction for Leafy       | 2.500E-01 | 2.500E-01 | ---                            | RWET(2)        |
| R19B | Wet Foliar Interception Fraction for Fodder      | not used  | 2.500E-01 | ---                            | RWET(3)        |
| R19B | Weathering Removal Constant for Vegetation       | 2.000E+01 | 2.000E+01 | ---                            | WLAM           |
|      |                                                  |           |           |                                |                |
| C14  | C-12 concentration in water (g/cm**3)            | not used  | 2.000E-05 | ---                            | C12WTR         |
| C14  | C-12 concentration in contaminated soil (g/g)    | not used  | 3.000E-02 | ---                            | C12CZ          |
| C14  | Fraction of vegetation carbon from soil          | not used  | 2.000E-02 | ---                            | CSOIL          |

Summary : 811 area-Resident-surface-Bkgd subtract-B

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKG SUBTR-B.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User<br>Input | Default    | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|------|--------------------------------------------------|---------------|------------|--------------------------------------------------|-------------------|
| C14  | Fraction of vegetation carbon from air           | not used      | 9.800E-01  | ---                                              | CAIR              |
| C14  | C-14 evasion layer thickness in soil (m)         | not used      | 3.000E-01  | ---                                              | DMC               |
| C14  | C-14 evasion flux rate from soil (l/sec)         | not used      | 7.000E-07  | ---                                              | EVSN              |
| C14  | C-12 evasion flux rate from soil (l/sec)         | not used      | 1.000E-10  | ---                                              | REVSN             |
| C14  | Fraction of grain in beef cattle feed            | not used      | 8.000E-01  | ---                                              | AVFG4             |
| C14  | Fraction of grain in milk cow feed               | not used      | 2.000E-01  | ---                                              | AVFG5             |
| STOR | Storage times of contaminated foodstuffs (days): |               |            |                                                  |                   |
| STOR | Fruits, non-leafy vegetables, and grain          | 1.400E+01     | 1.400E+01  | ---                                              | STOR_T(1)         |
| STOR | Leafy vegetables                                 | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T(2)         |
| STOR | Milk                                             | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T(3)         |
| STOR | Meat and poultry                                 | 2.000E+01     | 2.000E+01  | ---                                              | STOR_T(4)         |
| STOR | Fish                                             | 7.000E+00     | 7.000E+00  | ---                                              | STOR_T(5)         |
| STOR | Crustacea and mollusks                           | 7.000E+00     | 7.000E+00  | ---                                              | STOR_T(6)         |
| STOR | Well water                                       | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T(7)         |
| STOR | Surface water                                    | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T(8)         |
| STOR | Livestock fodder                                 | 4.500E+01     | 4.500E+01  | ---                                              | STOR_T(9)         |
| R021 | Thickness of building foundation (m)             | not used      | 1.500E-01  | ---                                              | FLOOR1            |
| R021 | Bulk density of building foundation (g/cm**3)    | not used      | 2.400E+00  | ---                                              | DENSFL            |
| R021 | Total porosity of the cover material             | not used      | 4.000E-01  | ---                                              | TPCV              |
| R021 | Total porosity of the building foundation        | not used      | 1.000E-01  | ---                                              | TPFL              |
| R021 | Volumetric water content of the cover material   | not used      | 5.000E-02  | ---                                              | PH2OCV            |
| R021 | Volumetric water content of the foundation       | not used      | 3.000E-02  | ---                                              | PH2OFL            |
| R021 | Diffusion coefficient for radon gas (m/sec):     |               |            |                                                  |                   |
| R021 | in cover material                                | not used      | 2.000E-06  | ---                                              | DIFCV             |
| R021 | in foundation material                           | not used      | 3.000E-07  | ---                                              | DIFFL             |
| R021 | in contaminated zone soil                        | not used      | 2.000E-06  | ---                                              | DIFCZ             |
| R021 | Radon vertical dimension of mixing (m)           | not used      | 2.000E+00  | ---                                              | HMIX              |
| R021 | Average building air exchange rate (1/hr)        | not used      | 5.000E-01  | ---                                              | REXG              |
| R021 | Height of the building (room) (m)                | not used      | 2.500E+00  | ---                                              | HRM               |
| R021 | Building interior area factor                    | not used      | 0.000E+00  | ---                                              | FAI               |
| R021 | Building depth below ground surface (m)          | not used      | -1.000E+00 | ---                                              | DMFL              |
| R021 | Emanating power of Rn-222 gas                    | not used      | 2.500E-01  | ---                                              | EMANA(1)          |
| R021 | Emanating power of Rn-220 gas                    | not used      | 1.500E-01  | ---                                              | EMANA(2)          |
| TITL | Number of graphical time points                  | 32            | ---        | ---                                              | NPTS              |
| TITL | Maximum number of integration points for dose    | 17            | ---        | ---                                              | LYMAX             |
| TITL | Maximum number of integration points for risk    | 65            | ---        | ---                                              | KYMAX             |



Summary of Pathway Selections

| Pathway                     | User Selection |
|-----------------------------|----------------|
| 1 -- external gamma         | active         |
| 2 -- inhalation (w/o radon) | active         |
| 3 -- plant ingestion        | active         |
| 4 -- meat ingestion         | suppressed     |
| 5 -- milk ingestion         | suppressed     |
| 6 -- aquatic foods          | suppressed     |
| 7 -- drinking water         | active         |
| 8 -- soil ingestion         | active         |
| 9 -- radon                  | suppressed     |
| Find peak pathway doses     | active         |

| Contaminated Zone Dimensions |                       | Initial Soil Concentrations, pCi/g |           |
|------------------------------|-----------------------|------------------------------------|-----------|
| Area:                        | 1860.00 square meters | Cs-137                             | 3.854E+00 |
| Thickness:                   | 5.00 meters           | Sr-90                              | 2.140E-01 |
| Cover Depth:                 | 0.00 meters           | U-238                              | 4.470E-01 |

| Total Dose TDOSE(t), mrem/yr                                               |           |           |           |           |           |           |           |
|----------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Basic Radiation Dose Limit = 1.500E+01 mrem/yr                             |           |           |           |           |           |           |           |
| Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t) |           |           |           |           |           |           |           |
| t (years):                                                                 | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 |
| TDOSE(t):                                                                  | 8.451E+00 | 8.258E+00 | 7.526E+00 | 6.703E+00 | 2.685E+00 | 8.870E-01 | 4.412E-02 |
| M(t):                                                                      | 5.634E-01 | 5.505E-01 | 5.017E-01 | 4.469E-01 | 1.790E-01 | 5.913E-02 | 2.941E-03 |

|                   |                   |                        |
|-------------------|-------------------|------------------------|
| Maximum TDOSE(t): | 8.451E+00 mrem/yr | at t = 0.000E+00 years |
|-------------------|-------------------|------------------------|

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 7.091E+00 | 0.8391 | 9.774E-06  | 0.0000 | 0.000E+00 | 0.0000 | 6.671E-01 | 0.0789 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.297E-03 | 0.0007 |
| Sr-90             | 5.058E-03 | 0.0006 | 2.172E-06  | 0.0000 | 0.000E+00 | 0.0000 | 6.175E-01 | 0.0731 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.772E-04 | 0.0001 |
| U-238             | 4.269E-02 | 0.0051 | 2.340E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.725E-02 | 0.0020 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.605E-03 | 0.0003 |
| Total             | 7.139E+00 | 0.8447 | 2.460E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.302E+00 | 0.1540 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.680E-03 | 0.0011 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.295E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.600E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.765E+00     | 0.9187 |
| Sr-90             | 2.637E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.964E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.236E-01     | 0.0738 |
| U-238             | 3.087E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.131E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.311E-02     | 0.0075 |
| Total             | 5.853E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.181E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.451E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.928E+00 | 0.8390 | 9.549E-06  | 0.0000 | 0.000E+00 | 0.0000 | 6.518E-01 | 0.0789 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.152E-03 | 0.0007 |
| Sr-90             | 4.924E-03 | 0.0006 | 2.115E-06  | 0.0000 | 0.000E+00 | 0.0000 | 6.012E-01 | 0.0728 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.566E-04 | 0.0001 |
| U-238             | 4.263E-02 | 0.0052 | 2.337E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.722E-02 | 0.0021 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.601E-03 | 0.0003 |
| Total             | 6.976E+00 | 0.8448 | 2.453E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.270E+00 | 0.1538 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.510E-03 | 0.0012 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 3.828E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.710E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.586E+00     | 0.9187 |
| Sr-90             | 7.757E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.969E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.077E-01     | 0.0736 |
| U-238             | 9.282E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.625E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.368E-02     | 0.0077 |
| Total             | 1.742E-03 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.286E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.258E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.312E+00 | 0.8387 | 8.700E-06  | 0.0000 | 0.000E+00 | 0.0000 | 5.938E-01 | 0.0789 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.606E-03 | 0.0007 |
| Sr-90             | 4.424E-03 | 0.0006 | 1.900E-06  | 0.0000 | 0.000E+00 | 0.0000 | 5.402E-01 | 0.0718 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.798E-04 | 0.0001 |
| U-238             | 4.235E-02 | 0.0056 | 2.322E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.711E-02 | 0.0023 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.584E-03 | 0.0003 |
| Total             | 6.359E+00 | 0.8450 | 2.428E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.151E+00 | 0.1530 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.870E-03 | 0.0012 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.284E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.352E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.912E+00     | 0.9184 |
| Sr-90             | 2.575E-03 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.011E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.481E-01     | 0.0728 |
| U-238             | 3.397E-03 | 0.0005 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.462E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.592E-02     | 0.0088 |
| Total             | 6.101E-03 | 0.0008 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.566E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.526E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 5.619E+00 | 0.8383 | 7.745E-06  | 0.0000 | 0.000E+00 | 0.0000 | 5.286E-01 | 0.0789 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.990E-03 | 0.0007 |
| Sr-90             | 3.870E-03 | 0.0006 | 1.662E-06  | 0.0000 | 0.000E+00 | 0.0000 | 4.725E-01 | 0.0705 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.947E-04 | 0.0001 |
| U-238             | 4.201E-02 | 0.0063 | 2.303E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.698E-02 | 0.0025 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.564E-03 | 0.0004 |
| Total             | 5.665E+00 | 0.8451 | 2.397E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.018E+00 | 0.1519 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.148E-03 | 0.0012 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 2.186E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.599E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.153E+00     | 0.9179 |
| Sr-90             | 4.331E-03 | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.391E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.817E-01     | 0.0719 |
| U-238             | 6.461E-03 | 0.0010 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.694E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.871E-02     | 0.0102 |
| Total             | 1.101E-02 | 0.0016 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.245E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.703E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.216E+00 | 0.8252 | 3.054E-06  | 0.0000 | 0.000E+00 | 0.0000 | 2.084E-01 | 0.0776 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.968E-03 | 0.0007 |
| Sr-90             | 1.327E-03 | 0.0005 | 5.698E-07  | 0.0000 | 0.000E+00 | 0.0000 | 1.620E-01 | 0.0603 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.039E-04 | 0.0001 |
| U-238             | 3.938E-02 | 0.0147 | 2.159E-04  | 0.0001 | 0.000E+00 | 0.0000 | 1.592E-02 | 0.0059 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.404E-03 | 0.0009 |
| Total             | 2.256E+00 | 0.8404 | 2.196E-04  | 0.0001 | 0.000E+00 | 0.0000 | 3.864E-01 | 0.1439 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.575E-03 | 0.0017 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 4.175E-04 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.068E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.427E+00     | 0.9037 |
| Sr-90             | 4.431E-03 | 0.0017 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.479E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.683E-01     | 0.0627 |
| U-238             | 3.008E-02 | 0.0112 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.191E-03 | 0.0008 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.019E-02     | 0.0336 |
| Total             | 3.493E-02 | 0.0130 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.569E-03 | 0.0010 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.685E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.923E-01 | 0.7805 | 9.542E-07  | 0.0000 | 0.000E+00 | 0.0000 | 6.513E-02 | 0.0734 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.148E-04 | 0.0007 |
| Sr-90             | 3.481E-04 | 0.0004 | 1.495E-07  | 0.0000 | 0.000E+00 | 0.0000 | 4.251E-02 | 0.0479 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.349E-05 | 0.0001 |
| U-238             | 3.633E-02 | 0.0410 | 1.992E-04  | 0.0002 | 0.000E+00 | 0.0000 | 1.468E-02 | 0.0166 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.218E-03 | 0.0025 |
| Total             | 7.290E-01 | 0.8218 | 2.003E-04  | 0.0002 | 0.000E+00 | 0.0000 | 1.223E-01 | 0.1379 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.886E-03 | 0.0033 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 2.618E-04 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.925E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.583E-01     | 0.8549 |
| Sr-90             | 1.160E-03 | 0.0013 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.106E-05 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.416E-02     | 0.0498 |
| U-238             | 2.898E-02 | 0.0327 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.112E-03 | 0.0024 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.452E-02     | 0.0953 |
| Total             | 3.040E-02 | 0.0343 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.222E-03 | 0.0025 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.870E-01     | 1.0000 |

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.289E-05 | 0.0014 | 8.668E-11  | 0.0000 | 0.000E+00 | 0.0000 | 5.917E-06 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.585E-08 | 0.0000 |
| Sr-90             | 7.815E-09 | 0.0000 | 3.356E-12  | 0.0000 | 0.000E+00 | 0.0000 | 9.541E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.201E-09 | 0.0000 |
| U-238             | 1.905E-02 | 0.4318 | 1.046E-04  | 0.0024 | 0.000E+00 | 0.0000 | 7.709E-03 | 0.1747 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.164E-03 | 0.0264 |
| Total             | 1.911E-02 | 0.4332 | 1.046E-04  | 0.0024 | 0.000E+00 | 0.0000 | 7.716E-03 | 0.1749 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.164E-03 | 0.0264 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.267E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.320E-09 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.900E-05     | 0.0016 |
| Sr-90             | 2.547E-08 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.000E-09 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.906E-07     | 0.0000 |
| U-238             | 1.493E-02 | 0.3385 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.088E-03 | 0.0247 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.405E-02     | 0.9984 |
| Total             | 1.493E-02 | 0.3385 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.088E-03 | 0.0247 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.412E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 5.578E-10 | 0.0000 | 7.688E-16  | 0.0000 | 0.000E+00 | 0.0000 | 5.248E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.954E-13 | 0.0000 |
| Sr-90             | 1.207E-14 | 0.0000 | 5.185E-18  | 0.0000 | 0.000E+00 | 0.0000 | 1.474E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.855E-15 | 0.0000 |
| U-238             | 8.501E-03 | 0.4371 | 4.676E-05  | 0.0024 | 0.000E+00 | 0.0000 | 3.447E-03 | 0.1772 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.203E-04 | 0.0268 |
| Total             | 8.501E-03 | 0.4371 | 4.676E-05  | 0.0024 | 0.000E+00 | 0.0000 | 3.447E-03 | 0.1772 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.203E-04 | 0.0268 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.242E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.138E-14 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.121E-10     | 0.0000 |
| Sr-90             | 3.791E-14 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.977E-15 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.529E-12     | 0.0000 |
| U-238             | 6.462E-03 | 0.3323 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.709E-04 | 0.0242 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.945E-02     | 1.0000 |
| Total             | 6.462E-03 | 0.3323 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.709E-04 | 0.0242 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.945E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-surface-Bkgd subtract-B

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKG SUBTR-B.RAD

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

| Parent<br>(i) | Product<br>(j) | Thread<br>Fraction | DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) |           |           |           |           |           |           |           |
|---------------|----------------|--------------------|---------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               |                |                    | 0.000E+00                                   | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137+D      | Cs-137+D       | 1.000E+00          | 2.015E+00                                   | 1.968E+00 | 1.793E+00 | 1.597E+00 | 6.296E-01 | 1.968E-01 | 1.790E-05 | 1.588E-10 |
| Sr-90+D       | Sr-90+D        | 1.000E+00          | 2.914E+00                                   | 2.840E+00 | 2.561E+00 | 2.251E+00 | 7.866E-01 | 2.063E-01 | 4.629E-06 | 7.145E-12 |
| U-238         | U-238          | 5.450E-07          | 2.322E-08                                   | 2.393E-08 | 2.679E-08 | 3.033E-08 | 5.764E-08 | 5.466E-08 | 2.832E-08 | 1.238E-08 |
| U-238+D       | U-238+D        | 1.000E+00          | 1.412E-01                                   | 1.425E-01 | 1.475E-01 | 1.537E-01 | 2.018E-01 | 1.891E-01 | 9.846E-02 | 4.343E-02 |
| U-238+D       | U-234          | 1.000E+00          | 6.728E-08                                   | 2.073E-07 | 8.496E-07 | 1.835E-06 | 1.675E-05 | 3.161E-05 | 8.153E-05 | 7.119E-05 |
| U-238+D       | Th-230         | 1.000E+00          | 5.188E-13                                   | 3.344E-12 | 4.088E-11 | 1.466E-10 | 3.218E-09 | 1.206E-08 | 1.976E-07 | 4.875E-07 |
| U-238+D       | Ra-226+D       | 1.000E+00          | 3.772E-11                                   | 1.264E-10 | 4.044E-10 | 9.029E-10 | 6.366E-09 | 2.105E-08 | 1.315E-06 | 5.971E-06 |
| U-238+D       | Pb-210+D       | 1.000E+00          | 1.806E-10                                   | 6.108E-10 | 1.942E-09 | 4.225E-09 | 1.994E-08 | 2.805E-08 | 8.729E-07 | 4.301E-06 |
| U-238+D       | ΣDSR(j)        |                    | 1.412E-01                                   | 1.425E-01 | 1.475E-01 | 1.537E-01 | 2.018E-01 | 1.891E-01 | 9.855E-02 | 4.351E-02 |

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

| Nuclide<br>(i) | t =       | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Cs-137         | 7.445E+00 | 7.621E+00 | 8.364E+00 | 9.395E+00 | 2.382E+01 | 7.623E+01 | 8.378E+05 | 9.444E+10 |           |
| Sr-90          | 5.147E+00 | 5.282E+00 | 5.857E+00 | 6.664E+00 | 1.907E+01 | 7.269E+01 | 3.240E+06 | 2.099E+12 |           |
| U-238          | 1.062E+02 | 1.053E+02 | 1.017E+02 | 9.758E+01 | 7.434E+01 | 7.933E+01 | 1.522E+02 | 3.448E+02 |           |

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
at tmin = time of minimum single radionuclide soil guideline  
and at tmax = time of maximum total dose = 0.000E+00 years

| Nuclide<br>(i) | Initial<br>(pCi/g) | tmin<br>(years) | DSR(i,tmin) | G(i,tmin)<br>(pCi/g) | DSR(i,tmax) | G(i,tmax)<br>(pCi/g) |
|----------------|--------------------|-----------------|-------------|----------------------|-------------|----------------------|
| Cs-137         | 3.854E+00          | 0.000E+00       | 2.015E+00   | 7.445E+00            | 2.015E+00   | 7.445E+00            |
| Sr-90          | 2.140E-01          | 0.000E+00       | 2.914E+00   | 5.147E+00            | 2.914E+00   | 5.147E+00            |
| U-238          | 4.470E-01          | 52.5 ± 0.1      | 2.042E-01   | 7.344E+01            | 1.412E-01   | 1.062E+02            |

Individual Nuclide Dose Summed Over All Pathways  
Parent Nuclide and Branch Fraction Indicated

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | DOSE(j,t), mrem/yr |           |           |           |           |           |           |           |
|----------------|---------------|-----------|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t= 0.000E+00       | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 7.765E+00          | 7.586E+00 | 6.912E+00 | 6.153E+00 | 2.427E+00 | 7.583E-01 | 6.900E-05 | 6.121E-10 |
| Sr-90          | Sr-90         | 1.000E+00 | 6.236E-01          | 6.077E-01 | 5.481E-01 | 4.817E-01 | 1.683E-01 | 4.416E-02 | 9.906E-07 | 1.529E-12 |
| U-238          | U-238         | 5.450E-07 | 1.038E-08          | 1.070E-08 | 1.197E-08 | 1.356E-08 | 2.576E-08 | 2.443E-08 | 1.266E-08 | 5.534E-09 |
| U-238          | U-238         | 1.000E+00 | 6.311E-02          | 6.368E-02 | 6.592E-02 | 6.871E-02 | 9.019E-02 | 8.451E-02 | 4.401E-02 | 1.941E-02 |
| U-238          | ΣDOSE(j)      |           | 6.311E-02          | 6.368E-02 | 6.592E-02 | 6.871E-02 | 9.019E-02 | 8.451E-02 | 4.401E-02 | 1.941E-02 |
| U-234          | U-238         | 1.000E+00 | 3.007E-08          | 9.267E-08 | 3.798E-07 | 8.204E-07 | 7.488E-06 | 1.413E-05 | 3.644E-05 | 3.182E-05 |
| Th-230         | U-238         | 1.000E+00 | 2.319E-13          | 1.495E-12 | 1.827E-11 | 6.551E-11 | 1.439E-09 | 5.392E-09 | 8.834E-08 | 2.179E-07 |
| Ra-226         | U-238         | 1.000E+00 | 1.686E-11          | 5.652E-11 | 1.808E-10 | 4.036E-10 | 2.846E-09 | 9.410E-09 | 5.876E-07 | 2.669E-06 |
| Pb-210         | U-238         | 1.000E+00 | 8.075E-11          | 2.730E-10 | 8.683E-10 | 1.889E-09 | 8.915E-09 | 1.254E-08 | 3.902E-07 | 1.923E-06 |

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration  
Parent Nuclide and Branch Fraction Indicated

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | S(j,t), pCi/g |           |           |           |           |           |           |           |
|----------------|---------------|-----------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t= 0.000E+00  | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 3.854E+00     | 3.765E+00 | 3.431E+00 | 3.054E+00 | 1.204E+00 | 3.763E-01 | 3.418E-05 | 3.032E-10 |
| Sr-90          | Sr-90         | 1.000E+00 | 2.140E-01     | 2.083E-01 | 1.872E-01 | 1.638E-01 | 5.614E-02 | 1.473E-02 | 3.306E-07 | 5.109E-13 |
| U-238          | U-238         | 5.450E-07 | 2.436E-07     | 2.432E-07 | 2.417E-07 | 2.397E-07 | 2.247E-07 | 2.073E-07 | 1.087E-07 | 4.850E-08 |
| U-238          | U-238         | 1.000E+00 | 4.470E-01     | 4.463E-01 | 4.434E-01 | 4.398E-01 | 4.123E-01 | 3.804E-01 | 1.994E-01 | 8.899E-02 |
| U-238          | ΣS(j):        |           | 4.470E-01     | 4.463E-01 | 4.434E-01 | 4.398E-01 | 4.123E-01 | 3.804E-01 | 1.994E-01 | 8.899E-02 |
| U-234          | U-238         | 1.000E+00 | 0.000E+00     | 1.260E-06 | 6.260E-06 | 1.242E-05 | 5.821E-05 | 1.074E-04 | 2.814E-04 | 2.509E-04 |
| Th-230         | U-238         | 1.000E+00 | 0.000E+00     | 5.796E-12 | 1.443E-10 | 5.740E-10 | 1.375E-08 | 5.212E-08 | 8.609E-07 | 2.125E-06 |
| Ra-226         | U-238         | 1.000E+00 | 0.000E+00     | 8.369E-16 | 1.041E-13 | 8.279E-13 | 9.862E-11 | 7.430E-10 | 5.800E-08 | 2.639E-07 |
| Pb-210         | U-238         | 1.000E+00 | 0.000E+00     | 6.493E-18 | 3.941E-15 | 6.083E-14 | 2.911E-11 | 3.482E-10 | 4.864E-08 | 2.422E-07 |

THF(i) is the thread fraction of the parent nuclide.

RESRAD-ONSITE execution time = 10.13 seconds

Table of Contents

---

Part I: Mixture Sums and Single Radionuclide Guidelines

---

|                                                            |    |
|------------------------------------------------------------|----|
| Dose Conversion Factor (and Related) Parameter Summary ... | 2  |
| Site-Specific Parameter Summary .....                      | 5  |
| Summary of Pathway Selections .....                        | 10 |
| Contaminated Zone and Total Dose Summary .....             | 11 |
| Total Dose Components                                      |    |
| Time = 0.000E+00 .....                                     | 12 |
| Time = 1.000E+00 .....                                     | 13 |
| Time = 5.000E+00 .....                                     | 14 |
| Time = 1.000E+01 .....                                     | 15 |
| Time = 5.000E+01 .....                                     | 16 |
| Time = 1.000E+02 .....                                     | 17 |
| Time = 5.000E+02 .....                                     | 18 |
| Time = 1.000E+03 .....                                     | 19 |
| Dose/Source Ratios Summed Over All Pathways .....          | 20 |
| Single Radionuclide Soil Guidelines .....                  | 20 |
| Dose Per Nuclide Summed Over All Pathways .....            | 21 |
| Soil Concentration Per Nuclide .....                       | 21 |

Summary : Bldg 811 Area-Industrial-Bkgd subtract-D

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-D.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| A-1  | DCF's for external ground radiation, (mrem/yr)/(pCi/g)   |                |            |                |
| A-1  | At-218 (Source: DCFPAK3.02)                              | 5.567E-05      | 5.567E-05  | DCF1( 1)       |
| A-1  | Ba-137m (Source: DCFPAK3.02)                             | 3.381E+00      | 3.381E+00  | DCF1( 2)       |
| A-1  | Bi-210 (Source: DCFPAK3.02)                              | 5.473E-03      | 5.473E-03  | DCF1( 3)       |
| A-1  | Bi-214 (Source: DCFPAK3.02)                              | 9.135E+00      | 9.135E+00  | DCF1( 4)       |
| A-1  | Cs-137 (Source: DCFPAK3.02)                              | 8.686E-04      | 8.686E-04  | DCF1( 5)       |
| A-1  | Hg-206 (Source: DCFPAK3.02)                              | 6.127E-01      | 6.127E-01  | DCF1( 6)       |
| A-1  | Pa-234 (Source: DCFPAK3.02)                              | 8.275E+00      | 8.275E+00  | DCF1( 7)       |
| A-1  | Pa-234m (Source: DCFPAK3.02)                             | 1.257E-01      | 1.257E-01  | DCF1( 8)       |
| A-1  | Pb-210 (Source: DCFPAK3.02)                              | 2.092E-03      | 2.092E-03  | DCF1( 9)       |
| A-1  | Pb-214 (Source: DCFPAK3.02)                              | 1.257E+00      | 1.257E+00  | DCF1( 10)      |
| A-1  | Po-210 (Source: DCFPAK3.02)                              | 5.641E-05      | 5.641E-05  | DCF1( 11)      |
| A-1  | Po-214 (Source: DCFPAK3.02)                              | 4.801E-04      | 4.801E-04  | DCF1( 12)      |
| A-1  | Po-218 (Source: DCFPAK3.02)                              | 9.228E-09      | 9.228E-09  | DCF1( 13)      |
| A-1  | Ra-226 (Source: DCFPAK3.02)                              | 3.176E-02      | 3.176E-02  | DCF1( 14)      |
| A-1  | Rn-218 (Source: DCFPAK3.02)                              | 4.259E-03      | 4.259E-03  | DCF1( 15)      |
| A-1  | Rn-222 (Source: DCFPAK3.02)                              | 2.130E-03      | 2.130E-03  | DCF1( 16)      |
| A-1  | Sr-90 (Source: DCFPAK3.02)                               | 6.463E-04      | 6.463E-04  | DCF1( 17)      |
| A-1  | Th-230 (Source: DCFPAK3.02)                              | 1.106E-03      | 1.106E-03  | DCF1( 18)      |
| A-1  | Th-234 (Source: DCFPAK3.02)                              | 2.316E-02      | 2.316E-02  | DCF1( 19)      |
| A-1  | Tl-206 (Source: DCFPAK3.02)                              | 1.278E-02      | 1.278E-02  | DCF1( 20)      |
| A-1  | Tl-210 (Source: DCFPAK3.02)                              | 1.677E+01      | 1.677E+01  | DCF1( 21)      |
| A-1  | U-234 (Source: DCFPAK3.02)                               | 3.456E-04      | 3.456E-04  | DCF1( 22)      |
| A-1  | U-238 (Source: DCFPAK3.02)                               | 1.713E-04      | 1.713E-04  | DCF1( 23)      |
| A-1  | Y-90 (Source: DCFPAK3.02)                                | 4.016E-02      | 4.016E-02  | DCF1( 24)      |
| B-1  | Dose conversion factors for inhalation, mrem/pCi:        |                |            |                |
| B-1  | Cs-137+D                                                 | 1.457E-04      | 1.457E-04  | DCF2( 1)       |
| B-1  | Pb-210+D                                                 | 3.708E-02      | 2.077E-02  | DCF2( 2)       |
| B-1  | Ra-226+D                                                 | 3.528E-02      | 3.517E-02  | DCF2( 3)       |
| B-1  | Sr-90+D                                                  | 5.841E-04      | 5.786E-04  | DCF2( 4)       |
| B-1  | Th-230                                                   | 3.759E-01      | 3.759E-01  | DCF2( 5)       |
| B-1  | U-234                                                    | 3.479E-02      | 3.479E-02  | DCF2( 6)       |
| B-1  | U-238                                                    | 2.973E-02      | 2.973E-02  | DCF2( 7)       |
| B-1  | U-238+D                                                  | 2.976E-02      | 2.973E-02  | DCF2( 8)       |
| D-1  | Dose conversion factors for ingestion, mrem/pCi:         |                |            |                |
| D-1  | Cs-137+D                                                 | 5.032E-05      | 5.032E-05  | DCF3( 1)       |
| D-1  | Pb-210+D                                                 | 7.057E-03      | 2.575E-03  | DCF3( 2)       |
| D-1  | Ra-226+D                                                 | 1.037E-03      | 1.036E-03  | DCF3( 3)       |
| D-1  | Sr-90+D                                                  | 1.120E-04      | 1.021E-04  | DCF3( 4)       |
| D-1  | Th-230                                                   | 7.918E-04      | 7.918E-04  | DCF3( 5)       |
| D-1  | U-234                                                    | 1.831E-04      | 1.831E-04  | DCF3( 6)       |
| D-1  | U-238                                                    | 1.650E-04      | 1.650E-04  | DCF3( 7)       |
| D-1  | U-238+D                                                  | 1.776E-04      | 1.650E-04  | DCF3( 8)       |
| D-34 | Food transfer factors:                                   |                |            |                |
| D-34 | Cs-137+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 1,1)      |
| D-34 | Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.000E-02      | 3.000E-02  | RTF( 1,2)      |
| D-34 | Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 1,3)      |

Summary : Bldg 811 Area-Industrial-Bkgd subtract-D

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-D.RAD

## Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| D-34 | Pb-210+D , plant/soil concentration ratio, dimensionless | 1.000E-02      | 1.000E-02  | RTF( 2,1)      |
| D-34 | Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-04      | 8.000E-04  | RTF( 2,2)      |
| D-34 | Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 3.000E-04      | 3.000E-04  | RTF( 2,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Ra-226+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 3,1)      |
| D-34 | Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-03      | 1.000E-03  | RTF( 3,2)      |
| D-34 | Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 1.000E-03      | 1.000E-03  | RTF( 3,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Sr-90+D , plant/soil concentration ratio, dimensionless  | 3.000E-01      | 3.000E-01  | RTF( 4,1)      |
| D-34 | Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 4,2)      |
| D-34 | Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 2.000E-03      | 2.000E-03  | RTF( 4,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Th-230 , plant/soil concentration ratio, dimensionless   | 1.000E-03      | 1.000E-03  | RTF( 5,1)      |
| D-34 | Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 1.000E-04      | 1.000E-04  | RTF( 5,2)      |
| D-34 | Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06      | 5.000E-06  | RTF( 5,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-234 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 6,1)      |
| D-34 | U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 6,2)      |
| D-34 | U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 6,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 7,1)      |
| D-34 | U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 7,2)      |
| D-34 | U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 7,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238+D , plant/soil concentration ratio, dimensionless  | 2.500E-03      | 2.500E-03  | RTF( 8,1)      |
| D-34 | U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04      | 3.400E-04  | RTF( 8,2)      |
| D-34 | U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04      | 6.000E-04  | RTF( 8,3)      |
| D-34 |                                                          |                |            |                |
| D-5  | Bioaccumulation factors, fresh water, L/kg:              |                |            |                |
| D-5  | Cs-137+D , fish                                          | 2.000E+03      | 2.000E+03  | BIOFAC( 1,1)   |
| D-5  | Cs-137+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 1,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Pb-210+D , fish                                          | 3.000E+02      | 3.000E+02  | BIOFAC( 2,1)   |
| D-5  | Pb-210+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 2,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Ra-226+D , fish                                          | 5.000E+01      | 5.000E+01  | BIOFAC( 3,1)   |
| D-5  | Ra-226+D , crustacea and mollusks                        | 2.500E+02      | 2.500E+02  | BIOFAC( 3,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Sr-90+D , fish                                           | 6.000E+01      | 6.000E+01  | BIOFAC( 4,1)   |
| D-5  | Sr-90+D , crustacea and mollusks                         | 1.000E+02      | 1.000E+02  | BIOFAC( 4,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Th-230 , fish                                            | 1.000E+02      | 1.000E+02  | BIOFAC( 5,1)   |
| D-5  | Th-230 , crustacea and mollusks                          | 5.000E+02      | 5.000E+02  | BIOFAC( 5,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-234 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 6,1)   |
| D-5  | U-234 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 6,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-238 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 7,1)   |
| D-5  | U-238 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 7,2)   |
| D-5  |                                                          |                |            |                |

Summary : Bldg 811 Area-Industrial-Bkgd subtract-D

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-D.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter |                          | Current   | Base      | Parameter    |
|------|-----------|--------------------------|-----------|-----------|--------------|
|      |           |                          | Value#    | Case*     | Name         |
| D-5  | U-238+D   | , fish                   | 1.000E+01 | 1.000E+01 | BIOFAC( 8,1) |
| D-5  | U-238+D   | , crustacea and mollusks | 6.000E+01 | 6.000E+01 | BIOFAC( 8,2) |

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.

\*Base Case means Default.Lib w/o Associate Nuclide contributions.



Summary : Bldg 811 Area-Industrial-Bkgd subtract-D

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-D.RAD

## Site-Specific Parameter Summary

| Menu | Parameter                                       | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|-------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R011 | Area of contaminated zone (m**2)                | 1.860E+03  | 1.000E+04 | ---                                              | AREA           |
| R011 | Thickness of contaminated zone (m)              | 5.000E+00  | 2.000E+00 | ---                                              | THICK0         |
| R011 | Fraction of contamination that is submerged     | 0.000E+00  | 0.000E+00 | ---                                              | SUBMFRACT      |
| R011 | Length parallel to aquifer flow (m)             | 7.600E+01  | 1.000E+02 | ---                                              | LCZPAQ         |
| R011 | Basic radiation dose limit (mrem/yr)            | 1.500E+01  | 3.000E+01 | ---                                              | BRDL           |
| R011 | Time since placement of material (yr)           | 0.000E+00  | 0.000E+00 | ---                                              | TI             |
| R011 | Times for calculations (yr)                     | 1.000E+00  | 1.000E+00 | ---                                              | T( 2)          |
| R011 | Times for calculations (yr)                     | 5.000E+00  | 3.000E+00 | ---                                              | T( 3)          |
| R011 | Times for calculations (yr)                     | 1.000E+01  | 1.000E+01 | ---                                              | T( 4)          |
| R011 | Times for calculations (yr)                     | 5.000E+01  | 3.000E+01 | ---                                              | T( 5)          |
| R011 | Times for calculations (yr)                     | 1.000E+02  | 1.000E+02 | ---                                              | T( 6)          |
| R011 | Times for calculations (yr)                     | 5.000E+02  | 3.000E+02 | ---                                              | T( 7)          |
| R011 | Times for calculations (yr)                     | 1.000E+03  | 1.000E+03 | ---                                              | T( 8)          |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T( 9)          |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T(10)          |
| R012 | Initial principal radionuclide (pCi/g): Cs-137  | 3.854E+00  | 0.000E+00 | ---                                              | S1(1)          |
| R012 | Initial principal radionuclide (pCi/g): Sr-90   | 2.140E-01  | 0.000E+00 | ---                                              | S1(4)          |
| R012 | Initial principal radionuclide (pCi/g): U-238   | 4.470E-01  | 0.000E+00 | ---                                              | S1(7)          |
| R012 | Concentration in groundwater (pCi/L): Cs-137    | not used   | 0.000E+00 | ---                                              | W1( 1)         |
| R012 | Concentration in groundwater (pCi/L): Sr-90     | not used   | 0.000E+00 | ---                                              | W1( 4)         |
| R012 | Concentration in groundwater (pCi/L): U-238     | not used   | 0.000E+00 | ---                                              | W1( 7)         |
| R013 | Cover depth (m)                                 | 0.000E+00  | 0.000E+00 | ---                                              | COVER0         |
| R013 | Density of cover material (g/cm**3)             | not used   | 1.500E+00 | ---                                              | DENSCV         |
| R013 | Cover depth erosion rate (m/yr)                 | not used   | 1.000E-03 | ---                                              | VCV            |
| R013 | Density of contaminated zone (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSCZ         |
| R013 | Contaminated zone erosion rate (m/yr)           | 1.000E-03  | 1.000E-03 | ---                                              | VCZ            |
| R013 | Contaminated zone total porosity                | 3.300E-01  | 4.000E-01 | ---                                              | TPCZ           |
| R013 | Contaminated zone field capacity                | 2.400E-01  | 2.000E-01 | ---                                              | FCCZ           |
| R013 | Contaminated zone hydraulic conductivity (m/yr) | 5.000E+03  | 1.000E+01 | ---                                              | HCCZ           |
| R013 | Contaminated zone b parameter                   | 4.900E+00  | 5.300E+00 | ---                                              | BCZ            |
| R013 | Average annual wind speed (m/sec)               | 6.230E+00  | 2.000E+00 | ---                                              | WIND           |
| R013 | Humidity in air (g/m**3)                        | not used   | 8.000E+00 | ---                                              | HUMID          |
| R013 | Evapotranspiration coefficient                  | 4.600E-01  | 5.000E-01 | ---                                              | EVAPTR         |
| R013 | Precipitation (m/yr)                            | 1.230E+00  | 1.000E+00 | ---                                              | PRECIP         |
| R013 | Irrigation (m/yr)                               | 2.600E-01  | 2.000E-01 | ---                                              | RI             |
| R013 | Irrigation mode                                 | overhead   | overhead  | ---                                              | IDITCH         |
| R013 | Runoff coefficient                              | 2.000E-01  | 2.000E-01 | ---                                              | RUNOFF         |
| R013 | Watershed area for nearby stream or pond (m**2) | 1.000E+06  | 1.000E+06 | ---                                              | WAREA          |
| R013 | Accuracy for water/soil computations            | 1.000E-03  | 1.000E-03 | Romberg failures occurred                        | EPS            |
| R014 | Density of saturated zone (g/cm**3)             | 1.660E+00  | 1.500E+00 | ---                                              | DENSAQ         |
| R014 | Saturated zone total porosity                   | 3.300E-01  | 4.000E-01 | ---                                              | TPSZ           |
| R014 | Saturated zone effective porosity               | 2.400E-01  | 2.000E-01 | ---                                              | EPSZ           |
| R014 | Saturated zone field capacity                   | 2.000E-01  | 2.000E-01 | ---                                              | FCSZ           |
| R014 | Saturated zone hydraulic conductivity (m/yr)    | 2.000E+04  | 1.000E+02 | ---                                              | HCSZ           |
| R014 | Saturated zone hydraulic gradient               | 4.800E-03  | 2.000E-02 | ---                                              | HGWT           |
| R014 | Saturated zone b parameter                      | 4.900E+00  | 5.300E+00 | ---                                              | BSZ            |
| R014 | Water table drop rate (m/yr)                    | 1.000E-03  | 1.000E-03 | ---                                              | VWT            |

Summary : Bldg 811 Area-Industrial-Bkgd subtract-D

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-D.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R014 | Well pump intake depth (m below water table)   | 1.800E+01  | 1.000E+01 | ---                                              | DWIBWT         |
| R014 | Model: Nondispersion (ND) or Mass-Balance (MB) | ND         | ND        | ---                                              | MODEL          |
| R014 | Well pumping rate (m**3/yr)                    | 2.500E+02  | 2.500E+02 | ---                                              | UW             |
| R015 | Number of unsaturated zone strata              | 1          | 1         | ---                                              | NS             |
| R015 | Unsat. zone 1, thickness (m)                   | 0.000E+00  | 4.000E+00 | ---                                              | H (1)          |
| R015 | Unsat. zone 1, soil density (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSUZ (1)     |
| R015 | Unsat. zone 1, total porosity                  | 3.300E-01  | 4.000E-01 | ---                                              | TPUZ (1)       |
| R015 | Unsat. zone 1, effective porosity              | 2.400E-01  | 2.000E-01 | ---                                              | EPUZ (1)       |
| R015 | Unsat. zone 1, field capacity                  | 2.000E-01  | 2.000E-01 | ---                                              | FCUZ (1)       |
| R015 | Unsat. zone 1, soil-specific b parameter       | 4.900E+00  | 5.300E+00 | ---                                              | BUZ (1)        |
| R015 | Unsat. zone 1, hydraulic conductivity (m/yr)   | 5.000E+03  | 1.000E+01 | ---                                              | HCUZ (1)       |
| R016 | Distribution coefficients for Cs-137           |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCC ( 1)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCU ( 1,1)  |
| R016 | Saturated zone (cm**3/g)                       | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCS ( 1)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 2.889E-04                                        | ALEACH ( 1)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 1)    |
| R016 | Distribution coefficients for Sr-90            |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 3.000E+00  | 3.000E+01 | ---                                              | DCNUCC ( 4)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 3.000E+00  | 3.000E+01 | ---                                              | DCNUCU ( 4,1)  |
| R016 | Saturated zone (cm**3/g)                       | 3.000E+00  | 3.000E+01 | ---                                              | DCNUCS ( 4)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 2.574E-02                                        | ALEACH ( 4)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 4)    |
| R016 | Distribution coefficients for U-238            |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 1.700E+01  | 5.000E+01 | ---                                              | DCNUCC ( 7)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 1.700E+01  | 5.000E+01 | ---                                              | DCNUCU ( 7,1)  |
| R016 | Saturated zone (cm**3/g)                       | 1.700E+01  | 5.000E+01 | ---                                              | DCNUCS ( 7)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 4.721E-03                                        | ALEACH ( 7)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 7)    |
| R016 | Distribution coefficients for daughter Pb-210  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCC ( 2)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCU ( 2,1)  |
| R016 | Saturated zone (cm**3/g)                       | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCS ( 2)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 8.082E-04                                        | ALEACH ( 2)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 2)    |
| R016 | Distribution coefficients for daughter Ra-226  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 7.000E+01  | 7.000E+01 | ---                                              | DCNUCC ( 3)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 7.000E+01  | 7.000E+01 | ---                                              | DCNUCU ( 3,1)  |
| R016 | Saturated zone (cm**3/g)                       | 7.000E+01  | 7.000E+01 | ---                                              | DCNUCS ( 3)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.154E-03                                        | ALEACH ( 3)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 3)    |

Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R016 | Distribution coefficients for daughter Th-230  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCC ( 5)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCU ( 5,1)  |
| R016 | Saturated zone (cm**3/g)                       | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCS ( 5)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.349E-06                                        | ALEACH ( 5)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 5)    |
| R016 | Distribution coefficients for daughter U-234   |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCC ( 6)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCU ( 6,1)  |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCS ( 6)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.614E-03                                        | ALEACH ( 6)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 6)    |
| R017 | Inhalation rate (m**3/yr)                      | 7.300E+03  | 8.400E+03 | ---                                              | INHALR         |
| R017 | Mass loading for inhalation (g/m**3)           | 1.000E-04  | 1.000E-04 | ---                                              | MLINH          |
| R017 | Exposure duration                              | 2.500E+01  | 3.000E+01 | ---                                              | ED             |
| R017 | Shielding factor, inhalation                   | 4.000E-01  | 4.000E-01 | ---                                              | SHF3           |
| R017 | Shielding factor, external gamma               | 8.000E-01  | 7.000E-01 | ---                                              | SHF1           |
| R017 | Fraction of time spent indoors                 | 1.700E-01  | 5.000E-01 | ---                                              | FIND           |
| R017 | Fraction of time spent outdoors (on site)      | 6.000E-02  | 2.500E-01 | ---                                              | FOTD           |
| R017 | Shape factor flag, external gamma              | 1.000E+00  | 1.000E+00 | >0 shows circular AREA.                          | FS             |
| R017 | Radii of shape factor array (used if FS = -1): |            |           |                                                  |                |
| R017 | Outer annular radius (m), ring 1:              | not used   | 5.000E+01 | ---                                              | RAD_SHAPE ( 1) |
| R017 | Outer annular radius (m), ring 2:              | not used   | 7.071E+01 | ---                                              | RAD_SHAPE ( 2) |
| R017 | Outer annular radius (m), ring 3:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 3) |
| R017 | Outer annular radius (m), ring 4:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 4) |
| R017 | Outer annular radius (m), ring 5:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 5) |
| R017 | Outer annular radius (m), ring 6:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 6) |
| R017 | Outer annular radius (m), ring 7:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 7) |
| R017 | Outer annular radius (m), ring 8:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 8) |
| R017 | Outer annular radius (m), ring 9:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 9) |
| R017 | Outer annular radius (m), ring 10:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(10)  |
| R017 | Outer annular radius (m), ring 11:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(11)  |
| R017 | Outer annular radius (m), ring 12:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(12)  |
| R017 | Fractions of annular areas within AREA:        |            |           |                                                  |                |
| R017 | Ring 1                                         | not used   | 1.000E+00 | ---                                              | FRACA ( 1)     |
| R017 | Ring 2                                         | not used   | 2.732E-01 | ---                                              | FRACA ( 2)     |
| R017 | Ring 3                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 3)     |
| R017 | Ring 4                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 4)     |
| R017 | Ring 5                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 5)     |
| R017 | Ring 6                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 6)     |
| R017 | Ring 7                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 7)     |
| R017 | Ring 8                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 8)     |
| R017 | Ring 9                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 9)     |
| R017 | Ring 10                                        | not used   | 0.000E+00 | ---                                              | FRACA(10)      |
| R017 | Ring 11                                        | not used   | 0.000E+00 | ---                                              | FRACA(11)      |
| R017 | Ring 12                                        | not used   | 0.000E+00 | ---                                              | FRACA(12)      |

Summary : Bldg 811 Area-Industrial-Bkgd subtract-D

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-D.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|--------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R018 | Fruits, vegetables and grain consumption (kg/yr) | not used   | 1.600E+02 | ---                                              | DIET (1)       |
| R018 | Leafy vegetable consumption (kg/yr)              | not used   | 1.400E+01 | ---                                              | DIET (2)       |
| R018 | Milk consumption (L/yr)                          | not used   | 9.200E+01 | ---                                              | DIET (3)       |
| R018 | Meat and poultry consumption (kg/yr)             | not used   | 6.300E+01 | ---                                              | DIET (4)       |
| R018 | Fish consumption (kg/yr)                         | not used   | 5.400E+00 | ---                                              | DIET (5)       |
| R018 | Other seafood consumption (kg/yr)                | not used   | 9.000E-01 | ---                                              | DIET (6)       |
| R018 | Soil ingestion rate (g/yr)                       | 3.650E+01  | 3.650E+01 | ---                                              | SOIL           |
| R018 | Drinking water intake (L/yr)                     | 3.500E+02  | 5.100E+02 | ---                                              | DWI            |
| R018 | Contamination fraction of drinking water         | 1.000E+00  | 1.000E+00 | ---                                              | FDW            |
| R018 | Contamination fraction of household water        | not used   | 1.000E+00 | ---                                              | FHHW           |
| R018 | Contamination fraction of livestock water        | not used   | 1.000E+00 | ---                                              | FLW            |
| R018 | Contamination fraction of irrigation water       | not used   | 1.000E+00 | ---                                              | FIRW           |
| R018 | Contamination fraction of aquatic food           | not used   | 5.000E-01 | ---                                              | FR9            |
| R018 | Contamination fraction of plant food             | not used   | -1        | ---                                              | FPLANT         |
| R018 | Contamination fraction of meat                   | not used   | -1        | ---                                              | FMEAT          |
| R018 | Contamination fraction of milk                   | not used   | -1        | ---                                              | FMILK          |
|      |                                                  |            |           |                                                  |                |
| R019 | Livestock fodder intake for meat (kg/day)        | not used   | 6.800E+01 | ---                                              | LFI5           |
| R019 | Livestock fodder intake for milk (kg/day)        | not used   | 5.500E+01 | ---                                              | LFI6           |
| R019 | Livestock water intake for meat (L/day)          | not used   | 5.000E+01 | ---                                              | LWI5           |
| R019 | Livestock water intake for milk (L/day)          | not used   | 1.600E+02 | ---                                              | LWI6           |
| R019 | Livestock soil intake (kg/day)                   | not used   | 5.000E-01 | ---                                              | LSI            |
| R019 | Mass loading for foliar deposition (g/m**3)      | not used   | 1.000E-04 | ---                                              | MLFD           |
| R019 | Depth of soil mixing layer (m)                   | 1.500E-01  | 1.500E-01 | ---                                              | DM             |
| R019 | Depth of roots (m)                               | not used   | 9.000E-01 | ---                                              | DROOT          |
| R019 | Drinking water fraction from ground water        | 1.000E+00  | 1.000E+00 | ---                                              | FGWDW          |
| R019 | Household water fraction from ground water       | not used   | 1.000E+00 | ---                                              | FGWHH          |
| R019 | Livestock water fraction from ground water       | not used   | 1.000E+00 | ---                                              | FGWLW          |
| R019 | Irrigation fraction from ground water            | not used   | 1.000E+00 | ---                                              | FGWIR          |
|      |                                                  |            |           |                                                  |                |
| R19B | Wet weight crop yield for Non-Leafy (kg/m**2)    | not used   | 7.000E-01 | ---                                              | YV (1)         |
| R19B | Wet weight crop yield for Leafy (kg/m**2)        | not used   | 1.500E+00 | ---                                              | YV (2)         |
| R19B | Wet weight crop yield for Fodder (kg/m**2)       | not used   | 1.100E+00 | ---                                              | YV (3)         |
| R19B | Growing Season for Non-Leafy (years)             | not used   | 1.700E-01 | ---                                              | TE (1)         |
| R19B | Growing Season for Leafy (years)                 | not used   | 2.500E-01 | ---                                              | TE (2)         |
| R19B | Growing Season for Fodder (years)                | not used   | 8.000E-02 | ---                                              | TE (3)         |
| R19B | Translocation Factor for Non-Leafy               | not used   | 1.000E-01 | ---                                              | TIV (1)        |
| R19B | Translocation Factor for Leafy                   | not used   | 1.000E+00 | ---                                              | TIV (2)        |
| R19B | Translocation Factor for Fodder                  | not used   | 1.000E+00 | ---                                              | TIV (3)        |
| R19B | Dry Foliar Interception Fraction for Non-Leafy   | not used   | 2.500E-01 | ---                                              | RDRY (1)       |
| R19B | Dry Foliar Interception Fraction for Leafy       | not used   | 2.500E-01 | ---                                              | RDRY (2)       |
| R19B | Dry Foliar Interception Fraction for Fodder      | not used   | 2.500E-01 | ---                                              | RDRY (3)       |
| R19B | Wet Foliar Interception Fraction for Non-Leafy   | not used   | 2.500E-01 | ---                                              | RWET (1)       |
| R19B | Wet Foliar Interception Fraction for Leafy       | not used   | 2.500E-01 | ---                                              | RWET (2)       |
| R19B | Wet Foliar Interception Fraction for Fodder      | not used   | 2.500E-01 | ---                                              | RWET (3)       |
| R19B | Weathering Removal Constant for Vegetation       | not used   | 2.000E+01 | ---                                              | WLAM           |
|      |                                                  |            |           |                                                  |                |
| C14  | C-12 concentration in water (g/cm**3)            | not used   | 2.000E-05 | ---                                              | C12WTR         |
| C14  | C-12 concentration in contaminated soil (g/g)    | not used   | 3.000E-02 | ---                                              | C12CZ          |
| C14  | Fraction of vegetation carbon from soil          | not used   | 2.000E-02 | ---                                              | CSOIL          |

Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User<br>Input | Default    | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|------|--------------------------------------------------|---------------|------------|--------------------------------------------------|-------------------|
| C14  | Fraction of vegetation carbon from air           | not used      | 9.800E-01  | ---                                              | CAIR              |
| C14  | C-14 evasion layer thickness in soil (m)         | not used      | 3.000E-01  | ---                                              | DMC               |
| C14  | C-14 evasion flux rate from soil (1/sec)         | not used      | 7.000E-07  | ---                                              | EVSN              |
| C14  | C-12 evasion flux rate from soil (1/sec)         | not used      | 1.000E-10  | ---                                              | REVSN             |
| C14  | Fraction of grain in beef cattle feed            | not used      | 8.000E-01  | ---                                              | AVFG4             |
| C14  | Fraction of grain in milk cow feed               | not used      | 2.000E-01  | ---                                              | AVFG5             |
| STOR | Storage times of contaminated foodstuffs (days): |               |            |                                                  |                   |
| STOR | Fruits, non-leafy vegetables, and grain          | 1.400E+01     | 1.400E+01  | ---                                              | STOR_T (1)        |
| STOR | Leafy vegetables                                 | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T (2)        |
| STOR | Milk                                             | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T (3)        |
| STOR | Meat and poultry                                 | 2.000E+01     | 2.000E+01  | ---                                              | STOR_T (4)        |
| STOR | Fish                                             | 7.000E+00     | 7.000E+00  | ---                                              | STOR_T (5)        |
| STOR | Crustacea and mollusks                           | 7.000E+00     | 7.000E+00  | ---                                              | STOR_T (6)        |
| STOR | Well water                                       | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T (7)        |
| STOR | Surface water                                    | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T (8)        |
| STOR | Livestock fodder                                 | 4.500E+01     | 4.500E+01  | ---                                              | STOR_T (9)        |
| R021 | Thickness of building foundation (m)             | not used      | 1.500E-01  | ---                                              | FLOOR1            |
| R021 | Bulk density of building foundation (g/cm**3)    | not used      | 2.400E+00  | ---                                              | DENSFL            |
| R021 | Total porosity of the cover material             | not used      | 4.000E-01  | ---                                              | TPCV              |
| R021 | Total porosity of the building foundation        | not used      | 1.000E-01  | ---                                              | TPFL              |
| R021 | Volumetric water content of the cover material   | not used      | 5.000E-02  | ---                                              | PH2OCV            |
| R021 | Volumetric water content of the foundation       | not used      | 3.000E-02  | ---                                              | PH2OFL            |
| R021 | Diffusion coefficient for radon gas (m/sec):     |               |            |                                                  |                   |
| R021 | in cover material                                | not used      | 2.000E-06  | ---                                              | DIFCV             |
| R021 | in foundation material                           | not used      | 3.000E-07  | ---                                              | DIFFL             |
| R021 | in contaminated zone soil                        | not used      | 2.000E-06  | ---                                              | DIFCZ             |
| R021 | Radon vertical dimension of mixing (m)           | not used      | 2.000E+00  | ---                                              | HMIX              |
| R021 | Average building air exchange rate (1/hr)        | not used      | 5.000E-01  | ---                                              | REXG              |
| R021 | Height of the building (room) (m)                | not used      | 2.500E+00  | ---                                              | HRM               |
| R021 | Building interior area factor                    | not used      | 0.000E+00  | ---                                              | FAI               |
| R021 | Building depth below ground surface (m)          | not used      | -1.000E+00 | ---                                              | DMFL              |
| R021 | Emanating power of Rn-222 gas                    | not used      | 2.500E-01  | ---                                              | EMANA (1)         |
| R021 | Emanating power of Rn-220 gas                    | not used      | 1.500E-01  | ---                                              | EMANA (2)         |
| TITL | Number of graphical time points                  | 32            | ---        | ---                                              | NPTS              |
| TITL | Maximum number of integration points for dose    | 17            | ---        | ---                                              | LYMAX             |
| TITL | Maximum number of integration points for risk    | 257           | ---        | ---                                              | KYMAX             |

Summary : Bldg 811 Area-Industrial-Bkgd subtract-D

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-D.RAD

## Summary of Pathway Selections

| Pathway                     | User Selection |
|-----------------------------|----------------|
| 1 -- external gamma         | active         |
| 2 -- inhalation (w/o radon) | active         |
| 3 -- plant ingestion        | suppressed     |
| 4 -- meat ingestion         | suppressed     |
| 5 -- milk ingestion         | suppressed     |
| 6 -- aquatic foods          | suppressed     |
| 7 -- drinking water         | active         |
| 8 -- soil ingestion         | active         |
| 9 -- radon                  | suppressed     |
| Find peak pathway doses     | active         |

Summary : Bldg 811 Area-Industrial-Bkgd subtract-D

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-D.RAD

| Contaminated Zone Dimensions |                       | Initial Soil Concentrations, pCi/g |           |
|------------------------------|-----------------------|------------------------------------|-----------|
| Area:                        | 1860.00 square meters | Cs-137                             | 3.854E+00 |
| Thickness:                   | 5.00 meters           | Sr-90                              | 2.140E-01 |
| Cover Depth:                 | 0.00 meters           | U-238                              | 4.470E-01 |

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 1.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

|            |           |           |           |           |           |           |           |           |
|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| t (years): | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| TDOSE(t):  | 2.169E+00 | 2.146E+00 | 1.997E+00 | 1.787E+00 | 7.255E-01 | 2.490E-01 | 5.868E-03 | 5.379E-04 |
| M(t):      | 1.446E-01 | 1.431E-01 | 1.331E-01 | 1.192E-01 | 4.837E-02 | 1.660E-02 | 3.912E-04 | 3.586E-05 |

Maximum TDOSE(t): 2.169E+00 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.138E+00 | 0.9858 | 2.780E-06  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.609E-03 | 0.0007 |
| Sr-90             | 1.508E-03 | 0.0007 | 6.108E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.963E-04 | 0.0001 |
| U-238             | 1.285E-02 | 0.0059 | 6.647E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.648E-04 | 0.0003 |
| Total             | 2.153E+00 | 0.9924 | 6.986E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.470E-03 | 0.0011 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 6.474E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.140E+00     | 0.9866 |
| Sr-90             | 1.245E-02 | 0.0057 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.416E-02     | 0.0065 |
| U-238             | 1.402E-03 | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.499E-02     | 0.0069 |
| Total             | 1.386E-02 | 0.0064 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.169E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.



Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.089E+00 | 0.9733 | 2.716E-06  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.572E-03 | 0.0007 |
| Sr-90             | 1.434E-03 | 0.0007 | 5.811E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.868E-04 | 0.0001 |
| U-238             | 1.279E-02 | 0.0060 | 6.616E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.616E-04 | 0.0003 |
| Total             | 2.103E+00 | 0.9800 | 6.945E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.421E-03 | 0.0011 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.914E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.091E+00     | 0.9741 |
| Sr-90             | 3.625E-02 | 0.0169 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.788E-02     | 0.0176 |
| U-238             | 4.211E-03 | 0.0020 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.773E-02     | 0.0083 |
| Total             | 4.048E-02 | 0.0189 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.146E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 1.903E+00 | 0.9530 | 2.475E-06  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.433E-03 | 0.0007 |
| Sr-90             | 1.175E-03 | 0.0006 | 4.761E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.531E-04 | 0.0001 |
| U-238             | 1.255E-02 | 0.0063 | 6.492E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.493E-04 | 0.0003 |
| Total             | 1.917E+00 | 0.9599 | 6.787E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.235E-03 | 0.0011 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 6.421E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.905E+00     | 0.9538 |
| Sr-90             | 6.238E-02 | 0.0312 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.371E-02     | 0.0319 |
| U-238             | 1.532E-02 | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.858E-02     | 0.0143 |
| Total             | 7.776E-02 | 0.0389 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.997E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Industrial-Bkgd subtract-D

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-D.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 1.694E+00 | 0.9480 | 2.203E-06  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.275E-03 | 0.0007 |
| Sr-90             | 9.162E-04 | 0.0005 | 3.711E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.193E-04 | 0.0001 |
| U-238             | 1.226E-02 | 0.0069 | 6.341E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.341E-04 | 0.0004 |
| Total             | 1.708E+00 | 0.9554 | 6.598E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.029E-03 | 0.0011 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.093E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.696E+00     | 0.9488 |
| Sr-90             | 4.861E-02 | 0.0272 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.965E-02     | 0.0278 |
| U-238             | 2.890E-02 | 0.0162 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.186E-02     | 0.0234 |
| Total             | 7.762E-02 | 0.0434 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.787E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Industrial-Bkgd subtract-D

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-D.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.681E-01 | 0.9209 | 8.686E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.028E-04 | 0.0007 |
| Sr-90             | 1.249E-04 | 0.0002 | 5.060E-08  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.627E-05 | 0.0000 |
| U-238             | 1.015E-02 | 0.0140 | 5.250E-05  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.251E-04 | 0.0007 |
| Total             | 6.784E-01 | 0.9351 | 5.342E-05  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.044E-03 | 0.0014 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 2.088E-04 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.688E-01     | 0.9219 |
| Sr-90             | 6.614E-03 | 0.0091 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.755E-03     | 0.0093 |
| U-238             | 3.919E-02 | 0.0540 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.992E-02     | 0.0688 |
| Total             | 4.601E-02 | 0.0634 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.255E-01     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.088E-01 | 0.8385 | 2.714E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.571E-04 | 0.0006 |
| Sr-90             | 1.035E-05 | 0.0000 | 4.193E-09  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.348E-06 | 0.0000 |
| U-238             | 8.017E-03 | 0.0322 | 4.147E-05  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.148E-04 | 0.0017 |
| Total             | 2.168E-01 | 0.8708 | 4.175E-05  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.732E-04 | 0.0023 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.309E-04 | 0.0005 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.090E-01     | 0.8397 |
| Sr-90             | 5.464E-04 | 0.0022 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.581E-04     | 0.0022 |
| U-238             | 3.087E-02 | 0.1240 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.935E-02     | 0.1581 |
| Total             | 3.155E-02 | 0.1267 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.490E-01     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 1.896E-05 | 0.0032 | 2.466E-11  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.427E-08 | 0.0000 |
| Sr-90             | 2.298E-14 | 0.0000 | 9.310E-18  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.993E-15 | 0.0000 |
| U-238             | 1.213E-03 | 0.2068 | 6.300E-06  | 0.0011 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.297E-05 | 0.0107 |
| Total             | 1.232E-03 | 0.2100 | 6.300E-06  | 0.0011 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.298E-05 | 0.0107 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 6.335E-08 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.904E-05     | 0.0032 |
| Sr-90             | 1.181E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.207E-12     | 0.0000 |
| U-238             | 4.566E-03 | 0.7782 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.848E-03     | 0.9968 |
| Total             | 4.566E-03 | 0.7782 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.868E-03     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 1.682E-10 | 0.0000 | 2.187E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.266E-13 | 0.0000 |
| Sr-90             | 3.503E-25 | 0.0000 | 1.419E-28  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.562E-26 | 0.0000 |
| U-238             | 1.148E-04 | 0.2134 | 6.076E-07  | 0.0011 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.057E-06 | 0.0113 |
| Total             | 1.148E-04 | 0.2134 | 6.076E-07  | 0.0011 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.057E-06 | 0.0113 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 6.210E-13 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.690E-10     | 0.0000 |
| Sr-90             | 1.721E-23 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.761E-23     | 0.0000 |
| U-238             | 4.164E-04 | 0.7742 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.379E-04     | 1.0000 |
| Total             | 4.164E-04 | 0.7742 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.379E-04     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Industrial-Bkgd subtract-D

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-D.RAD

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

| Parent<br>(i) | Product<br>(j) | Thread<br>Fraction | DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) |           |           |           |           |           |           |           |
|---------------|----------------|--------------------|---------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               |                |                    | 0.000E+00                                   | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137+D      | Cs-137+D       | 1.000E+00          | 5.552E-01                                   | 5.425E-01 | 4.943E-01 | 4.400E-01 | 1.735E-01 | 5.424E-02 | 4.941E-06 | 4.384E-11 |
| Sr-90+D       | Sr-90+D        | 1.000E+00          | 6.615E-02                                   | 1.770E-01 | 2.977E-01 | 2.320E-01 | 3.156E-02 | 2.608E-03 | 5.640E-12 | 8.228E-23 |
| U-238         | U-238          | 5.450E-07          | 2.441E-09                                   | 5.618E-09 | 1.819E-08 | 3.356E-08 | 4.508E-08 | 3.551E-08 | 5.248E-09 | 4.758E-10 |
| U-238+D       | U-238+D        | 1.000E+00          | 3.353E-02                                   | 3.967E-02 | 6.394E-02 | 9.365E-02 | 1.117E-01 | 8.802E-02 | 1.307E-02 | 1.195E-03 |
| U-238+D       | U-234          | 1.000E+00          | 3.906E-09                                   | 1.723E-08 | 1.524E-07 | 5.025E-07 | 5.005E-06 | 8.518E-06 | 1.289E-05 | 6.746E-06 |
| U-238+D       | Th-230         | 1.000E+00          | 1.028E-13                                   | 4.514E-13 | 4.077E-12 | 1.354E-11 | 2.726E-10 | 9.591E-10 | 1.124E-08 | 2.117E-08 |
| U-238+D       | Ra-226+D       | 1.000E+00          | 7.331E-11                                   | 2.107E-10 | 7.460E-10 | 1.388E-09 | 1.066E-08 | 1.951E-08 | 2.257E-07 | 7.351E-07 |
| U-238+D       | Pb-210+D       | 1.000E+00          | 3.496E-10                                   | 1.005E-09 | 3.555E-09 | 6.601E-09 | 4.882E-08 | 7.865E-08 | 2.429E-07 | 5.438E-07 |
| U-238+D       | ΣDSR(j)        |                    | 3.353E-02                                   | 3.967E-02 | 6.394E-02 | 9.365E-02 | 1.117E-01 | 8.803E-02 | 1.308E-02 | 1.203E-03 |

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

| Nuclide<br>(i) | t =       | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02  | 1.000E+03 |
|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|-----------|
| Cs-137         | 2.702E+01 | 2.765E+01 | 3.035E+01 | 3.409E+01 | 8.643E+01 | 2.765E+02 | 3.036E+06 | 3.422E+11  |           |
| Sr-90          | 2.268E+02 | 8.475E+01 | 5.038E+01 | 6.465E+01 | 4.752E+02 | 5.752E+03 | 2.659E+12 | *1.366E+14 |           |
| U-238          | 4.474E+02 | 3.781E+02 | 2.346E+02 | 1.602E+02 | 1.343E+02 | 1.704E+02 | 1.146E+03 | 1.247E+04  |           |

\*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
at tmin = time of minimum single radionuclide soil guideline  
and at tmax = time of maximum total dose = 0.000E+00 years

| Nuclide<br>(i) | Initial<br>(pCi/g) | tmin<br>(years) | DSR(i,tmin) | G(i,tmin)<br>(pCi/g) | DSR(i,tmax) | G(i,tmax)<br>(pCi/g) |
|----------------|--------------------|-----------------|-------------|----------------------|-------------|----------------------|
| Cs-137         | 3.854E+00          | 0.000E+00       | 5.552E-01   | 2.702E+01            | 5.552E-01   | 2.702E+01            |
| Sr-90          | 2.140E-01          | 2.825 ± 0.006   | 3.294E-01   | 4.554E+01            | 6.615E-02   | 2.268E+02            |
| U-238          | 4.470E-01          | 16.89 ± 0.03    | 1.307E-01   | 1.147E+02            | 3.353E-02   | 4.474E+02            |



Individual Nuclide Dose Summed Over All Pathways  
 Parent Nuclide and Branch Fraction Indicated

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | DOSE(j,t), mrem/yr |           |           |           |           |           |           |           |
|----------------|---------------|-----------|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t= 0.000E+00       | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 2.140E+00          | 2.091E+00 | 1.905E+00 | 1.696E+00 | 6.688E-01 | 2.090E-01 | 1.904E-05 | 1.690E-10 |
| Sr-90          | Sr-90         | 1.000E+00 | 1.416E-02          | 3.788E-02 | 6.371E-02 | 4.965E-02 | 6.755E-03 | 5.581E-04 | 1.207E-12 | 1.761E-23 |
| U-238          | U-238         | 5.450E-07 | 1.091E-09          | 2.511E-09 | 8.129E-09 | 1.500E-08 | 2.015E-08 | 1.587E-08 | 2.346E-09 | 2.127E-10 |
| U-238          | U-238         | 1.000E+00 | 1.499E-02          | 1.773E-02 | 2.858E-02 | 4.186E-02 | 4.992E-02 | 3.934E-02 | 5.842E-03 | 5.343E-04 |
| U-238          | ΣDOSE(j)      |           | 1.499E-02          | 1.773E-02 | 2.858E-02 | 4.186E-02 | 4.992E-02 | 3.934E-02 | 5.843E-03 | 5.343E-04 |
| U-234          | U-238         | 1.000E+00 | 1.746E-09          | 7.703E-09 | 6.813E-08 | 2.246E-07 | 2.237E-06 | 3.808E-06 | 5.760E-06 | 3.016E-06 |
| Th-230         | U-238         | 1.000E+00 | 4.595E-14          | 2.018E-13 | 1.822E-12 | 6.051E-12 | 1.218E-10 | 4.287E-10 | 5.023E-09 | 9.465E-09 |
| Ra-226         | U-238         | 1.000E+00 | 3.277E-11          | 9.420E-11 | 3.335E-10 | 6.205E-10 | 4.765E-09 | 8.722E-09 | 1.009E-07 | 3.286E-07 |
| Pb-210         | U-238         | 1.000E+00 | 1.563E-10          | 4.492E-10 | 1.589E-09 | 2.951E-09 | 2.182E-08 | 3.515E-08 | 1.086E-07 | 2.431E-07 |

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration  
 Parent Nuclide and Branch Fraction Indicated

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | S(j,t), pCi/g |           |           |           |           |           |           |           |
|----------------|---------------|-----------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t= 0.000E+00  | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 3.854E+00     | 3.765E+00 | 3.431E+00 | 3.054E+00 | 1.204E+00 | 3.763E-01 | 3.418E-05 | 3.032E-10 |
| Sr-90          | Sr-90         | 1.000E+00 | 2.140E-01     | 2.036E-01 | 1.668E-01 | 1.300E-01 | 1.773E-02 | 1.469E-03 | 3.262E-12 | 4.972E-23 |
| U-238          | U-238         | 5.450E-07 | 2.436E-07     | 2.425E-07 | 2.379E-07 | 2.324E-07 | 1.924E-07 | 1.519E-07 | 2.299E-08 | 2.170E-09 |
| U-238          | U-238         | 1.000E+00 | 4.470E-01     | 4.449E-01 | 4.366E-01 | 4.264E-01 | 3.530E-01 | 2.788E-01 | 4.219E-02 | 3.982E-03 |
| U-238          | ΣS(j):        |           | 4.470E-01     | 4.449E-01 | 4.366E-01 | 4.264E-01 | 3.530E-01 | 2.788E-01 | 4.219E-02 | 3.982E-03 |
| U-234          | U-238         | 1.000E+00 | 0.000E+00     | 1.258E-06 | 6.211E-06 | 1.223E-05 | 5.391E-05 | 9.230E-05 | 1.428E-04 | 7.710E-05 |
| Th-230         | U-238         | 1.000E+00 | 0.000E+00     | 5.790E-12 | 1.435E-10 | 5.681E-10 | 1.307E-08 | 4.718E-08 | 5.636E-07 | 1.063E-06 |
| Ra-226         | U-238         | 1.000E+00 | 0.000E+00     | 8.363E-16 | 1.037E-13 | 8.215E-13 | 9.492E-11 | 6.891E-10 | 4.160E-08 | 1.491E-07 |
| Pb-210         | U-238         | 1.000E+00 | 0.000E+00     | 6.489E-18 | 3.929E-15 | 6.045E-14 | 2.819E-11 | 3.263E-10 | 3.543E-08 | 1.385E-07 |

THF(i) is the thread fraction of the parent nuclide.

RESRAD.EXE execution time = 16.37 seconds  
 Total water/soil iteration failures = 2.

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

# Table of Contents

## Part I: Mixture Sums and Single Radionuclide Guidelines

|                                                            |    |
|------------------------------------------------------------|----|
| Dose Conversion Factor (and Related) Parameter Summary ... | 2  |
| Site-Specific Parameter Summary .....                      | 5  |
| Summary of Pathway Selections .....                        | 10 |
| Contaminated Zone and Total Dose Summary .....             | 11 |
| Total Dose Components                                      |    |
| Time = 0.000E+00 .....                                     | 12 |
| Time = 1.000E+00 .....                                     | 13 |
| Time = 5.000E+00 .....                                     | 14 |
| Time = 1.000E+01 .....                                     | 15 |
| Time = 5.000E+01 .....                                     | 16 |
| Time = 1.000E+02 .....                                     | 17 |
| Time = 5.000E+02 .....                                     | 18 |
| Time = 1.000E+03 .....                                     | 19 |
| Dose/Source Ratios Summed Over All Pathways .....          | 20 |
| Single Radionuclide Soil Guidelines .....                  | 20 |
| Dose Per Nuclide Summed Over All Pathways .....            | 21 |
| Soil Concentration Per Nuclide .....                       | 21 |

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| A-1  | DCF's for external ground radiation, (mrem/yr)/(pCi/g)   |                |            |                |
| A-1  | At-218 (Source: DCFPAK3.02)                              | 5.567E-05      | 5.567E-05  | DCF1( 1)       |
| A-1  | Ba-137m (Source: DCFPAK3.02)                             | 3.381E+00      | 3.381E+00  | DCF1( 2)       |
| A-1  | Bi-210 (Source: DCFPAK3.02)                              | 5.473E-03      | 5.473E-03  | DCF1( 3)       |
| A-1  | Bi-214 (Source: DCFPAK3.02)                              | 9.135E+00      | 9.135E+00  | DCF1( 4)       |
| A-1  | Cs-137 (Source: DCFPAK3.02)                              | 8.686E-04      | 8.686E-04  | DCF1( 5)       |
| A-1  | Hg-206 (Source: DCFPAK3.02)                              | 6.127E-01      | 6.127E-01  | DCF1( 6)       |
| A-1  | Pa-234 (Source: DCFPAK3.02)                              | 8.275E+00      | 8.275E+00  | DCF1( 7)       |
| A-1  | Pa-234m (Source: DCFPAK3.02)                             | 1.257E-01      | 1.257E-01  | DCF1( 8)       |
| A-1  | Pb-210 (Source: DCFPAK3.02)                              | 2.092E-03      | 2.092E-03  | DCF1( 9)       |
| A-1  | Pb-214 (Source: DCFPAK3.02)                              | 1.257E+00      | 1.257E+00  | DCF1( 10)      |
| A-1  | Po-210 (Source: DCFPAK3.02)                              | 5.641E-05      | 5.641E-05  | DCF1( 11)      |
| A-1  | Po-214 (Source: DCFPAK3.02)                              | 4.801E-04      | 4.801E-04  | DCF1( 12)      |
| A-1  | Po-218 (Source: DCFPAK3.02)                              | 9.228E-09      | 9.228E-09  | DCF1( 13)      |
| A-1  | Ra-226 (Source: DCFPAK3.02)                              | 3.176E-02      | 3.176E-02  | DCF1( 14)      |
| A-1  | Rn-218 (Source: DCFPAK3.02)                              | 4.259E-03      | 4.259E-03  | DCF1( 15)      |
| A-1  | Rn-222 (Source: DCFPAK3.02)                              | 2.130E-03      | 2.130E-03  | DCF1( 16)      |
| A-1  | Sr-90 (Source: DCFPAK3.02)                               | 6.463E-04      | 6.463E-04  | DCF1( 17)      |
| A-1  | Th-230 (Source: DCFPAK3.02)                              | 1.106E-03      | 1.106E-03  | DCF1( 18)      |
| A-1  | Th-234 (Source: DCFPAK3.02)                              | 2.316E-02      | 2.316E-02  | DCF1( 19)      |
| A-1  | Tl-206 (Source: DCFPAK3.02)                              | 1.278E-02      | 1.278E-02  | DCF1( 20)      |
| A-1  | Tl-210 (Source: DCFPAK3.02)                              | 1.677E+01      | 1.677E+01  | DCF1( 21)      |
| A-1  | U-234 (Source: DCFPAK3.02)                               | 3.456E-04      | 3.456E-04  | DCF1( 22)      |
| A-1  | U-238 (Source: DCFPAK3.02)                               | 1.713E-04      | 1.713E-04  | DCF1( 23)      |
| A-1  | Y-90 (Source: DCFPAK3.02)                                | 4.016E-02      | 4.016E-02  | DCF1( 24)      |
| B-1  | Dose conversion factors for inhalation, mrem/pCi:        |                |            |                |
| B-1  | Cs-137+D                                                 | 1.457E-04      | 1.457E-04  | DCF2( 1)       |
| B-1  | Pb-210+D                                                 | 3.708E-02      | 2.077E-02  | DCF2( 2)       |
| B-1  | Ra-226+D                                                 | 3.528E-02      | 3.517E-02  | DCF2( 3)       |
| B-1  | Sr-90+D                                                  | 5.841E-04      | 5.786E-04  | DCF2( 4)       |
| B-1  | Th-230                                                   | 3.759E-01      | 3.759E-01  | DCF2( 5)       |
| B-1  | U-234                                                    | 3.479E-02      | 3.479E-02  | DCF2( 6)       |
| B-1  | U-238                                                    | 2.973E-02      | 2.973E-02  | DCF2( 7)       |
| B-1  | U-238+D                                                  | 2.976E-02      | 2.973E-02  | DCF2( 8)       |
| D-1  | Dose conversion factors for ingestion, mrem/pCi:         |                |            |                |
| D-1  | Cs-137+D                                                 | 5.032E-05      | 5.032E-05  | DCF3( 1)       |
| D-1  | Pb-210+D                                                 | 7.057E-03      | 2.575E-03  | DCF3( 2)       |
| D-1  | Ra-226+D                                                 | 1.037E-03      | 1.036E-03  | DCF3( 3)       |
| D-1  | Sr-90+D                                                  | 1.120E-04      | 1.021E-04  | DCF3( 4)       |
| D-1  | Th-230                                                   | 7.918E-04      | 7.918E-04  | DCF3( 5)       |
| D-1  | U-234                                                    | 1.831E-04      | 1.831E-04  | DCF3( 6)       |
| D-1  | U-238                                                    | 1.650E-04      | 1.650E-04  | DCF3( 7)       |
| D-1  | U-238+D                                                  | 1.776E-04      | 1.650E-04  | DCF3( 8)       |
| D-34 | Food transfer factors:                                   |                |            |                |
| D-34 | Cs-137+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 1,1)      |
| D-34 | Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.000E-02      | 3.000E-02  | RTF( 1,2)      |
| D-34 | Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 1,3)      |

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

## Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| D-34 | Pb-210+D , plant/soil concentration ratio, dimensionless | 1.000E-02      | 1.000E-02  | RTF( 2,1)      |
| D-34 | Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-04      | 8.000E-04  | RTF( 2,2)      |
| D-34 | Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 3.000E-04      | 3.000E-04  | RTF( 2,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Ra-226+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 3,1)      |
| D-34 | Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-03      | 1.000E-03  | RTF( 3,2)      |
| D-34 | Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 1.000E-03      | 1.000E-03  | RTF( 3,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Sr-90+D , plant/soil concentration ratio, dimensionless  | 3.000E-01      | 3.000E-01  | RTF( 4,1)      |
| D-34 | Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 4,2)      |
| D-34 | Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 2.000E-03      | 2.000E-03  | RTF( 4,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Th-230 , plant/soil concentration ratio, dimensionless   | 1.000E-03      | 1.000E-03  | RTF( 5,1)      |
| D-34 | Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 1.000E-04      | 1.000E-04  | RTF( 5,2)      |
| D-34 | Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06      | 5.000E-06  | RTF( 5,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-234 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 6,1)      |
| D-34 | U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 6,2)      |
| D-34 | U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 6,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 7,1)      |
| D-34 | U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 7,2)      |
| D-34 | U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 7,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238+D , plant/soil concentration ratio, dimensionless  | 2.500E-03      | 2.500E-03  | RTF( 8,1)      |
| D-34 | U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04      | 3.400E-04  | RTF( 8,2)      |
| D-34 | U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04      | 6.000E-04  | RTF( 8,3)      |
| D-34 |                                                          |                |            |                |
| D-5  | Bioaccumulation factors, fresh water, L/kg:              |                |            |                |
| D-5  | Cs-137+D , fish                                          | 2.000E+03      | 2.000E+03  | BIOFAC( 1,1)   |
| D-5  | Cs-137+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 1,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Pb-210+D , fish                                          | 3.000E+02      | 3.000E+02  | BIOFAC( 2,1)   |
| D-5  | Pb-210+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 2,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Ra-226+D , fish                                          | 5.000E+01      | 5.000E+01  | BIOFAC( 3,1)   |
| D-5  | Ra-226+D , crustacea and mollusks                        | 2.500E+02      | 2.500E+02  | BIOFAC( 3,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Sr-90+D , fish                                           | 6.000E+01      | 6.000E+01  | BIOFAC( 4,1)   |
| D-5  | Sr-90+D , crustacea and mollusks                         | 1.000E+02      | 1.000E+02  | BIOFAC( 4,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Th-230 , fish                                            | 1.000E+02      | 1.000E+02  | BIOFAC( 5,1)   |
| D-5  | Th-230 , crustacea and mollusks                          | 5.000E+02      | 5.000E+02  | BIOFAC( 5,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-234 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 6,1)   |
| D-5  | U-234 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 6,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-238 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 7,1)   |
| D-5  | U-238 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 7,2)   |
| D-5  |                                                          |                |            |                |

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter |                          | Current   | Base      | Parameter    |
|------|-----------|--------------------------|-----------|-----------|--------------|
|      |           |                          | Value#    | Case*     | Name         |
| D-5  | U-238D    | , fish                   | 1.000E+01 | 1.000E+01 | BIOFAC( 8,1) |
| D-5  | U-238D    | , crustacea and mollusks | 6.000E+01 | 6.000E+01 | BIOFAC( 8,2) |

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.

\*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

## Site-Specific Parameter Summary

| Menu | Parameter                                       | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|-------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R011 | Area of contaminated zone (m**2)                | 1.860E+03  | 1.000E+04 | ---                                              | AREA           |
| R011 | Thickness of contaminated zone (m)              | 8.000E+00  | 2.000E+00 | ---                                              | THICK0         |
| R011 | Fraction of contamination that is submerged     | 0.000E+00  | 0.000E+00 | ---                                              | SUBMFRACT      |
| R011 | Length parallel to aquifer flow (m)             | 7.600E+01  | 1.000E+02 | ---                                              | LCZPAQ         |
| R011 | Basic radiation dose limit (mrem/yr)            | 1.500E+01  | 3.000E+01 | ---                                              | BRDL           |
| R011 | Time since placement of material (yr)           | 0.000E+00  | 0.000E+00 | ---                                              | TI             |
| R011 | Times for calculations (yr)                     | 1.000E+00  | 1.000E+00 | ---                                              | T( 2)          |
| R011 | Times for calculations (yr)                     | 5.000E+00  | 3.000E+00 | ---                                              | T( 3)          |
| R011 | Times for calculations (yr)                     | 1.000E+01  | 1.000E+01 | ---                                              | T( 4)          |
| R011 | Times for calculations (yr)                     | 5.000E+01  | 3.000E+01 | ---                                              | T( 5)          |
| R011 | Times for calculations (yr)                     | 1.000E+02  | 1.000E+02 | ---                                              | T( 6)          |
| R011 | Times for calculations (yr)                     | 5.000E+02  | 3.000E+02 | ---                                              | T( 7)          |
| R011 | Times for calculations (yr)                     | 1.000E+03  | 1.000E+03 | ---                                              | T( 8)          |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T( 9)          |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T(10)          |
| R012 | Initial principal radionuclide (pCi/g): Cs-137  | 5.050E+01  | 0.000E+00 | ---                                              | S1(1)          |
| R012 | Initial principal radionuclide (pCi/g): Sr-90   | 2.140E-01  | 0.000E+00 | ---                                              | S1(4)          |
| R012 | Initial principal radionuclide (pCi/g): U-238   | 4.470E-01  | 0.000E+00 | ---                                              | S1(7)          |
| R012 | Concentration in groundwater (pCi/L): Cs-137    | not used   | 0.000E+00 | ---                                              | W1( 1)         |
| R012 | Concentration in groundwater (pCi/L): Sr-90     | not used   | 0.000E+00 | ---                                              | W1( 4)         |
| R012 | Concentration in groundwater (pCi/L): U-238     | not used   | 0.000E+00 | ---                                              | W1( 7)         |
| R013 | Cover depth (m)                                 | 6.100E-01  | 0.000E+00 | ---                                              | COVER0         |
| R013 | Density of cover material (g/cm**3)             | 1.500E+00  | 1.500E+00 | ---                                              | DENSCV         |
| R013 | Cover depth erosion rate (m/yr)                 | 1.000E-03  | 1.000E-03 | ---                                              | VCV            |
| R013 | Density of contaminated zone (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSCZ         |
| R013 | Contaminated zone erosion rate (m/yr)           | 1.000E-03  | 1.000E-03 | ---                                              | VCZ            |
| R013 | Contaminated zone total porosity                | 3.300E-01  | 4.000E-01 | ---                                              | TPCZ           |
| R013 | Contaminated zone field capacity                | 2.400E-01  | 2.000E-01 | ---                                              | FCCZ           |
| R013 | Contaminated zone hydraulic conductivity (m/yr) | 5.000E+03  | 1.000E+01 | ---                                              | HCCZ           |
| R013 | Contaminated zone b parameter                   | 4.900E+00  | 5.300E+00 | ---                                              | BCZ            |
| R013 | Average annual wind speed (m/sec)               | 6.230E+00  | 2.000E+00 | ---                                              | WIND           |
| R013 | Humidity in air (g/m**3)                        | not used   | 8.000E+00 | ---                                              | HUMID          |
| R013 | Evapotranspiration coefficient                  | 4.600E-01  | 5.000E-01 | ---                                              | EVAPTR         |
| R013 | Precipitation (m/yr)                            | 1.230E+00  | 1.000E+00 | ---                                              | PRECIP         |
| R013 | Irrigation (m/yr)                               | 2.600E-01  | 2.000E-01 | ---                                              | RI             |
| R013 | Irrigation mode                                 | overhead   | overhead  | ---                                              | IDITCH         |
| R013 | Runoff coefficient                              | 2.000E-01  | 2.000E-01 | ---                                              | RUNOFF         |
| R013 | Watershed area for nearby stream or pond (m**2) | 1.000E+06  | 1.000E+06 | ---                                              | WAREA          |
| R013 | Accuracy for water/soil computations            | 1.000E-03  | 1.000E-03 | ---                                              | EPS            |
| R014 | Density of saturated zone (g/cm**3)             | 1.660E+00  | 1.500E+00 | ---                                              | DENSAQ         |
| R014 | Saturated zone total porosity                   | 3.300E-01  | 4.000E-01 | ---                                              | TPSZ           |
| R014 | Saturated zone effective porosity               | 2.400E-01  | 2.000E-01 | ---                                              | EPSZ           |
| R014 | Saturated zone field capacity                   | 2.000E-01  | 2.000E-01 | ---                                              | FCSZ           |
| R014 | Saturated zone hydraulic conductivity (m/yr)    | 2.000E+04  | 1.000E+02 | ---                                              | HCSZ           |
| R014 | Saturated zone hydraulic gradient               | 4.800E-03  | 2.000E-02 | ---                                              | HGWT           |
| R014 | Saturated zone b parameter                      | 4.900E+00  | 5.300E+00 | ---                                              | BSZ            |
| R014 | Water table drop rate (m/yr)                    | 1.000E-03  | 1.000E-03 | ---                                              | VWT            |

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R014 | Well pump intake depth (m below water table)   | 1.800E+01  | 1.000E+01 | ---                                              | DWIBWT         |
| R014 | Model: Nondispersion (ND) or Mass-Balance (MB) | ND         | ND        | ---                                              | MODEL          |
| R014 | Well pumping rate (m**3/yr)                    | 2.500E+02  | 2.500E+02 | ---                                              | UW             |
| R015 | Number of unsaturated zone strata              | 1          | 1         | ---                                              | NS             |
| R015 | Unsat. zone 1, thickness (m)                   | 0.000E+00  | 4.000E+00 | ---                                              | H (1)          |
| R015 | Unsat. zone 1, soil density (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSUZ (1)     |
| R015 | Unsat. zone 1, total porosity                  | 3.300E-01  | 4.000E-01 | ---                                              | TPUZ (1)       |
| R015 | Unsat. zone 1, effective porosity              | 2.400E-01  | 2.000E-01 | ---                                              | EPUZ (1)       |
| R015 | Unsat. zone 1, field capacity                  | 2.000E-01  | 2.000E-01 | ---                                              | FCUZ (1)       |
| R015 | Unsat. zone 1, soil-specific b parameter       | 4.900E+00  | 5.300E+00 | ---                                              | BUZ (1)        |
| R015 | Unsat. zone 1, hydraulic conductivity (m/yr)   | 5.000E+03  | 1.000E+01 | ---                                              | HCUZ (1)       |
| R016 | Distribution coefficients for Cs-137           |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCC ( 1)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCU ( 1,1)  |
| R016 | Saturated zone (cm**3/g)                       | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCS ( 1)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.806E-04                                        | ALEACH ( 1)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 1)    |
| R016 | Distribution coefficients for Sr-90            |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 3.000E+01  | 3.000E+01 | ---                                              | DCNUCC ( 4)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 3.000E+01  | 3.000E+01 | ---                                              | DCNUCU ( 4,1)  |
| R016 | Saturated zone (cm**3/g)                       | 3.000E+01  | 3.000E+01 | ---                                              | DCNUCS ( 4)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.678E-03                                        | ALEACH ( 4)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 4)    |
| R016 | Distribution coefficients for U-238            |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCC ( 7)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCU ( 7,1)  |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCS ( 7)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.009E-03                                        | ALEACH ( 7)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 7)    |
| R016 | Distribution coefficients for daughter Pb-210  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCC ( 2)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCU ( 2,1)  |
| R016 | Saturated zone (cm**3/g)                       | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCS ( 2)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 5.051E-04                                        | ALEACH ( 2)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 2)    |
| R016 | Distribution coefficients for daughter Ra-226  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 7.000E+01  | 7.000E+01 | ---                                              | DCNUCC ( 3)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 7.000E+01  | 7.000E+01 | ---                                              | DCNUCU ( 3,1)  |
| R016 | Saturated zone (cm**3/g)                       | 7.000E+01  | 7.000E+01 | ---                                              | DCNUCS ( 3)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 7.211E-04                                        | ALEACH ( 3)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 3)    |

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R016 | Distribution coefficients for daughter Th-230  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCC ( 5)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCU ( 5,1)  |
| R016 | Saturated zone (cm**3/g)                       | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCS ( 5)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 8.431E-07                                        | ALEACH ( 5)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 5)    |
| R016 | Distribution coefficients for daughter U-234   |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCC ( 6)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCU ( 6,1)  |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCS ( 6)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.009E-03                                        | ALEACH ( 6)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 6)    |
| R017 | Inhalation rate (m**3/yr)                      | 7.300E+03  | 8.400E+03 | ---                                              | INHALR         |
| R017 | Mass loading for inhalation (g/m**3)           | 1.000E-04  | 1.000E-04 | ---                                              | MLINH          |
| R017 | Exposure duration                              | 3.000E+01  | 3.000E+01 | ---                                              | ED             |
| R017 | Shielding factor, inhalation                   | 4.000E-01  | 4.000E-01 | ---                                              | SHF3           |
| R017 | Shielding factor, external gamma               | 8.000E-01  | 7.000E-01 | ---                                              | SHF1           |
| R017 | Fraction of time spent indoors                 | 5.000E-01  | 5.000E-01 | ---                                              | FIND           |
| R017 | Fraction of time spent outdoors (on site)      | 2.500E-01  | 2.500E-01 | ---                                              | FOTD           |
| R017 | Shape factor flag, external gamma              | 1.000E+00  | 1.000E+00 | >0 shows circular AREA.                          | FS             |
| R017 | Radii of shape factor array (used if FS = -1): |            |           |                                                  |                |
| R017 | Outer annular radius (m), ring 1:              | not used   | 5.000E+01 | ---                                              | RAD_SHAPE ( 1) |
| R017 | Outer annular radius (m), ring 2:              | not used   | 7.071E+01 | ---                                              | RAD_SHAPE ( 2) |
| R017 | Outer annular radius (m), ring 3:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 3) |
| R017 | Outer annular radius (m), ring 4:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 4) |
| R017 | Outer annular radius (m), ring 5:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 5) |
| R017 | Outer annular radius (m), ring 6:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 6) |
| R017 | Outer annular radius (m), ring 7:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 7) |
| R017 | Outer annular radius (m), ring 8:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 8) |
| R017 | Outer annular radius (m), ring 9:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 9) |
| R017 | Outer annular radius (m), ring 10:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(10)  |
| R017 | Outer annular radius (m), ring 11:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(11)  |
| R017 | Outer annular radius (m), ring 12:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(12)  |
| R017 | Fractions of annular areas within AREA:        |            |           |                                                  |                |
| R017 | Ring 1                                         | not used   | 1.000E+00 | ---                                              | FRACA ( 1)     |
| R017 | Ring 2                                         | not used   | 2.732E-01 | ---                                              | FRACA ( 2)     |
| R017 | Ring 3                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 3)     |
| R017 | Ring 4                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 4)     |
| R017 | Ring 5                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 5)     |
| R017 | Ring 6                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 6)     |
| R017 | Ring 7                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 7)     |
| R017 | Ring 8                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 8)     |
| R017 | Ring 9                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 9)     |
| R017 | Ring 10                                        | not used   | 0.000E+00 | ---                                              | FRACA(10)      |
| R017 | Ring 11                                        | not used   | 0.000E+00 | ---                                              | FRACA(11)      |
| R017 | Ring 12                                        | not used   | 0.000E+00 | ---                                              | FRACA(12)      |



Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|--------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R018 | Fruits, vegetables and grain consumption (kg/yr) | 1.600E+02  | 1.600E+02 | ---                                              | DIET (1)       |
| R018 | Leafy vegetable consumption (kg/yr)              | 1.400E+01  | 1.400E+01 | ---                                              | DIET (2)       |
| R018 | Milk consumption (L/yr)                          | not used   | 9.200E+01 | ---                                              | DIET (3)       |
| R018 | Meat and poultry consumption (kg/yr)             | not used   | 6.300E+01 | ---                                              | DIET (4)       |
| R018 | Fish consumption (kg/yr)                         | not used   | 5.400E+00 | ---                                              | DIET (5)       |
| R018 | Other seafood consumption (kg/yr)                | not used   | 9.000E-01 | ---                                              | DIET (6)       |
| R018 | Soil ingestion rate (g/yr)                       | 4.380E+01  | 3.650E+01 | ---                                              | SOIL           |
| R018 | Drinking water intake (L/yr)                     | 7.000E+02  | 5.100E+02 | ---                                              | DWI            |
| R018 | Contamination fraction of drinking water         | 1.000E+00  | 1.000E+00 | ---                                              | FDW            |
| R018 | Contamination fraction of household water        | not used   | 1.000E+00 | ---                                              | FHHW           |
| R018 | Contamination fraction of livestock water        | not used   | 1.000E+00 | ---                                              | FLW            |
| R018 | Contamination fraction of irrigation water       | 1.000E+00  | 1.000E+00 | ---                                              | FIRW           |
| R018 | Contamination fraction of aquatic food           | not used   | 5.000E-01 | ---                                              | FR9            |
| R018 | Contamination fraction of plant food             | -1         | -1        | 0.500E+00                                        | FPLANT         |
| R018 | Contamination fraction of meat                   | not used   | -1        | ---                                              | FMEAT          |
| R018 | Contamination fraction of milk                   | not used   | -1        | ---                                              | FMILK          |
|      |                                                  |            |           |                                                  |                |
| R019 | Livestock fodder intake for meat (kg/day)        | not used   | 6.800E+01 | ---                                              | LFI5           |
| R019 | Livestock fodder intake for milk (kg/day)        | not used   | 5.500E+01 | ---                                              | LFI6           |
| R019 | Livestock water intake for meat (L/day)          | not used   | 5.000E+01 | ---                                              | LWI5           |
| R019 | Livestock water intake for milk (L/day)          | not used   | 1.600E+02 | ---                                              | LWI6           |
| R019 | Livestock soil intake (kg/day)                   | not used   | 5.000E-01 | ---                                              | LSI            |
| R019 | Mass loading for foliar deposition (g/m**3)      | 1.000E-05  | 1.000E-04 | ---                                              | MLFD           |
| R019 | Depth of soil mixing layer (m)                   | 1.500E-01  | 1.500E-01 | ---                                              | DM             |
| R019 | Depth of roots (m)                               | 9.000E-01  | 9.000E-01 | ---                                              | DROOT          |
| R019 | Drinking water fraction from ground water        | 1.000E+00  | 1.000E+00 | ---                                              | FGWDW          |
| R019 | Household water fraction from ground water       | not used   | 1.000E+00 | ---                                              | FGWHH          |
| R019 | Livestock water fraction from ground water       | not used   | 1.000E+00 | ---                                              | FGWLW          |
| R019 | Irrigation fraction from ground water            | 1.000E+00  | 1.000E+00 | ---                                              | FGWIR          |
|      |                                                  |            |           |                                                  |                |
| R19B | Wet weight crop yield for Non-Leafy (kg/m**2)    | 7.000E-01  | 7.000E-01 | ---                                              | YV (1)         |
| R19B | Wet weight crop yield for Leafy (kg/m**2)        | 1.500E+00  | 1.500E+00 | ---                                              | YV (2)         |
| R19B | Wet weight crop yield for Fodder (kg/m**2)       | not used   | 1.100E+00 | ---                                              | YV (3)         |
| R19B | Growing Season for Non-Leafy (years)             | 1.700E-01  | 1.700E-01 | ---                                              | TE (1)         |
| R19B | Growing Season for Leafy (years)                 | 2.500E-01  | 2.500E-01 | ---                                              | TE (2)         |
| R19B | Growing Season for Fodder (years)                | not used   | 8.000E-02 | ---                                              | TE (3)         |
| R19B | Translocation Factor for Non-Leafy               | 1.000E-01  | 1.000E-01 | ---                                              | TIV (1)        |
| R19B | Translocation Factor for Leafy                   | 1.000E+00  | 1.000E+00 | ---                                              | TIV (2)        |
| R19B | Translocation Factor for Fodder                  | not used   | 1.000E+00 | ---                                              | TIV (3)        |
| R19B | Dry Foliar Interception Fraction for Non-Leafy   | 2.500E-01  | 2.500E-01 | ---                                              | RDRY (1)       |
| R19B | Dry Foliar Interception Fraction for Leafy       | 2.500E-01  | 2.500E-01 | ---                                              | RDRY (2)       |
| R19B | Dry Foliar Interception Fraction for Fodder      | not used   | 2.500E-01 | ---                                              | RDRY (3)       |
| R19B | Wet Foliar Interception Fraction for Non-Leafy   | 2.500E-01  | 2.500E-01 | ---                                              | RWET (1)       |
| R19B | Wet Foliar Interception Fraction for Leafy       | 2.500E-01  | 2.500E-01 | ---                                              | RWET (2)       |
| R19B | Wet Foliar Interception Fraction for Fodder      | not used   | 2.500E-01 | ---                                              | RWET (3)       |
| R19B | Weathering Removal Constant for Vegetation       | 2.000E+01  | 2.000E+01 | ---                                              | WLAM           |
|      |                                                  |            |           |                                                  |                |
| C14  | C-12 concentration in water (g/cm**3)            | not used   | 2.000E-05 | ---                                              | C12WTR         |
| C14  | C-12 concentration in contaminated soil (g/g)    | not used   | 3.000E-02 | ---                                              | C12CZ          |
| C14  | Fraction of vegetation carbon from soil          | not used   | 2.000E-02 | ---                                              | CSOIL          |

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User<br>Input | Default    | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|------|--------------------------------------------------|---------------|------------|--------------------------------------------------|-------------------|
| C14  | Fraction of vegetation carbon from air           | not used      | 9.800E-01  | ---                                              | CAIR              |
| C14  | C-14 evasion layer thickness in soil (m)         | not used      | 3.000E-01  | ---                                              | DMC               |
| C14  | C-14 evasion flux rate from soil (1/sec)         | not used      | 7.000E-07  | ---                                              | EVSN              |
| C14  | C-12 evasion flux rate from soil (1/sec)         | not used      | 1.000E-10  | ---                                              | REVSN             |
| C14  | Fraction of grain in beef cattle feed            | not used      | 8.000E-01  | ---                                              | AVFG4             |
| C14  | Fraction of grain in milk cow feed               | not used      | 2.000E-01  | ---                                              | AVFG5             |
| STOR | Storage times of contaminated foodstuffs (days): |               |            |                                                  |                   |
| STOR | Fruits, non-leafy vegetables, and grain          | 1.400E+01     | 1.400E+01  | ---                                              | STOR_T (1)        |
| STOR | Leafy vegetables                                 | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T (2)        |
| STOR | Milk                                             | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T (3)        |
| STOR | Meat and poultry                                 | 2.000E+01     | 2.000E+01  | ---                                              | STOR_T (4)        |
| STOR | Fish                                             | 7.000E+00     | 7.000E+00  | ---                                              | STOR_T (5)        |
| STOR | Crustacea and mollusks                           | 7.000E+00     | 7.000E+00  | ---                                              | STOR_T (6)        |
| STOR | Well water                                       | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T (7)        |
| STOR | Surface water                                    | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T (8)        |
| STOR | Livestock fodder                                 | 4.500E+01     | 4.500E+01  | ---                                              | STOR_T (9)        |
| R021 | Thickness of building foundation (m)             | not used      | 1.500E-01  | ---                                              | FLOOR1            |
| R021 | Bulk density of building foundation (g/cm**3)    | not used      | 2.400E+00  | ---                                              | DENSFL            |
| R021 | Total porosity of the cover material             | not used      | 4.000E-01  | ---                                              | TPCV              |
| R021 | Total porosity of the building foundation        | not used      | 1.000E-01  | ---                                              | TPFL              |
| R021 | Volumetric water content of the cover material   | not used      | 5.000E-02  | ---                                              | PH2OCV            |
| R021 | Volumetric water content of the foundation       | not used      | 3.000E-02  | ---                                              | PH2OFL            |
| R021 | Diffusion coefficient for radon gas (m/sec):     |               |            |                                                  |                   |
| R021 | in cover material                                | not used      | 2.000E-06  | ---                                              | DIFCV             |
| R021 | in foundation material                           | not used      | 3.000E-07  | ---                                              | DIFFL             |
| R021 | in contaminated zone soil                        | not used      | 2.000E-06  | ---                                              | DIFCZ             |
| R021 | Radon vertical dimension of mixing (m)           | not used      | 2.000E+00  | ---                                              | HMIX              |
| R021 | Average building air exchange rate (1/hr)        | not used      | 5.000E-01  | ---                                              | REXG              |
| R021 | Height of the building (room) (m)                | not used      | 2.500E+00  | ---                                              | HRM               |
| R021 | Building interior area factor                    | not used      | 0.000E+00  | ---                                              | FAI               |
| R021 | Building depth below ground surface (m)          | not used      | -1.000E+00 | ---                                              | DMFL              |
| R021 | Emanating power of Rn-222 gas                    | not used      | 2.500E-01  | ---                                              | EMANA (1)         |
| R021 | Emanating power of Rn-220 gas                    | not used      | 1.500E-01  | ---                                              | EMANA (2)         |
| TITL | Number of graphical time points                  | 32            | ---        | ---                                              | NPTS              |
| TITL | Maximum number of integration points for dose    | 17            | ---        | ---                                              | LYMAX             |
| TITL | Maximum number of integration points for risk    | 65            | ---        | ---                                              | KYMAX             |

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

## Summary of Pathway Selections

| Pathway                     | User Selection |
|-----------------------------|----------------|
| 1 -- external gamma         | active         |
| 2 -- inhalation (w/o radon) | active         |
| 3 -- plant ingestion        | active         |
| 4 -- meat ingestion         | suppressed     |
| 5 -- milk ingestion         | suppressed     |
| 6 -- aquatic foods          | suppressed     |
| 7 -- drinking water         | active         |
| 8 -- soil ingestion         | active         |
| 9 -- radon                  | suppressed     |
| Find peak pathway doses     | active         |

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

| Contaminated Zone Dimensions |                       | Initial Soil Concentrations, pCi/g |           |
|------------------------------|-----------------------|------------------------------------|-----------|
| Area:                        | 1860.00 square meters | Cs-137                             | 5.050E+01 |
| Thickness:                   | 8.00 meters           | Sr-90                              | 2.140E-01 |
| Cover Depth:                 | 0.61 meters           | U-238                              | 4.470E-01 |

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 1.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

|            |           |           |           |           |           |           |           |           |
|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| t (years): | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| TDOSE(t):  | 3.051E+00 | 2.993E+00 | 2.771E+00 | 2.517E+00 | 1.168E+00 | 4.486E-01 | 3.756E-02 | 3.684E-02 |
| M(t):      | 2.034E-01 | 1.995E-01 | 1.847E-01 | 1.678E-01 | 7.787E-02 | 2.990E-02 | 2.504E-03 | 2.456E-03 |

Maximum TDOSE(t): 3.051E+00 mrem/yr at t = 0.000E+00 years

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.385E-02 | 0.0078 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.821E+00 | 0.9247 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 5.990E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.994E-01 | 0.0654 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 1.145E-05 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 5.569E-03 | 0.0018 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 2.386E-02 | 0.0078 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 3.026E+00 | 0.9919 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.697E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.127E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.845E+00     | 0.9326 |
| Sr-90             | 2.638E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.965E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.997E-01     | 0.0654 |
| U-238             | 3.087E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.131E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.911E-03     | 0.0019 |
| Total             | 7.422E-04 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.223E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.051E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.363E-02 | 0.0079 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.766E+00 | 0.9243 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 5.942E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.950E-01 | 0.0652 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 1.159E-05 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 5.583E-03 | 0.0019 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 2.364E-02 | 0.0079 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.967E+00 | 0.9913 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 5.016E-04 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.551E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.790E+00     | 0.9324 |
| Sr-90             | 7.764E-04 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.974E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.958E-01     | 0.0654 |
| U-238             | 9.288E-04 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.629E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.589E-03     | 0.0022 |
| Total             | 2.207E-03 | 0.0007 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.615E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.993E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.274E-02 | 0.0082 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.556E+00 | 0.9224 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 5.751E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.783E-01 | 0.0644 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 1.216E-05 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 5.636E-03 | 0.0020 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 2.275E-02 | 0.0082 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.740E+00 | 0.9888 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.683E-03 | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.226E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.581E+00     | 0.9313 |
| Sr-90             | 2.584E-03 | 0.0009 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.017E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.811E-01     | 0.0654 |
| U-238             | 3.404E-03 | 0.0012 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.467E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.299E-03     | 0.0034 |
| Total             | 7.671E-03 | 0.0028 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.710E-04 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.771E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.167E-02 | 0.0086 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.315E+00 | 0.9199 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 5.522E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.594E-01 | 0.0633 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 1.291E-05 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 5.703E-03 | 0.0023 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 2.169E-02 | 0.0086 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.480E+00 | 0.9855 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 2.866E-03 | 0.0011 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.097E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.340E+00     | 0.9297 |
| Sr-90             | 4.357E-03 | 0.0017 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.411E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.641E-01     | 0.0652 |
| U-238             | 6.486E-03 | 0.0026 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.712E-04 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.267E-02     | 0.0050 |
| Total             | 1.371E-02 | 0.0054 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.022E-03 | 0.0004 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.517E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.



Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 1.477E-02 | 0.0126 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.039E+00 | 0.8894 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 3.987E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 6.448E-02 | 0.0552 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 2.092E-05 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 6.207E-03 | 0.0053 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 1.479E-02 | 0.0127 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.110E+00 | 0.9499 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 5.492E-03 | 0.0047 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.036E-04 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.060E+00     | 0.9071 |
| Sr-90             | 4.612E-03 | 0.0039 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.621E-04 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.946E-02     | 0.0595 |
| U-238             | 3.064E-02 | 0.0262 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.231E-03 | 0.0019 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.910E-02     | 0.0335 |
| Total             | 4.074E-02 | 0.0349 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.997E-03 | 0.0026 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.168E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 9.149E-03 | 0.0204 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 3.743E-01 | 0.8344 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 2.654E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.040E-02 | 0.0455 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 3.824E-05 | 0.0001 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 6.770E-03 | 0.0151 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 9.187E-03 | 0.0205 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 4.015E-01 | 0.8950 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 3.457E-03 | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.542E-04 | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.872E-01     | 0.8631 |
| Sr-90             | 1.278E-03 | 0.0028 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.004E-04 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.178E-02     | 0.0486 |
| U-238             | 3.059E-02 | 0.0682 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.229E-03 | 0.0050 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.963E-02     | 0.0884 |
| Total             | 3.533E-02 | 0.0788 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.584E-03 | 0.0058 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.486E-01     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 1.980E-04 | 0.0053 | 3.238E-10  | 0.0000 | 0.000E+00 | 0.0000 | 7.189E-05 | 0.0019 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.086E-07 | 0.0000 |
| Sr-90             | 1.032E-09 | 0.0000 | 1.500E-12  | 0.0000 | 0.000E+00 | 0.0000 | 1.387E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.366E-10 | 0.0000 |
| U-238             | 4.893E-03 | 0.1303 | 3.824E-05  | 0.0010 | 0.000E+00 | 0.0000 | 9.166E-03 | 0.2440 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.255E-04 | 0.0113 |
| Total             | 5.091E-03 | 0.1355 | 3.824E-05  | 0.0010 | 0.000E+00 | 0.0000 | 9.239E-03 | 0.2460 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.257E-04 | 0.0113 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.725E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.269E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.720E-04     | 0.0072 |
| Sr-90             | 4.451E-08 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.495E-09 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.437E-06     | 0.0000 |
| U-238             | 2.122E-02 | 0.5649 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.546E-03 | 0.0412 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.729E-02     | 0.9927 |
| Total             | 2.122E-02 | 0.5650 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.546E-03 | 0.0412 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.756E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 8.146E-09 | 0.0000 | 1.123E-14  | 0.0000 | 0.000E+00 | 0.0000 | 7.663E-10 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.234E-12 | 0.0000 |
| Sr-90             | 3.306E-14 | 0.0000 | 1.420E-17  | 0.0000 | 0.000E+00 | 0.0000 | 4.037E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.080E-15 | 0.0000 |
| U-238             | 1.558E-02 | 0.4228 | 8.567E-05  | 0.0023 | 0.000E+00 | 0.0000 | 6.315E-03 | 0.1714 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.533E-04 | 0.0259 |
| Total             | 1.558E-02 | 0.4228 | 8.567E-05  | 0.0023 | 0.000E+00 | 0.0000 | 6.315E-03 | 0.1714 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.533E-04 | 0.0259 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.824E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.342E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.939E-09     | 0.0000 |
| Sr-90             | 1.143E-13 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.972E-15 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.198E-12     | 0.0000 |
| U-238             | 1.296E-02 | 0.3519 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.446E-04 | 0.0256 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.684E-02     | 1.0000 |
| Total             | 1.296E-02 | 0.3519 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.446E-04 | 0.0256 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.684E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

| Parent<br>(i) | Product<br>(j) | Thread<br>Fraction | DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) |           |           |           |           |           |           |           |
|---------------|----------------|--------------------|---------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               |                |                    | 0.000E+00                                   | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137+D      | Cs-137+D       | 1.000E+00          | 5.634E-02                                   | 5.525E-02 | 5.110E-02 | 4.633E-02 | 2.098E-02 | 7.666E-03 | 5.386E-06 | 1.770E-10 |
| Sr-90+D       | Sr-90+D        | 1.000E+00          | 9.331E-01                                   | 9.151E-01 | 8.463E-01 | 7.669E-01 | 3.246E-01 | 1.018E-01 | 6.713E-06 | 1.962E-11 |
| U-238         | U-238          | 5.450E-07          | 6.684E-09                                   | 7.453E-09 | 1.052E-08 | 1.434E-08 | 4.427E-08 | 4.485E-08 | 3.666E-08 | 2.405E-08 |
| U-238+D       | U-238+D        | 1.000E+00          | 1.322E-02                                   | 1.474E-02 | 2.080E-02 | 2.835E-02 | 8.746E-02 | 8.864E-02 | 8.331E-02 | 8.226E-02 |
| U-238+D       | U-234          | 1.000E+00          | 1.958E-08                                   | 6.465E-08 | 3.332E-07 | 8.664E-07 | 1.286E-05 | 2.591E-05 | 1.054E-04 | 1.383E-04 |
| U-238+D       | Th-230         | 1.000E+00          | 1.427E-13                                   | 8.346E-13 | 9.409E-12 | 3.392E-11 | 8.457E-10 | 3.694E-09 | 1.625E-07 | 6.965E-07 |
| U-238+D       | Ra-226+D       | 1.000E+00          | 3.601E-11                                   | 1.220E-10 | 3.847E-10 | 8.501E-10 | 4.322E-09 | 7.288E-09 | 8.320E-07 | 8.762E-06 |
| U-238+D       | Pb-210+D       | 1.000E+00          | 1.710E-10                                   | 5.792E-10 | 1.822E-09 | 4.022E-09 | 1.909E-08 | 2.274E-08 | 9.473E-07 | 6.377E-06 |
| U-238+D       | ΣDSR(j)        |                    | 1.322E-02                                   | 1.474E-02 | 2.080E-02 | 2.835E-02 | 8.747E-02 | 8.866E-02 | 8.341E-02 | 8.241E-02 |

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

| Nuclide<br>(i) | t=        | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Cs-137         | 2.662E+02 | 2.715E+02 | 2.935E+02 | 3.237E+02 | 7.149E+02 | 1.957E+03 | 2.785E+06 | 8.474E+10 |           |
| Sr-90          | 1.608E+01 | 1.639E+01 | 1.772E+01 | 1.956E+01 | 4.622E+01 | 1.474E+02 | 2.234E+06 | 7.646E+11 |           |
| U-238          | 1.134E+03 | 1.018E+03 | 7.210E+02 | 5.291E+02 | 1.715E+02 | 1.692E+02 | 1.798E+02 | 1.820E+02 |           |

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
at tmin = time of minimum single radionuclide soil guideline  
and at tmax = time of maximum total dose = 0.000E+00 years

| Nuclide<br>(i) | Initial<br>(pCi/g) | tmin<br>(years) | DSR(i,tmin) | G(i,tmin)<br>(pCi/g) | DSR(i,tmax) | G(i,tmax)<br>(pCi/g) |
|----------------|--------------------|-----------------|-------------|----------------------|-------------|----------------------|
| Cs-137         | 5.050E+01          | 0.000E+00       | 5.634E-02   | 2.662E+02            | 5.634E-02   | 2.662E+02            |
| Sr-90          | 2.140E-01          | 0.000E+00       | 9.331E-01   | 1.608E+01            | 9.331E-01   | 1.608E+01            |
| U-238          | 4.470E-01          | 610 ± 1         | 1.220E-01   | 1.229E+02            | 1.322E-02   | 1.134E+03            |

Summary : 811 area-Resident-deep-Bkdg subtract-F

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-BKD SUBTR-DEEP-F.RAD

Individual Nuclide Dose Summed Over All Pathways  
Parent Nuclide and Branch Fraction Indicated

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | DOSE(j,t), mrem/yr |           |           |           |           |           |           |           |
|----------------|---------------|-----------|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t= 0.000E+00       | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 2.845E+00          | 2.790E+00 | 2.581E+00 | 2.340E+00 | 1.060E+00 | 3.872E-01 | 2.720E-04 | 8.939E-09 |
| Sr-90          | Sr-90         | 1.000E+00 | 1.997E-01          | 1.958E-01 | 1.811E-01 | 1.641E-01 | 6.946E-02 | 2.178E-02 | 1.437E-06 | 4.198E-12 |
| U-238          | U-238         | 5.450E-07 | 2.988E-09          | 3.331E-09 | 4.704E-09 | 6.412E-09 | 1.979E-08 | 2.005E-08 | 1.639E-08 | 1.075E-08 |
| U-238          | U-238         | 1.000E+00 | 5.911E-03          | 6.589E-03 | 9.299E-03 | 1.267E-02 | 3.909E-02 | 3.962E-02 | 3.724E-02 | 3.677E-02 |
| U-238          | ΣDOSE(j)      |           | 5.911E-03          | 6.589E-03 | 9.299E-03 | 1.267E-02 | 3.909E-02 | 3.962E-02 | 3.724E-02 | 3.677E-02 |
| U-234          | U-238         | 1.000E+00 | 8.754E-09          | 2.890E-08 | 1.489E-07 | 3.873E-07 | 5.746E-06 | 1.158E-05 | 4.712E-05 | 6.181E-05 |
| Th-230         | U-238         | 1.000E+00 | 6.377E-14          | 3.731E-13 | 4.206E-12 | 1.516E-11 | 3.780E-10 | 1.651E-09 | 7.264E-08 | 3.113E-07 |
| Ra-226         | U-238         | 1.000E+00 | 1.610E-11          | 5.453E-11 | 1.720E-10 | 3.800E-10 | 1.932E-09 | 3.258E-09 | 3.719E-07 | 3.917E-06 |
| Pb-210         | U-238         | 1.000E+00 | 7.643E-11          | 2.589E-10 | 8.143E-10 | 1.798E-09 | 8.534E-09 | 1.017E-08 | 4.235E-07 | 2.850E-06 |

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration  
Parent Nuclide and Branch Fraction Indicated

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | S(j,t), pCi/g |           |           |           |           |           |           |           |
|----------------|---------------|-----------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t= 0.000E+00  | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 5.050E+01     | 4.934E+01 | 4.498E+01 | 4.006E+01 | 1.586E+01 | 4.984E+00 | 4.728E-04 | 4.427E-09 |
| Sr-90          | Sr-90         | 1.000E+00 | 2.140E-01     | 2.086E-01 | 1.881E-01 | 1.654E-01 | 5.904E-02 | 1.629E-02 | 5.470E-07 | 1.398E-12 |
| U-238          | U-238         | 5.450E-07 | 2.436E-07     | 2.434E-07 | 2.424E-07 | 2.412E-07 | 2.316E-07 | 2.202E-07 | 1.471E-07 | 8.884E-08 |
| U-238          | U-238         | 1.000E+00 | 4.470E-01     | 4.465E-01 | 4.448E-01 | 4.425E-01 | 4.250E-01 | 4.041E-01 | 2.699E-01 | 1.630E-01 |
| U-238          | ΣS(j):        |           | 4.470E-01     | 4.465E-01 | 4.448E-01 | 4.425E-01 | 4.250E-01 | 4.041E-01 | 2.699E-01 | 1.630E-01 |
| U-234          | U-238         | 1.000E+00 | 0.000E+00     | 1.261E-06 | 6.279E-06 | 1.249E-05 | 6.000E-05 | 1.141E-04 | 3.808E-04 | 4.596E-04 |
| Th-230         | U-238         | 1.000E+00 | 0.000E+00     | 5.799E-12 | 1.446E-10 | 5.763E-10 | 1.402E-08 | 5.424E-08 | 1.042E-06 | 3.036E-06 |
| Ra-226         | U-238         | 1.000E+00 | 0.000E+00     | 8.373E-16 | 1.043E-13 | 8.313E-13 | 1.007E-10 | 7.740E-10 | 7.072E-08 | 3.864E-07 |
| Pb-210         | U-238         | 1.000E+00 | 0.000E+00     | 6.495E-18 | 3.949E-15 | 6.107E-14 | 2.969E-11 | 3.622E-10 | 5.918E-08 | 3.541E-07 |

THF(i) is the thread fraction of the parent nuclide.

RESRAD-ONSITE execution time = 15.45 seconds

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

|                                                            |    |
|------------------------------------------------------------|----|
| Dose Conversion Factor (and Related) Parameter Summary ... | 2  |
| Site-Specific Parameter Summary .....                      | 5  |
| Summary of Pathway Selections .....                        | 10 |
| Contaminated Zone and Total Dose Summary .....             | 11 |
| Total Dose Components                                      |    |
| Time = 0.000E+00 .....                                     | 12 |
| Time = 1.000E+00 .....                                     | 13 |
| Time = 5.000E+00 .....                                     | 14 |
| Time = 1.000E+01 .....                                     | 15 |
| Time = 5.000E+01 .....                                     | 16 |
| Time = 1.000E+02 .....                                     | 17 |
| Time = 5.000E+02 .....                                     | 18 |
| Time = 1.000E+03 .....                                     | 19 |
| Dose/Source Ratios Summed Over All Pathways .....          | 20 |
| Single Radionuclide Soil Guidelines .....                  | 20 |
| Dose Per Nuclide Summed Over All Pathways .....            | 21 |
| Soil Concentration Per Nuclide .....                       | 21 |

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| A-1  | DCF's for external ground radiation, (mrem/yr)/(pCi/g)   |                |            |                |
| A-1  | At-218 (Source: DCFPAK3.02)                              | 5.567E-05      | 5.567E-05  | DCF1( 1)       |
| A-1  | Ba-137m (Source: DCFPAK3.02)                             | 3.381E+00      | 3.381E+00  | DCF1( 2)       |
| A-1  | Bi-210 (Source: DCFPAK3.02)                              | 5.473E-03      | 5.473E-03  | DCF1( 3)       |
| A-1  | Bi-214 (Source: DCFPAK3.02)                              | 9.135E+00      | 9.135E+00  | DCF1( 4)       |
| A-1  | Cs-137 (Source: DCFPAK3.02)                              | 8.686E-04      | 8.686E-04  | DCF1( 5)       |
| A-1  | Hg-206 (Source: DCFPAK3.02)                              | 6.127E-01      | 6.127E-01  | DCF1( 6)       |
| A-1  | Pa-234 (Source: DCFPAK3.02)                              | 8.275E+00      | 8.275E+00  | DCF1( 7)       |
| A-1  | Pa-234m (Source: DCFPAK3.02)                             | 1.257E-01      | 1.257E-01  | DCF1( 8)       |
| A-1  | Pb-210 (Source: DCFPAK3.02)                              | 2.092E-03      | 2.092E-03  | DCF1( 9)       |
| A-1  | Pb-214 (Source: DCFPAK3.02)                              | 1.257E+00      | 1.257E+00  | DCF1( 10)      |
| A-1  | Po-210 (Source: DCFPAK3.02)                              | 5.641E-05      | 5.641E-05  | DCF1( 11)      |
| A-1  | Po-214 (Source: DCFPAK3.02)                              | 4.801E-04      | 4.801E-04  | DCF1( 12)      |
| A-1  | Po-218 (Source: DCFPAK3.02)                              | 9.228E-09      | 9.228E-09  | DCF1( 13)      |
| A-1  | Ra-226 (Source: DCFPAK3.02)                              | 3.176E-02      | 3.176E-02  | DCF1( 14)      |
| A-1  | Rn-218 (Source: DCFPAK3.02)                              | 4.259E-03      | 4.259E-03  | DCF1( 15)      |
| A-1  | Rn-222 (Source: DCFPAK3.02)                              | 2.130E-03      | 2.130E-03  | DCF1( 16)      |
| A-1  | Sr-90 (Source: DCFPAK3.02)                               | 6.463E-04      | 6.463E-04  | DCF1( 17)      |
| A-1  | Th-230 (Source: DCFPAK3.02)                              | 1.106E-03      | 1.106E-03  | DCF1( 18)      |
| A-1  | Th-234 (Source: DCFPAK3.02)                              | 2.316E-02      | 2.316E-02  | DCF1( 19)      |
| A-1  | Tl-206 (Source: DCFPAK3.02)                              | 1.278E-02      | 1.278E-02  | DCF1( 20)      |
| A-1  | Tl-210 (Source: DCFPAK3.02)                              | 1.677E+01      | 1.677E+01  | DCF1( 21)      |
| A-1  | U-234 (Source: DCFPAK3.02)                               | 3.456E-04      | 3.456E-04  | DCF1( 22)      |
| A-1  | U-238 (Source: DCFPAK3.02)                               | 1.713E-04      | 1.713E-04  | DCF1( 23)      |
| A-1  | Y-90 (Source: DCFPAK3.02)                                | 4.016E-02      | 4.016E-02  | DCF1( 24)      |
| B-1  | Dose conversion factors for inhalation, mrem/pCi:        |                |            |                |
| B-1  | Cs-137+D                                                 | 1.457E-04      | 1.457E-04  | DCF2( 1)       |
| B-1  | Pb-210+D                                                 | 3.708E-02      | 2.077E-02  | DCF2( 2)       |
| B-1  | Ra-226+D                                                 | 3.528E-02      | 3.517E-02  | DCF2( 3)       |
| B-1  | Sr-90+D                                                  | 5.841E-04      | 5.786E-04  | DCF2( 4)       |
| B-1  | Th-230                                                   | 3.759E-01      | 3.759E-01  | DCF2( 5)       |
| B-1  | U-234                                                    | 3.479E-02      | 3.479E-02  | DCF2( 6)       |
| B-1  | U-238                                                    | 2.973E-02      | 2.973E-02  | DCF2( 7)       |
| B-1  | U-238+D                                                  | 2.976E-02      | 2.973E-02  | DCF2( 8)       |
| D-1  | Dose conversion factors for ingestion, mrem/pCi:         |                |            |                |
| D-1  | Cs-137+D                                                 | 5.032E-05      | 5.032E-05  | DCF3( 1)       |
| D-1  | Pb-210+D                                                 | 7.057E-03      | 2.575E-03  | DCF3( 2)       |
| D-1  | Ra-226+D                                                 | 1.037E-03      | 1.036E-03  | DCF3( 3)       |
| D-1  | Sr-90+D                                                  | 1.120E-04      | 1.021E-04  | DCF3( 4)       |
| D-1  | Th-230                                                   | 7.918E-04      | 7.918E-04  | DCF3( 5)       |
| D-1  | U-234                                                    | 1.831E-04      | 1.831E-04  | DCF3( 6)       |
| D-1  | U-238                                                    | 1.650E-04      | 1.650E-04  | DCF3( 7)       |
| D-1  | U-238+D                                                  | 1.776E-04      | 1.650E-04  | DCF3( 8)       |
| D-34 | Food transfer factors:                                   |                |            |                |
| D-34 | Cs-137+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 1,1)      |
| D-34 | Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.000E-02      | 3.000E-02  | RTF( 1,2)      |
| D-34 | Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 1,3)      |



Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

## Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| D-34 | Pb-210+D , plant/soil concentration ratio, dimensionless | 1.000E-02      | 1.000E-02  | RTF( 2,1)      |
| D-34 | Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-04      | 8.000E-04  | RTF( 2,2)      |
| D-34 | Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 3.000E-04      | 3.000E-04  | RTF( 2,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Ra-226+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 3,1)      |
| D-34 | Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-03      | 1.000E-03  | RTF( 3,2)      |
| D-34 | Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 1.000E-03      | 1.000E-03  | RTF( 3,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Sr-90+D , plant/soil concentration ratio, dimensionless  | 3.000E-01      | 3.000E-01  | RTF( 4,1)      |
| D-34 | Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 4,2)      |
| D-34 | Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 2.000E-03      | 2.000E-03  | RTF( 4,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Th-230 , plant/soil concentration ratio, dimensionless   | 1.000E-03      | 1.000E-03  | RTF( 5,1)      |
| D-34 | Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 1.000E-04      | 1.000E-04  | RTF( 5,2)      |
| D-34 | Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06      | 5.000E-06  | RTF( 5,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-234 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 6,1)      |
| D-34 | U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 6,2)      |
| D-34 | U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 6,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 7,1)      |
| D-34 | U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 7,2)      |
| D-34 | U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 7,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238+D , plant/soil concentration ratio, dimensionless  | 2.500E-03      | 2.500E-03  | RTF( 8,1)      |
| D-34 | U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04      | 3.400E-04  | RTF( 8,2)      |
| D-34 | U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04      | 6.000E-04  | RTF( 8,3)      |
| D-34 |                                                          |                |            |                |
| D-5  | Bioaccumulation factors, fresh water, L/kg:              |                |            |                |
| D-5  | Cs-137+D , fish                                          | 2.000E+03      | 2.000E+03  | BIOFAC( 1,1)   |
| D-5  | Cs-137+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 1,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Pb-210+D , fish                                          | 3.000E+02      | 3.000E+02  | BIOFAC( 2,1)   |
| D-5  | Pb-210+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 2,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Ra-226+D , fish                                          | 5.000E+01      | 5.000E+01  | BIOFAC( 3,1)   |
| D-5  | Ra-226+D , crustacea and mollusks                        | 2.500E+02      | 2.500E+02  | BIOFAC( 3,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Sr-90+D , fish                                           | 6.000E+01      | 6.000E+01  | BIOFAC( 4,1)   |
| D-5  | Sr-90+D , crustacea and mollusks                         | 1.000E+02      | 1.000E+02  | BIOFAC( 4,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Th-230 , fish                                            | 1.000E+02      | 1.000E+02  | BIOFAC( 5,1)   |
| D-5  | Th-230 , crustacea and mollusks                          | 5.000E+02      | 5.000E+02  | BIOFAC( 5,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-234 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 6,1)   |
| D-5  | U-234 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 6,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-238 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 7,1)   |
| D-5  | U-238 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 7,2)   |
| D-5  |                                                          |                |            |                |

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter |                          | Current   | Base      | Parameter    |
|------|-----------|--------------------------|-----------|-----------|--------------|
|      |           |                          | Value#    | Case*     | Name         |
| D-5  | U-238+D   | , fish                   | 1.000E+01 | 1.000E+01 | BIOFAC( 8,1) |
| D-5  | U-238+D   | , crustacea and mollusks | 6.000E+01 | 6.000E+01 | BIOFAC( 8,2) |

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.

\*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

## Site-Specific Parameter Summary

| Menu | Parameter                                       | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|-------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R011 | Area of contaminated zone (m**2)                | 1.860E+03  | 1.000E+04 | ---                                              | AREA           |
| R011 | Thickness of contaminated zone (m)              | 8.000E+00  | 2.000E+00 | ---                                              | THICK0         |
| R011 | Fraction of contamination that is submerged     | 0.000E+00  | 0.000E+00 | ---                                              | SUBMFRACT      |
| R011 | Length parallel to aquifer flow (m)             | 7.600E+01  | 1.000E+02 | ---                                              | LCZPAQ         |
| R011 | Basic radiation dose limit (mrem/yr)            | 1.500E+01  | 3.000E+01 | ---                                              | BRDL           |
| R011 | Time since placement of material (yr)           | 0.000E+00  | 0.000E+00 | ---                                              | TI             |
| R011 | Times for calculations (yr)                     | 1.000E+00  | 1.000E+00 | ---                                              | T( 2)          |
| R011 | Times for calculations (yr)                     | 5.000E+00  | 3.000E+00 | ---                                              | T( 3)          |
| R011 | Times for calculations (yr)                     | 1.000E+01  | 1.000E+01 | ---                                              | T( 4)          |
| R011 | Times for calculations (yr)                     | 5.000E+01  | 3.000E+01 | ---                                              | T( 5)          |
| R011 | Times for calculations (yr)                     | 1.000E+02  | 1.000E+02 | ---                                              | T( 6)          |
| R011 | Times for calculations (yr)                     | 5.000E+02  | 3.000E+02 | ---                                              | T( 7)          |
| R011 | Times for calculations (yr)                     | 1.000E+03  | 1.000E+03 | ---                                              | T( 8)          |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T( 9)          |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T(10)          |
| R012 | Initial principal radionuclide (pCi/g): Cs-137  | 5.050E+01  | 0.000E+00 | ---                                              | S1(1)          |
| R012 | Initial principal radionuclide (pCi/g): Sr-90   | 2.140E-01  | 0.000E+00 | ---                                              | S1(4)          |
| R012 | Initial principal radionuclide (pCi/g): U-238   | 4.470E-01  | 0.000E+00 | ---                                              | S1(7)          |
| R012 | Concentration in groundwater (pCi/L): Cs-137    | not used   | 0.000E+00 | ---                                              | W1( 1)         |
| R012 | Concentration in groundwater (pCi/L): Sr-90     | not used   | 0.000E+00 | ---                                              | W1( 4)         |
| R012 | Concentration in groundwater (pCi/L): U-238     | not used   | 0.000E+00 | ---                                              | W1( 7)         |
| R013 | Cover depth (m)                                 | 6.100E-01  | 0.000E+00 | ---                                              | COVER0         |
| R013 | Density of cover material (g/cm**3)             | 1.500E+00  | 1.500E+00 | ---                                              | DENSCV         |
| R013 | Cover depth erosion rate (m/yr)                 | 1.000E-03  | 1.000E-03 | ---                                              | VCV            |
| R013 | Density of contaminated zone (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSCZ         |
| R013 | Contaminated zone erosion rate (m/yr)           | 1.000E-03  | 1.000E-03 | ---                                              | VCZ            |
| R013 | Contaminated zone total porosity                | 3.300E-01  | 4.000E-01 | ---                                              | TPCZ           |
| R013 | Contaminated zone field capacity                | 2.400E-01  | 2.000E-01 | ---                                              | FCCZ           |
| R013 | Contaminated zone hydraulic conductivity (m/yr) | 5.000E+03  | 1.000E+01 | ---                                              | HCCZ           |
| R013 | Contaminated zone b parameter                   | 4.900E+00  | 5.300E+00 | ---                                              | BCZ            |
| R013 | Average annual wind speed (m/sec)               | 6.230E+00  | 2.000E+00 | ---                                              | WIND           |
| R013 | Humidity in air (g/m**3)                        | not used   | 8.000E+00 | ---                                              | HUMID          |
| R013 | Evapotranspiration coefficient                  | 4.600E-01  | 5.000E-01 | ---                                              | EVAPTR         |
| R013 | Precipitation (m/yr)                            | 1.230E+00  | 1.000E+00 | ---                                              | PRECIP         |
| R013 | Irrigation (m/yr)                               | 2.600E-01  | 2.000E-01 | ---                                              | RI             |
| R013 | Irrigation mode                                 | overhead   | overhead  | ---                                              | IDITCH         |
| R013 | Runoff coefficient                              | 2.000E-01  | 2.000E-01 | ---                                              | RUNOFF         |
| R013 | Watershed area for nearby stream or pond (m**2) | 1.000E+06  | 1.000E+06 | ---                                              | WAREA          |
| R013 | Accuracy for water/soil computations            | 1.000E-03  | 1.000E-03 | ---                                              | EPS            |
| R014 | Density of saturated zone (g/cm**3)             | 1.660E+00  | 1.500E+00 | ---                                              | DENSAQ         |
| R014 | Saturated zone total porosity                   | 3.300E-01  | 4.000E-01 | ---                                              | TPSZ           |
| R014 | Saturated zone effective porosity               | 2.400E-01  | 2.000E-01 | ---                                              | EPSZ           |
| R014 | Saturated zone field capacity                   | 2.000E-01  | 2.000E-01 | ---                                              | FCSZ           |
| R014 | Saturated zone hydraulic conductivity (m/yr)    | 2.000E+04  | 1.000E+02 | ---                                              | HCSZ           |
| R014 | Saturated zone hydraulic gradient               | 4.800E-03  | 2.000E-02 | ---                                              | HGWT           |
| R014 | Saturated zone b parameter                      | 4.900E+00  | 5.300E+00 | ---                                              | BSZ            |
| R014 | Water table drop rate (m/yr)                    | 1.000E-03  | 1.000E-03 | ---                                              | VWT            |

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R014 | Well pump intake depth (m below water table)   | 1.800E+01  | 1.000E+01 | ---                                              | DWIBWT         |
| R014 | Model: Nondispersion (ND) or Mass-Balance (MB) | ND         | ND        | ---                                              | MODEL          |
| R014 | Well pumping rate (m**3/yr)                    | 2.500E+02  | 2.500E+02 | ---                                              | UW             |
| R015 | Number of unsaturated zone strata              | 1          | 1         | ---                                              | NS             |
| R015 | Unsat. zone 1, thickness (m)                   | 0.000E+00  | 4.000E+00 | ---                                              | H (1)          |
| R015 | Unsat. zone 1, soil density (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSUZ (1)     |
| R015 | Unsat. zone 1, total porosity                  | 3.300E-01  | 4.000E-01 | ---                                              | TPUZ (1)       |
| R015 | Unsat. zone 1, effective porosity              | 2.400E-01  | 2.000E-01 | ---                                              | EPUZ (1)       |
| R015 | Unsat. zone 1, field capacity                  | 2.000E-01  | 2.000E-01 | ---                                              | FCUZ (1)       |
| R015 | Unsat. zone 1, soil-specific b parameter       | 4.900E+00  | 5.300E+00 | ---                                              | BUZ (1)        |
| R015 | Unsat. zone 1, hydraulic conductivity (m/yr)   | 5.000E+03  | 1.000E+01 | ---                                              | HCUZ (1)       |
| R016 | Distribution coefficients for Cs-137           |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCC ( 1)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCU ( 1,1)  |
| R016 | Saturated zone (cm**3/g)                       | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCS ( 1)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.806E-04                                        | ALEACH ( 1)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 1)    |
| R016 | Distribution coefficients for Sr-90            |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 3.000E+00  | 3.000E+01 | ---                                              | DCNUCC ( 4)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 3.000E+00  | 3.000E+01 | ---                                              | DCNUCU ( 4,1)  |
| R016 | Saturated zone (cm**3/g)                       | 3.000E+00  | 3.000E+01 | ---                                              | DCNUCS ( 4)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.609E-02                                        | ALEACH ( 4)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 4)    |
| R016 | Distribution coefficients for U-238            |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 1.700E+01  | 5.000E+01 | ---                                              | DCNUCC ( 7)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 1.700E+01  | 5.000E+01 | ---                                              | DCNUCU ( 7,1)  |
| R016 | Saturated zone (cm**3/g)                       | 1.700E+01  | 5.000E+01 | ---                                              | DCNUCS ( 7)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 2.950E-03                                        | ALEACH ( 7)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 7)    |
| R016 | Distribution coefficients for daughter Pb-210  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCC ( 2)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCU ( 2,1)  |
| R016 | Saturated zone (cm**3/g)                       | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCS ( 2)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 5.051E-04                                        | ALEACH ( 2)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 2)    |
| R016 | Distribution coefficients for daughter Ra-226  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 7.000E+01  | 7.000E+01 | ---                                              | DCNUCC ( 3)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 7.000E+01  | 7.000E+01 | ---                                              | DCNUCU ( 3,1)  |
| R016 | Saturated zone (cm**3/g)                       | 7.000E+01  | 7.000E+01 | ---                                              | DCNUCS ( 3)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 7.211E-04                                        | ALEACH ( 3)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 3)    |

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R016 | Distribution coefficients for daughter Th-230  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCC ( 5)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCU ( 5,1)  |
| R016 | Saturated zone (cm**3/g)                       | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCS ( 5)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 8.431E-07                                        | ALEACH ( 5)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 5)    |
| R016 | Distribution coefficients for daughter U-234   |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCC ( 6)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCU ( 6,1)  |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCS ( 6)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.009E-03                                        | ALEACH ( 6)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 6)    |
| R017 | Inhalation rate (m**3/yr)                      | 7.300E+03  | 8.400E+03 | ---                                              | INHALR         |
| R017 | Mass loading for inhalation (g/m**3)           | 1.000E-04  | 1.000E-04 | ---                                              | MLINH          |
| R017 | Exposure duration                              | 2.500E+01  | 3.000E+01 | ---                                              | ED             |
| R017 | Shielding factor, inhalation                   | 4.000E-01  | 4.000E-01 | ---                                              | SHF3           |
| R017 | Shielding factor, external gamma               | 8.000E-01  | 7.000E-01 | ---                                              | SHF1           |
| R017 | Fraction of time spent indoors                 | 1.700E-01  | 5.000E-01 | ---                                              | FIND           |
| R017 | Fraction of time spent outdoors (on site)      | 6.000E-02  | 2.500E-01 | ---                                              | FOTD           |
| R017 | Shape factor flag, external gamma              | 1.000E+00  | 1.000E+00 | >0 shows circular AREA.                          | FS             |
| R017 | Radii of shape factor array (used if FS = -1): |            |           |                                                  |                |
| R017 | Outer annular radius (m), ring 1:              | not used   | 5.000E+01 | ---                                              | RAD_SHAPE ( 1) |
| R017 | Outer annular radius (m), ring 2:              | not used   | 7.071E+01 | ---                                              | RAD_SHAPE ( 2) |
| R017 | Outer annular radius (m), ring 3:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 3) |
| R017 | Outer annular radius (m), ring 4:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 4) |
| R017 | Outer annular radius (m), ring 5:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 5) |
| R017 | Outer annular radius (m), ring 6:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 6) |
| R017 | Outer annular radius (m), ring 7:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 7) |
| R017 | Outer annular radius (m), ring 8:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 8) |
| R017 | Outer annular radius (m), ring 9:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 9) |
| R017 | Outer annular radius (m), ring 10:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(10)  |
| R017 | Outer annular radius (m), ring 11:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(11)  |
| R017 | Outer annular radius (m), ring 12:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(12)  |
| R017 | Fractions of annular areas within AREA:        |            |           |                                                  |                |
| R017 | Ring 1                                         | not used   | 1.000E+00 | ---                                              | FRACA ( 1)     |
| R017 | Ring 2                                         | not used   | 2.732E-01 | ---                                              | FRACA ( 2)     |
| R017 | Ring 3                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 3)     |
| R017 | Ring 4                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 4)     |
| R017 | Ring 5                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 5)     |
| R017 | Ring 6                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 6)     |
| R017 | Ring 7                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 7)     |
| R017 | Ring 8                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 8)     |
| R017 | Ring 9                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 9)     |
| R017 | Ring 10                                        | not used   | 0.000E+00 | ---                                              | FRACA(10)      |
| R017 | Ring 11                                        | not used   | 0.000E+00 | ---                                              | FRACA(11)      |
| R017 | Ring 12                                        | not used   | 0.000E+00 | ---                                              | FRACA(12)      |

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|--------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R018 | Fruits, vegetables and grain consumption (kg/yr) | not used   | 1.600E+02 | ---                                              | DIET (1)       |
| R018 | Leafy vegetable consumption (kg/yr)              | not used   | 1.400E+01 | ---                                              | DIET (2)       |
| R018 | Milk consumption (L/yr)                          | not used   | 9.200E+01 | ---                                              | DIET (3)       |
| R018 | Meat and poultry consumption (kg/yr)             | not used   | 6.300E+01 | ---                                              | DIET (4)       |
| R018 | Fish consumption (kg/yr)                         | not used   | 5.400E+00 | ---                                              | DIET (5)       |
| R018 | Other seafood consumption (kg/yr)                | not used   | 9.000E-01 | ---                                              | DIET (6)       |
| R018 | Soil ingestion rate (g/yr)                       | 3.650E+01  | 3.650E+01 | ---                                              | SOIL           |
| R018 | Drinking water intake (L/yr)                     | 3.500E+02  | 5.100E+02 | ---                                              | DWI            |
| R018 | Contamination fraction of drinking water         | 1.000E+00  | 1.000E+00 | ---                                              | FDW            |
| R018 | Contamination fraction of household water        | not used   | 1.000E+00 | ---                                              | FHHW           |
| R018 | Contamination fraction of livestock water        | not used   | 1.000E+00 | ---                                              | FLW            |
| R018 | Contamination fraction of irrigation water       | not used   | 1.000E+00 | ---                                              | FIRW           |
| R018 | Contamination fraction of aquatic food           | not used   | 5.000E-01 | ---                                              | FR9            |
| R018 | Contamination fraction of plant food             | not used   | -1        | ---                                              | FPLANT         |
| R018 | Contamination fraction of meat                   | not used   | -1        | ---                                              | FMEAT          |
| R018 | Contamination fraction of milk                   | not used   | -1        | ---                                              | FMILK          |
|      |                                                  |            |           |                                                  |                |
| R019 | Livestock fodder intake for meat (kg/day)        | not used   | 6.800E+01 | ---                                              | LFI5           |
| R019 | Livestock fodder intake for milk (kg/day)        | not used   | 5.500E+01 | ---                                              | LFI6           |
| R019 | Livestock water intake for meat (L/day)          | not used   | 5.000E+01 | ---                                              | LWI5           |
| R019 | Livestock water intake for milk (L/day)          | not used   | 1.600E+02 | ---                                              | LWI6           |
| R019 | Livestock soil intake (kg/day)                   | not used   | 5.000E-01 | ---                                              | LSI            |
| R019 | Mass loading for foliar deposition (g/m**3)      | not used   | 1.000E-04 | ---                                              | MLFD           |
| R019 | Depth of soil mixing layer (m)                   | 1.500E-01  | 1.500E-01 | ---                                              | DM             |
| R019 | Depth of roots (m)                               | not used   | 9.000E-01 | ---                                              | DROOT          |
| R019 | Drinking water fraction from ground water        | 1.000E+00  | 1.000E+00 | ---                                              | FGWDW          |
| R019 | Household water fraction from ground water       | not used   | 1.000E+00 | ---                                              | FGWHH          |
| R019 | Livestock water fraction from ground water       | not used   | 1.000E+00 | ---                                              | FGWLW          |
| R019 | Irrigation fraction from ground water            | not used   | 1.000E+00 | ---                                              | FGWIR          |
|      |                                                  |            |           |                                                  |                |
| R19B | Wet weight crop yield for Non-Leafy (kg/m**2)    | not used   | 7.000E-01 | ---                                              | YV (1)         |
| R19B | Wet weight crop yield for Leafy (kg/m**2)        | not used   | 1.500E+00 | ---                                              | YV (2)         |
| R19B | Wet weight crop yield for Fodder (kg/m**2)       | not used   | 1.100E+00 | ---                                              | YV (3)         |
| R19B | Growing Season for Non-Leafy (years)             | not used   | 1.700E-01 | ---                                              | TE (1)         |
| R19B | Growing Season for Leafy (years)                 | not used   | 2.500E-01 | ---                                              | TE (2)         |
| R19B | Growing Season for Fodder (years)                | not used   | 8.000E-02 | ---                                              | TE (3)         |
| R19B | Translocation Factor for Non-Leafy               | not used   | 1.000E-01 | ---                                              | TIV (1)        |
| R19B | Translocation Factor for Leafy                   | not used   | 1.000E+00 | ---                                              | TIV (2)        |
| R19B | Translocation Factor for Fodder                  | not used   | 1.000E+00 | ---                                              | TIV (3)        |
| R19B | Dry Foliar Interception Fraction for Non-Leafy   | not used   | 2.500E-01 | ---                                              | RDRY (1)       |
| R19B | Dry Foliar Interception Fraction for Leafy       | not used   | 2.500E-01 | ---                                              | RDRY (2)       |
| R19B | Dry Foliar Interception Fraction for Fodder      | not used   | 2.500E-01 | ---                                              | RDRY (3)       |
| R19B | Wet Foliar Interception Fraction for Non-Leafy   | not used   | 2.500E-01 | ---                                              | RWET (1)       |
| R19B | Wet Foliar Interception Fraction for Leafy       | not used   | 2.500E-01 | ---                                              | RWET (2)       |
| R19B | Wet Foliar Interception Fraction for Fodder      | not used   | 2.500E-01 | ---                                              | RWET (3)       |
| R19B | Weathering Removal Constant for Vegetation       | not used   | 2.000E+01 | ---                                              | WLAM           |
|      |                                                  |            |           |                                                  |                |
| C14  | C-12 concentration in water (g/cm**3)            | not used   | 2.000E-05 | ---                                              | C12WTR         |
| C14  | C-12 concentration in contaminated soil (g/g)    | not used   | 3.000E-02 | ---                                              | C12CZ          |
| C14  | Fraction of vegetation carbon from soil          | not used   | 2.000E-02 | ---                                              | CSOIL          |

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User Input | Default    | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|--------------------------------------------------|------------|------------|--------------------------------------------------|----------------|
| C14  | Fraction of vegetation carbon from air           | not used   | 9.800E-01  | ---                                              | CAIR           |
| C14  | C-14 evasion layer thickness in soil (m)         | not used   | 3.000E-01  | ---                                              | DMC            |
| C14  | C-14 evasion flux rate from soil (1/sec)         | not used   | 7.000E-07  | ---                                              | EVSN           |
| C14  | C-12 evasion flux rate from soil (1/sec)         | not used   | 1.000E-10  | ---                                              | REVSN          |
| C14  | Fraction of grain in beef cattle feed            | not used   | 8.000E-01  | ---                                              | AVFG4          |
| C14  | Fraction of grain in milk cow feed               | not used   | 2.000E-01  | ---                                              | AVFG5          |
| STOR | Storage times of contaminated foodstuffs (days): |            |            |                                                  |                |
| STOR | Fruits, non-leafy vegetables, and grain          | 1.400E+01  | 1.400E+01  | ---                                              | STOR_T (1)     |
| STOR | Leafy vegetables                                 | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (2)     |
| STOR | Milk                                             | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (3)     |
| STOR | Meat and poultry                                 | 2.000E+01  | 2.000E+01  | ---                                              | STOR_T (4)     |
| STOR | Fish                                             | 7.000E+00  | 7.000E+00  | ---                                              | STOR_T (5)     |
| STOR | Crustacea and mollusks                           | 7.000E+00  | 7.000E+00  | ---                                              | STOR_T (6)     |
| STOR | Well water                                       | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (7)     |
| STOR | Surface water                                    | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (8)     |
| STOR | Livestock fodder                                 | 4.500E+01  | 4.500E+01  | ---                                              | STOR_T (9)     |
| R021 | Thickness of building foundation (m)             | not used   | 1.500E-01  | ---                                              | FLOOR1         |
| R021 | Bulk density of building foundation (g/cm**3)    | not used   | 2.400E+00  | ---                                              | DENSFL         |
| R021 | Total porosity of the cover material             | not used   | 4.000E-01  | ---                                              | TPCV           |
| R021 | Total porosity of the building foundation        | not used   | 1.000E-01  | ---                                              | TPFL           |
| R021 | Volumetric water content of the cover material   | not used   | 5.000E-02  | ---                                              | PH2OCV         |
| R021 | Volumetric water content of the foundation       | not used   | 3.000E-02  | ---                                              | PH2OFL         |
| R021 | Diffusion coefficient for radon gas (m/sec):     |            |            |                                                  |                |
| R021 | in cover material                                | not used   | 2.000E-06  | ---                                              | DIFCV          |
| R021 | in foundation material                           | not used   | 3.000E-07  | ---                                              | DIFFL          |
| R021 | in contaminated zone soil                        | not used   | 2.000E-06  | ---                                              | DIFCZ          |
| R021 | Radon vertical dimension of mixing (m)           | not used   | 2.000E+00  | ---                                              | HMIX           |
| R021 | Average building air exchange rate (1/hr)        | not used   | 5.000E-01  | ---                                              | REXG           |
| R021 | Height of the building (room) (m)                | not used   | 2.500E+00  | ---                                              | HRM            |
| R021 | Building interior area factor                    | not used   | 0.000E+00  | ---                                              | FAI            |
| R021 | Building depth below ground surface (m)          | not used   | -1.000E+00 | ---                                              | DMFL           |
| R021 | Emanating power of Rn-222 gas                    | not used   | 2.500E-01  | ---                                              | EMANA (1)      |
| R021 | Emanating power of Rn-220 gas                    | not used   | 1.500E-01  | ---                                              | EMANA (2)      |
| TITL | Number of graphical time points                  | 32         | ---        | ---                                              | NPTS           |
| TITL | Maximum number of integration points for dose    | 17         | ---        | ---                                              | LYMAX          |
| TITL | Maximum number of integration points for risk    | 257        | ---        | ---                                              | KYMAX          |

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

## Summary of Pathway Selections

| Pathway                     | User Selection |
|-----------------------------|----------------|
| 1 -- external gamma         | active         |
| 2 -- inhalation (w/o radon) | active         |
| 3 -- plant ingestion        | suppressed     |
| 4 -- meat ingestion         | suppressed     |
| 5 -- milk ingestion         | suppressed     |
| 6 -- aquatic foods          | suppressed     |
| 7 -- drinking water         | active         |
| 8 -- soil ingestion         | active         |
| 9 -- radon                  | suppressed     |
| Find peak pathway doses     | active         |



Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

| Contaminated Zone Dimensions |                       | Initial Soil Concentrations, pCi/g |           |
|------------------------------|-----------------------|------------------------------------|-----------|
| Area:                        | 1860.00 square meters | Cs-137                             | 5.050E+01 |
| Thickness:                   | 8.00 meters           | Sr-90                              | 2.140E-01 |
| Cover Depth:                 | 0.61 meters           | U-238                              | 4.470E-01 |

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 1.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

|            |           |           |           |           |           |           |           |           |
|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| t (years): | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| TDOSE(t):  | 2.118E-02 | 4.812E-02 | 8.793E-02 | 9.023E-02 | 6.035E-02 | 4.274E-02 | 1.240E-02 | 3.404E-03 |
| M(t):      | 1.412E-03 | 3.208E-03 | 5.862E-03 | 6.015E-03 | 4.023E-03 | 2.849E-03 | 8.266E-04 | 2.269E-04 |

Maximum TDOSE(t): 9.550E-02 mrem/yr at t = 16.34 ± 0.03 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.634E+01 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|------------------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                              | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137                       | 6.150E-03 | 0.0644 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90                        | 1.241E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238                        | 4.068E-06 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total                        | 6.154E-03 | 0.0644 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.634E+01 years

Water Dependent Pathways

| Radio-<br>Nuclide<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|------------------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                              | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137                       | 1.987E-03 | 0.0208 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.137E-03     | 0.0852 |
| Sr-90                        | 4.117E-02 | 0.4311 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.117E-02     | 0.4311 |
| U-238                        | 4.619E-02 | 0.4837 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.620E-02     | 0.4837 |
| Total                        | 8.935E-02 | 0.9356 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.550E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 7.193E-03 | 0.3397 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 1.793E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 3.448E-06 | 0.0002 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 7.196E-03 | 0.3398 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 8.483E-05 | 0.0040 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.277E-03     | 0.3437 |
| Sr-90             | 1.249E-02 | 0.5899 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.249E-02     | 0.5899 |
| U-238             | 1.403E-03 | 0.0663 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.407E-03     | 0.0664 |
| Total             | 1.398E-02 | 0.6602 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.118E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 7.124E-03 | 0.1480 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 1.753E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 3.483E-06 | 0.0001 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 7.127E-03 | 0.1481 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 2.508E-04 | 0.0052 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.375E-03     | 0.1532 |
| Sr-90             | 3.653E-02 | 0.7591 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.653E-02     | 0.7591 |
| U-238             | 4.217E-03 | 0.0876 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.220E-03     | 0.0877 |
| Total             | 4.100E-02 | 0.8519 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.812E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.856E-03 | 0.0780 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 1.602E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 3.627E-06 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 6.860E-03 | 0.0780 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 8.417E-04 | 0.0096 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.698E-03     | 0.0875 |
| Sr-90             | 6.484E-02 | 0.7373 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.484E-02     | 0.7373 |
| U-238             | 1.540E-02 | 0.1751 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.540E-02     | 0.1751 |
| Total             | 8.107E-02 | 0.9220 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.793E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.535E-03 | 0.0724 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 1.431E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 3.815E-06 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 6.539E-03 | 0.0725 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.433E-03 | 0.0159 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.968E-03     | 0.0883 |
| Sr-90             | 5.306E-02 | 0.5881 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.306E-02     | 0.5881 |
| U-238             | 2.919E-02 | 0.3235 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.919E-02     | 0.3236 |
| Total             | 8.369E-02 | 0.9275 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.023E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 4.455E-03 | 0.0738 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 5.808E-09 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 5.719E-06 | 0.0001 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 4.460E-03 | 0.0739 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 2.746E-03 | 0.0455 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.201E-03     | 0.1193 |
| Sr-90             | 1.068E-02 | 0.1770 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.068E-02     | 0.1770 |
| U-238             | 4.246E-02 | 0.7036 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.247E-02     | 0.7037 |
| Total             | 5.589E-02 | 0.9261 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.035E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.759E-03 | 0.0645 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 1.881E-09 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 9.487E-06 | 0.0002 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 2.768E-03 | 0.0648 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.729E-03 | 0.0404 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.487E-03     | 0.1050 |
| Sr-90             | 1.441E-03 | 0.0337 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.441E-03     | 0.0337 |
| U-238             | 3.680E-02 | 0.8611 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.681E-02     | 0.8613 |
| Total             | 3.997E-02 | 0.9352 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.274E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 5.972E-05 | 0.0048 | 9.209E-11  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.331E-08 | 0.0000 |
| Sr-90             | 2.298E-13 | 0.0000 | 3.149E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.012E-13 | 0.0000 |
| U-238             | 5.583E-04 | 0.0450 | 4.120E-06  | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.119E-05 | 0.0033 |
| Total             | 6.180E-04 | 0.0498 | 4.120E-06  | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.125E-05 | 0.0033 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 8.624E-07 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.063E-05     | 0.0049 |
| Sr-90             | 1.575E-10 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.578E-10     | 0.0000 |
| U-238             | 1.173E-02 | 0.9464 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.234E-02     | 0.9951 |
| Total             | 1.173E-02 | 0.9465 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.240E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.



Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.456E-09 | 0.0000 | 3.194E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.849E-12 | 0.0000 |
| Sr-90             | 5.473E-21 | 0.0000 | 2.217E-24  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.127E-22 | 0.0000 |
| U-238             | 6.736E-04 | 0.1979 | 3.519E-06  | 0.0010 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.515E-05 | 0.0103 |
| Total             | 6.736E-04 | 0.1979 | 3.519E-06  | 0.0010 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.515E-05 | 0.0103 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 9.121E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.467E-09     | 0.0000 |
| Sr-90             | 2.982E-19 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.044E-19     | 0.0000 |
| U-238             | 2.692E-03 | 0.7908 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.404E-03     | 1.0000 |
| Total             | 2.692E-03 | 0.7908 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.404E-03     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

| Parent<br>(i) | Product<br>(j) | Thread<br>Fraction | DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) |           |           |           |           |           |           |           |
|---------------|----------------|--------------------|---------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               |                |                    | 0.000E+00                                   | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137+D      | Cs-137+D       | 1.000E+00          | 1.441E-04                                   | 1.460E-04 | 1.524E-04 | 1.578E-04 | 1.426E-04 | 8.886E-05 | 1.201E-06 | 4.886E-11 |
| Sr-90+D       | Sr-90+D        | 1.000E+00          | 5.837E-02                                   | 1.707E-01 | 3.030E-01 | 2.480E-01 | 4.992E-02 | 6.732E-03 | 7.376E-10 | 1.422E-18 |
| U-238         | U-238          | 5.450E-07          | 1.590E-09                                   | 4.778E-09 | 1.744E-08 | 3.308E-08 | 4.811E-08 | 4.170E-08 | 1.334E-08 | 3.085E-09 |
| U-238+D       | U-238+D        | 1.000E+00          | 3.147E-03                                   | 9.441E-03 | 3.445E-02 | 6.531E-02 | 9.500E-02 | 8.235E-02 | 2.758E-02 | 7.593E-03 |
| U-238+D       | U-234          | 1.000E+00          | 1.400E-09                                   | 9.745E-09 | 1.257E-07 | 4.548E-07 | 5.018E-06 | 9.107E-06 | 2.233E-05 | 1.935E-05 |
| U-238+D       | Th-230         | 1.000E+00          | 6.512E-14                                   | 1.881E-13 | 6.785E-13 | 1.319E-12 | 1.297E-11 | 3.156E-11 | 4.355E-09 | 3.656E-08 |
| U-238+D       | Ra-226+D       | 1.000E+00          | 7.335E-11                                   | 2.110E-10 | 7.491E-10 | 1.398E-09 | 1.084E-08 | 1.816E-08 | 1.393E-07 | 1.272E-06 |
| U-238+D       | Pb-210+D       | 1.000E+00          | 3.498E-10                                   | 1.006E-09 | 3.573E-09 | 6.667E-09 | 5.159E-08 | 8.595E-08 | 3.325E-07 | 9.287E-07 |
| U-238+D       | ΣDSR(j)        |                    | 3.147E-03                                   | 9.441E-03 | 3.445E-02 | 6.531E-02 | 9.500E-02 | 8.236E-02 | 2.760E-02 | 7.615E-03 |

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

| Nuclide<br>(i) | t= | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03  |
|----------------|----|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| Cs-137         |    | 1.041E+05 | 1.027E+05 | 9.840E+04 | 9.506E+04 | 1.052E+05 | 1.688E+05 | 1.249E+07 | 3.070E+11  |
| Sr-90          |    | 2.570E+02 | 8.787E+01 | 4.951E+01 | 6.049E+01 | 3.005E+02 | 2.228E+03 | 2.034E+10 | *1.366E+14 |
| U-238          |    | 4.767E+03 | 1.589E+03 | 4.354E+02 | 2.297E+02 | 1.579E+02 | 1.821E+02 | 5.435E+02 | 1.970E+03  |

\*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
at tmin = time of minimum single radionuclide soil guideline  
and at tmax = time of maximum total dose = 16.34 ± 0.03 years

| Nuclide<br>(i) | Initial<br>(pCi/g) | tmin<br>(years) | DSR(i,tmin) | G(i,tmin)<br>(pCi/g) | DSR(i,tmax) | G(i,tmax)<br>(pCi/g) |
|----------------|--------------------|-----------------|-------------|----------------------|-------------|----------------------|
| Cs-137         | 5.050E+01          | 20.13 ± 0.04    | 1.616E-04   | 9.281E+04            | 1.611E-04   | 9.309E+04            |
| Sr-90          | 2.140E-01          | 2.825 ± 0.006   | 3.281E-01   | 4.572E+01            | 1.924E-01   | 7.798E+01            |
| U-238          | 4.470E-01          | 16.91 ± 0.03    | 1.044E-01   | 1.437E+02            | 1.033E-01   | 1.451E+02            |

Summary : 811 area-Resident-surface-No Bkdg subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

## Table of Contents

## Part I: Mixture Sums and Single Radionuclide Guidelines

|                                                            |    |
|------------------------------------------------------------|----|
| Dose Conversion Factor (and Related) Parameter Summary ... | 2  |
| Site-Specific Parameter Summary .....                      | 5  |
| Summary of Pathway Selections .....                        | 10 |
| Contaminated Zone and Total Dose Summary .....             | 11 |
| Total Dose Components                                      |    |
| Time = 0.000E+00 .....                                     | 12 |
| Time = 1.000E+00 .....                                     | 13 |
| Time = 5.000E+00 .....                                     | 14 |
| Time = 1.000E+01 .....                                     | 15 |
| Time = 5.000E+01 .....                                     | 16 |
| Time = 1.000E+02 .....                                     | 17 |
| Time = 5.000E+02 .....                                     | 18 |
| Time = 1.000E+03 .....                                     | 19 |
| Dose/Source Ratios Summed Over All Pathways .....          | 20 |
| Single Radionuclide Soil Guidelines .....                  | 20 |
| Dose Per Nuclide Summed Over All Pathways .....            | 21 |
| Soil Concentration Per Nuclide .....                       | 21 |

Summary : 811 area-Resident-surface-No Bkgd subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| A-1  | DCF's for external ground radiation, (mrem/yr)/(pCi/g)   |                |            |                |
| A-1  | At-218 (Source: DCFPAK3.02)                              | 5.567E-05      | 5.567E-05  | DCF1 ( 1)      |
| A-1  | Ba-137m (Source: DCFPAK3.02)                             | 3.381E+00      | 3.381E+00  | DCF1 ( 2)      |
| A-1  | Bi-210 (Source: DCFPAK3.02)                              | 5.473E-03      | 5.473E-03  | DCF1 ( 3)      |
| A-1  | Bi-214 (Source: DCFPAK3.02)                              | 9.135E+00      | 9.135E+00  | DCF1 ( 4)      |
| A-1  | Cs-137 (Source: DCFPAK3.02)                              | 8.686E-04      | 8.686E-04  | DCF1 ( 5)      |
| A-1  | Hg-206 (Source: DCFPAK3.02)                              | 6.127E-01      | 6.127E-01  | DCF1 ( 6)      |
| A-1  | Pa-234 (Source: DCFPAK3.02)                              | 8.275E+00      | 8.275E+00  | DCF1 ( 7)      |
| A-1  | Pa-234m (Source: DCFPAK3.02)                             | 1.257E-01      | 1.257E-01  | DCF1 ( 8)      |
| A-1  | Pb-210 (Source: DCFPAK3.02)                              | 2.092E-03      | 2.092E-03  | DCF1 ( 9)      |
| A-1  | Pb-214 (Source: DCFPAK3.02)                              | 1.257E+00      | 1.257E+00  | DCF1 ( 10)     |
| A-1  | Po-210 (Source: DCFPAK3.02)                              | 5.641E-05      | 5.641E-05  | DCF1 ( 11)     |
| A-1  | Po-214 (Source: DCFPAK3.02)                              | 4.801E-04      | 4.801E-04  | DCF1 ( 12)     |
| A-1  | Po-218 (Source: DCFPAK3.02)                              | 9.228E-09      | 9.228E-09  | DCF1 ( 13)     |
| A-1  | Ra-226 (Source: DCFPAK3.02)                              | 3.176E-02      | 3.176E-02  | DCF1 ( 14)     |
| A-1  | Rn-218 (Source: DCFPAK3.02)                              | 4.259E-03      | 4.259E-03  | DCF1 ( 15)     |
| A-1  | Rn-222 (Source: DCFPAK3.02)                              | 2.130E-03      | 2.130E-03  | DCF1 ( 16)     |
| A-1  | Sr-90 (Source: DCFPAK3.02)                               | 6.463E-04      | 6.463E-04  | DCF1 ( 17)     |
| A-1  | Th-230 (Source: DCFPAK3.02)                              | 1.106E-03      | 1.106E-03  | DCF1 ( 18)     |
| A-1  | Th-234 (Source: DCFPAK3.02)                              | 2.316E-02      | 2.316E-02  | DCF1 ( 19)     |
| A-1  | Tl-206 (Source: DCFPAK3.02)                              | 1.278E-02      | 1.278E-02  | DCF1 ( 20)     |
| A-1  | Tl-210 (Source: DCFPAK3.02)                              | 1.677E+01      | 1.677E+01  | DCF1 ( 21)     |
| A-1  | U-234 (Source: DCFPAK3.02)                               | 3.456E-04      | 3.456E-04  | DCF1 ( 22)     |
| A-1  | U-238 (Source: DCFPAK3.02)                               | 1.713E-04      | 1.713E-04  | DCF1 ( 23)     |
| A-1  | Y-90 (Source: DCFPAK3.02)                                | 4.016E-02      | 4.016E-02  | DCF1 ( 24)     |
| B-1  | Dose conversion factors for inhalation, mrem/pCi:        |                |            |                |
| B-1  | Cs-137+D                                                 | 1.457E-04      | 1.457E-04  | DCF2 ( 1)      |
| B-1  | Pb-210+D                                                 | 3.708E-02      | 2.077E-02  | DCF2 ( 2)      |
| B-1  | Ra-226+D                                                 | 3.528E-02      | 3.517E-02  | DCF2 ( 3)      |
| B-1  | Sr-90+D                                                  | 5.841E-04      | 5.786E-04  | DCF2 ( 4)      |
| B-1  | Th-230                                                   | 3.759E-01      | 3.759E-01  | DCF2 ( 5)      |
| B-1  | U-234                                                    | 3.479E-02      | 3.479E-02  | DCF2 ( 6)      |
| B-1  | U-238                                                    | 2.973E-02      | 2.973E-02  | DCF2 ( 7)      |
| B-1  | U-238+D                                                  | 2.976E-02      | 2.973E-02  | DCF2 ( 8)      |
| D-1  | Dose conversion factors for ingestion, mrem/pCi:         |                |            |                |
| D-1  | Cs-137+D                                                 | 5.032E-05      | 5.032E-05  | DCF3 ( 1)      |
| D-1  | Pb-210+D                                                 | 7.057E-03      | 2.575E-03  | DCF3 ( 2)      |
| D-1  | Ra-226+D                                                 | 1.037E-03      | 1.036E-03  | DCF3 ( 3)      |
| D-1  | Sr-90+D                                                  | 1.120E-04      | 1.021E-04  | DCF3 ( 4)      |
| D-1  | Th-230                                                   | 7.918E-04      | 7.918E-04  | DCF3 ( 5)      |
| D-1  | U-234                                                    | 1.831E-04      | 1.831E-04  | DCF3 ( 6)      |
| D-1  | U-238                                                    | 1.650E-04      | 1.650E-04  | DCF3 ( 7)      |
| D-1  | U-238+D                                                  | 1.776E-04      | 1.650E-04  | DCF3 ( 8)      |
| D-34 | Food transfer factors:                                   |                |            |                |
| D-34 | Cs-137+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF ( 1,1)     |
| D-34 | Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.000E-02      | 3.000E-02  | RTF ( 1,2)     |
| D-34 | Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF ( 1,3)     |

Summary : 811 area-Resident-surface-No Bkgd subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

## Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| D-34 | Pb-210+D , plant/soil concentration ratio, dimensionless | 1.000E-02      | 1.000E-02  | RTF( 2,1)      |
| D-34 | Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-04      | 8.000E-04  | RTF( 2,2)      |
| D-34 | Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 3.000E-04      | 3.000E-04  | RTF( 2,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Ra-226+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 3,1)      |
| D-34 | Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-03      | 1.000E-03  | RTF( 3,2)      |
| D-34 | Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 1.000E-03      | 1.000E-03  | RTF( 3,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Sr-90+D , plant/soil concentration ratio, dimensionless  | 3.000E-01      | 3.000E-01  | RTF( 4,1)      |
| D-34 | Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 4,2)      |
| D-34 | Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 2.000E-03      | 2.000E-03  | RTF( 4,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Th-230 , plant/soil concentration ratio, dimensionless   | 1.000E-03      | 1.000E-03  | RTF( 5,1)      |
| D-34 | Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 1.000E-04      | 1.000E-04  | RTF( 5,2)      |
| D-34 | Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06      | 5.000E-06  | RTF( 5,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-234 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 6,1)      |
| D-34 | U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 6,2)      |
| D-34 | U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 6,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 7,1)      |
| D-34 | U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 7,2)      |
| D-34 | U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 7,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238+D , plant/soil concentration ratio, dimensionless  | 2.500E-03      | 2.500E-03  | RTF( 8,1)      |
| D-34 | U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04      | 3.400E-04  | RTF( 8,2)      |
| D-34 | U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04      | 6.000E-04  | RTF( 8,3)      |
| D-5  |                                                          |                |            |                |
| D-5  | Bioaccumulation factors, fresh water, L/kg:              |                |            |                |
| D-5  | Cs-137+D , fish                                          | 2.000E+03      | 2.000E+03  | BIOFAC( 1,1)   |
| D-5  | Cs-137+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 1,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Pb-210+D , fish                                          | 3.000E+02      | 3.000E+02  | BIOFAC( 2,1)   |
| D-5  | Pb-210+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 2,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Ra-226+D , fish                                          | 5.000E+01      | 5.000E+01  | BIOFAC( 3,1)   |
| D-5  | Ra-226+D , crustacea and mollusks                        | 2.500E+02      | 2.500E+02  | BIOFAC( 3,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Sr-90+D , fish                                           | 6.000E+01      | 6.000E+01  | BIOFAC( 4,1)   |
| D-5  | Sr-90+D , crustacea and mollusks                         | 1.000E+02      | 1.000E+02  | BIOFAC( 4,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Th-230 , fish                                            | 1.000E+02      | 1.000E+02  | BIOFAC( 5,1)   |
| D-5  | Th-230 , crustacea and mollusks                          | 5.000E+02      | 5.000E+02  | BIOFAC( 5,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-234 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 6,1)   |
| D-5  | U-234 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 6,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-238 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 7,1)   |
| D-5  | U-238 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 7,2)   |
| D-5  |                                                          |                |            |                |

Summary : 811 area-Resident-surface-No Bkdg subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter |                          | Current   | Base      | Parameter    |
|------|-----------|--------------------------|-----------|-----------|--------------|
|      |           |                          | Value#    | Case*     | Name         |
| D-5  | U-238+D   | , fish                   | 1.000E+01 | 1.000E+01 | BIOFAC( 8,1) |
| D-5  | U-238+D   | , crustacea and mollusks | 6.000E+01 | 6.000E+01 | BIOFAC( 8,2) |

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.

\*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : 811 area-Resident-surface-No Bkgd subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

## Site-Specific Parameter Summary

| Menu | Parameter                                       | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|-------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R011 | Area of contaminated zone (m**2)                | 1.860E+03  | 1.000E+04 | ---                                              | AREA           |
| R011 | Thickness of contaminated zone (m)              | 5.000E+00  | 2.000E+00 | ---                                              | THICK0         |
| R011 | Fraction of contamination that is submerged     | 0.000E+00  | 0.000E+00 | ---                                              | SUBMFRACT      |
| R011 | Length parallel to aquifer flow (m)             | 7.600E+01  | 1.000E+02 | ---                                              | LCZPAQ         |
| R011 | Basic radiation dose limit (mrem/yr)            | 1.500E+01  | 3.000E+01 | ---                                              | BRDL           |
| R011 | Time since placement of material (yr)           | 0.000E+00  | 0.000E+00 | ---                                              | TI             |
| R011 | Times for calculations (yr)                     | 1.000E+00  | 1.000E+00 | ---                                              | T ( 2)         |
| R011 | Times for calculations (yr)                     | 5.000E+00  | 3.000E+00 | ---                                              | T ( 3)         |
| R011 | Times for calculations (yr)                     | 1.000E+01  | 1.000E+01 | ---                                              | T ( 4)         |
| R011 | Times for calculations (yr)                     | 5.000E+01  | 3.000E+01 | ---                                              | T ( 5)         |
| R011 | Times for calculations (yr)                     | 1.000E+02  | 1.000E+02 | ---                                              | T ( 6)         |
| R011 | Times for calculations (yr)                     | 5.000E+02  | 3.000E+02 | ---                                              | T ( 7)         |
| R011 | Times for calculations (yr)                     | 1.000E+03  | 1.000E+03 | ---                                              | T ( 8)         |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T ( 9)         |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T(10)          |
|      |                                                 |            |           |                                                  |                |
| R012 | Initial principal radionuclide (pCi/g): Cs-137  | 3.854E+00  | 0.000E+00 | ---                                              | S1(1)          |
| R012 | Initial principal radionuclide (pCi/g): Ra-226  | 4.960E-01  | 0.000E+00 | ---                                              | S1(3)          |
| R012 | Initial principal radionuclide (pCi/g): Sr-90   | 2.140E-01  | 0.000E+00 | ---                                              | S1(4)          |
| R012 | Initial principal radionuclide (pCi/g): U-238   | 4.470E-01  | 0.000E+00 | ---                                              | S1(7)          |
| R012 | Concentration in groundwater (pCi/L): Cs-137    | not used   | 0.000E+00 | ---                                              | W1 ( 1)        |
| R012 | Concentration in groundwater (pCi/L): Ra-226    | not used   | 0.000E+00 | ---                                              | W1 ( 3)        |
| R012 | Concentration in groundwater (pCi/L): Sr-90     | not used   | 0.000E+00 | ---                                              | W1 ( 4)        |
| R012 | Concentration in groundwater (pCi/L): U-238     | not used   | 0.000E+00 | ---                                              | W1 ( 7)        |
|      |                                                 |            |           |                                                  |                |
| R013 | Cover depth (m)                                 | 0.000E+00  | 0.000E+00 | ---                                              | COVER0         |
| R013 | Density of cover material (g/cm**3)             | not used   | 1.500E+00 | ---                                              | DENSCV         |
| R013 | Cover depth erosion rate (m/yr)                 | not used   | 1.000E-03 | ---                                              | VCV            |
| R013 | Density of contaminated zone (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSCZ         |
| R013 | Contaminated zone erosion rate (m/yr)           | 1.000E-03  | 1.000E-03 | ---                                              | VCZ            |
| R013 | Contaminated zone total porosity                | 3.300E-01  | 4.000E-01 | ---                                              | TPCZ           |
| R013 | Contaminated zone field capacity                | 2.400E-01  | 2.000E-01 | ---                                              | FCCZ           |
| R013 | Contaminated zone hydraulic conductivity (m/yr) | 5.000E+03  | 1.000E+01 | ---                                              | HCCZ           |
| R013 | Contaminated zone b parameter                   | 4.900E+00  | 5.300E+00 | ---                                              | BCZ            |
| R013 | Average annual wind speed (m/sec)               | 6.230E+00  | 2.000E+00 | ---                                              | WIND           |
| R013 | Humidity in air (g/m**3)                        | not used   | 8.000E+00 | ---                                              | HUMID          |
| R013 | Evapotranspiration coefficient                  | 4.600E-01  | 5.000E-01 | ---                                              | EVAPTR         |
| R013 | Precipitation (m/yr)                            | 1.230E+00  | 1.000E+00 | ---                                              | PRECIP         |
| R013 | Irrigation (m/yr)                               | 2.600E-01  | 2.000E-01 | ---                                              | RI             |
| R013 | Irrigation mode                                 | overhead   | overhead  | ---                                              | IDITCH         |
| R013 | Runoff coefficient                              | 2.000E-01  | 2.000E-01 | ---                                              | RUNOFF         |
| R013 | Watershed area for nearby stream or pond (m**2) | 1.000E+06  | 1.000E+06 | ---                                              | WAREA          |
| R013 | Accuracy for water/soil computations            | 1.000E-03  | 1.000E-03 | ---                                              | EPS            |
|      |                                                 |            |           |                                                  |                |
| R014 | Density of saturated zone (g/cm**3)             | 1.660E+00  | 1.500E+00 | ---                                              | DENSAQ         |
| R014 | Saturated zone total porosity                   | 3.300E-01  | 4.000E-01 | ---                                              | TPSZ           |
| R014 | Saturated zone effective porosity               | 2.400E-01  | 2.000E-01 | ---                                              | EPSZ           |
| R014 | Saturated zone field capacity                   | 2.000E-01  | 2.000E-01 | ---                                              | FCSZ           |
| R014 | Saturated zone hydraulic conductivity (m/yr)    | 2.000E+04  | 1.000E+02 | ---                                              | HCSZ           |
| R014 | Saturated zone hydraulic gradient               | 4.800E-03  | 2.000E-02 | ---                                              | HGWT           |

Summary : 811 area-Resident-surface-No Bkgd subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|------|------------------------------------------------|---------------|-----------|--------------------------------------------------|-------------------|
| R014 | Saturated zone b parameter                     | 4.900E+00     | 5.300E+00 | ---                                              | BSZ               |
| R014 | Water table drop rate (m/yr)                   | 1.000E-03     | 1.000E-03 | ---                                              | VWT               |
| R014 | Well pump intake depth (m below water table)   | 1.800E+01     | 1.000E+01 | ---                                              | DWIBWT            |
| R014 | Model: Nondispersion (ND) or Mass-Balance (MB) | ND            | ND        | ---                                              | MODEL             |
| R014 | Well pumping rate (m**3/yr)                    | 2.500E+02     | 2.500E+02 | ---                                              | UW                |
|      |                                                |               |           |                                                  |                   |
| R015 | Number of unsaturated zone strata              | 1             | 1         | ---                                              | NS                |
| R015 | Unsat. zone 1, thickness (m)                   | 0.000E+00     | 4.000E+00 | ---                                              | H(1)              |
| R015 | Unsat. zone 1, soil density (g/cm**3)          | 1.660E+00     | 1.500E+00 | ---                                              | DENSUZ(1)         |
| R015 | Unsat. zone 1, total porosity                  | 3.300E-01     | 4.000E-01 | ---                                              | TPUZ(1)           |
| R015 | Unsat. zone 1, effective porosity              | 2.400E-01     | 2.000E-01 | ---                                              | EPUZ(1)           |
| R015 | Unsat. zone 1, field capacity                  | 2.000E-01     | 2.000E-01 | ---                                              | FCUZ(1)           |
| R015 | Unsat. zone 1, soil-specific b parameter       | 4.900E+00     | 5.300E+00 | ---                                              | BUZ(1)            |
| R015 | Unsat. zone 1, hydraulic conductivity (m/yr)   | 5.000E+03     | 1.000E+01 | ---                                              | HCUZ(1)           |
|      |                                                |               |           |                                                  |                   |
| R016 | Distribution coefficients for Cs-137           |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 2.800E+02     | 4.600E+03 | ---                                              | DCNUCC( 1)        |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 2.800E+02     | 4.600E+03 | ---                                              | DCNUCU( 1,1)      |
| R016 | Saturated zone (cm**3/g)                       | 2.800E+02     | 4.600E+03 | ---                                              | DCNUCS( 1)        |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 2.889E-04                                        | ALEACH( 1)        |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK( 1)        |
|      |                                                |               |           |                                                  |                   |
| R016 | Distribution coefficients for Ra-226           |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 7.000E+01     | 7.000E+01 | ---                                              | DCNUCC( 3)        |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 7.000E+01     | 7.000E+01 | ---                                              | DCNUCU( 3,1)      |
| R016 | Saturated zone (cm**3/g)                       | 7.000E+01     | 7.000E+01 | ---                                              | DCNUCS( 3)        |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 1.154E-03                                        | ALEACH( 3)        |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK( 3)        |
|      |                                                |               |           |                                                  |                   |
| R016 | Distribution coefficients for Sr-90            |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 3.000E+01     | 3.000E+01 | ---                                              | DCNUCC( 4)        |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 3.000E+01     | 3.000E+01 | ---                                              | DCNUCU( 4,1)      |
| R016 | Saturated zone (cm**3/g)                       | 3.000E+01     | 3.000E+01 | ---                                              | DCNUCS( 4)        |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 2.685E-03                                        | ALEACH( 4)        |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK( 4)        |
|      |                                                |               |           |                                                  |                   |
| R016 | Distribution coefficients for U-238            |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---                                              | DCNUCC( 7)        |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01     | 5.000E+01 | ---                                              | DCNUCU( 7,1)      |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+01     | 5.000E+01 | ---                                              | DCNUCS( 7)        |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 1.614E-03                                        | ALEACH( 7)        |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK( 7)        |
|      |                                                |               |           |                                                  |                   |
| R016 | Distribution coefficients for daughter Pb-210  |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 1.000E+02     | 1.000E+02 | ---                                              | DCNUCC( 2)        |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 1.000E+02     | 1.000E+02 | ---                                              | DCNUCU( 2,1)      |
| R016 | Saturated zone (cm**3/g)                       | 1.000E+02     | 1.000E+02 | ---                                              | DCNUCS( 2)        |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 8.082E-04                                        | ALEACH( 2)        |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK( 2)        |



Summary : 811 area-Resident-surface-No Bkgd subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|------|------------------------------------------------|---------------|-----------|--------------------------------------------------|-------------------|
| R016 | Distribution coefficients for daughter Th-230  |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 6.000E+04     | 6.000E+04 | ---                                              | DCNUCC( 5)        |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 6.000E+04     | 6.000E+04 | ---                                              | DCNUCU( 5,1)      |
| R016 | Saturated zone (cm**3/g)                       | 6.000E+04     | 6.000E+04 | ---                                              | DCNUCS( 5)        |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 1.349E-06                                        | ALEACH( 5)        |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK( 5)        |
| R016 | Distribution coefficients for daughter U-234   |               |           |                                                  |                   |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---                                              | DCNUCC( 6)        |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01     | 5.000E+01 | ---                                              | DCNUCU( 6,1)      |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+01     | 5.000E+01 | ---                                              | DCNUCS( 6)        |
| R016 | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 1.614E-03                                        | ALEACH( 6)        |
| R016 | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used                                         | SOLUBK( 6)        |
| R017 | Inhalation rate (m**3/yr)                      | 7.300E+03     | 8.400E+03 | ---                                              | INHALR            |
| R017 | Mass loading for inhalation (g/m**3)           | 1.000E-04     | 1.000E-04 | ---                                              | MLINH             |
| R017 | Exposure duration                              | 3.000E+01     | 3.000E+01 | ---                                              | ED                |
| R017 | Shielding factor, inhalation                   | 4.000E-01     | 4.000E-01 | ---                                              | SHF3              |
| R017 | Shielding factor, external gamma               | 8.000E-01     | 7.000E-01 | ---                                              | SHF1              |
| R017 | Fraction of time spent indoors                 | 5.000E-01     | 5.000E-01 | ---                                              | FIND              |
| R017 | Fraction of time spent outdoors (on site)      | 2.500E-01     | 2.500E-01 | ---                                              | FOTD              |
| R017 | Shape factor flag, external gamma              | 1.000E+00     | 1.000E+00 | >0 shows circular AREA.                          | FS                |
| R017 | Radii of shape factor array (used if FS = -1): |               |           |                                                  |                   |
| R017 | Outer annular radius (m), ring 1:              | not used      | 5.000E+01 | ---                                              | RAD_SHAPE( 1)     |
| R017 | Outer annular radius (m), ring 2:              | not used      | 7.071E+01 | ---                                              | RAD_SHAPE( 2)     |
| R017 | Outer annular radius (m), ring 3:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 3)     |
| R017 | Outer annular radius (m), ring 4:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 4)     |
| R017 | Outer annular radius (m), ring 5:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 5)     |
| R017 | Outer annular radius (m), ring 6:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 6)     |
| R017 | Outer annular radius (m), ring 7:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 7)     |
| R017 | Outer annular radius (m), ring 8:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 8)     |
| R017 | Outer annular radius (m), ring 9:              | not used      | 0.000E+00 | ---                                              | RAD_SHAPE( 9)     |
| R017 | Outer annular radius (m), ring 10:             | not used      | 0.000E+00 | ---                                              | RAD_SHAPE(10)     |
| R017 | Outer annular radius (m), ring 11:             | not used      | 0.000E+00 | ---                                              | RAD_SHAPE(11)     |
| R017 | Outer annular radius (m), ring 12:             | not used      | 0.000E+00 | ---                                              | RAD_SHAPE(12)     |
| R017 | Fractions of annular areas within AREA:        |               |           |                                                  |                   |
| R017 | Ring 1                                         | not used      | 1.000E+00 | ---                                              | FRACA( 1)         |
| R017 | Ring 2                                         | not used      | 2.732E-01 | ---                                              | FRACA( 2)         |
| R017 | Ring 3                                         | not used      | 0.000E+00 | ---                                              | FRACA( 3)         |
| R017 | Ring 4                                         | not used      | 0.000E+00 | ---                                              | FRACA( 4)         |
| R017 | Ring 5                                         | not used      | 0.000E+00 | ---                                              | FRACA( 5)         |
| R017 | Ring 6                                         | not used      | 0.000E+00 | ---                                              | FRACA( 6)         |
| R017 | Ring 7                                         | not used      | 0.000E+00 | ---                                              | FRACA( 7)         |
| R017 | Ring 8                                         | not used      | 0.000E+00 | ---                                              | FRACA( 8)         |
| R017 | Ring 9                                         | not used      | 0.000E+00 | ---                                              | FRACA( 9)         |
| R017 | Ring 10                                        | not used      | 0.000E+00 | ---                                              | FRACA(10)         |
| R017 | Ring 11                                        | not used      | 0.000E+00 | ---                                              | FRACA(11)         |
| R017 | Ring 12                                        | not used      | 0.000E+00 | ---                                              | FRACA(12)         |

Summary : 811 area-Resident-surface-No Bkgd subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User      | Default   | Used by RESRAD                 | Parameter Name |
|------|--------------------------------------------------|-----------|-----------|--------------------------------|----------------|
|      |                                                  | Input     |           | (If different from user input) |                |
| R018 | Fruits, vegetables and grain consumption (kg/yr) | 1.600E+02 | 1.600E+02 | ---                            | DIET(1)        |
| R018 | Leafy vegetable consumption (kg/yr)              | 1.400E+01 | 1.400E+01 | ---                            | DIET(2)        |
| R018 | Milk consumption (L/yr)                          | not used  | 9.200E+01 | ---                            | DIET(3)        |
| R018 | Meat and poultry consumption (kg/yr)             | not used  | 6.300E+01 | ---                            | DIET(4)        |
| R018 | Fish consumption (kg/yr)                         | not used  | 5.400E+00 | ---                            | DIET(5)        |
| R018 | Other seafood consumption (kg/yr)                | not used  | 9.000E-01 | ---                            | DIET(6)        |
| R018 | Soil ingestion rate (g/yr)                       | 4.380E+01 | 3.650E+01 | ---                            | SOIL           |
| R018 | Drinking water intake (L/yr)                     | 7.000E+02 | 5.100E+02 | ---                            | DWI            |
| R018 | Contamination fraction of drinking water         | 1.000E+00 | 1.000E+00 | ---                            | FDW            |
| R018 | Contamination fraction of household water        | not used  | 1.000E+00 | ---                            | FHHW           |
| R018 | Contamination fraction of livestock water        | not used  | 1.000E+00 | ---                            | FLW            |
| R018 | Contamination fraction of irrigation water       | 1.000E+00 | 1.000E+00 | ---                            | FIRW           |
| R018 | Contamination fraction of aquatic food           | not used  | 5.000E-01 | ---                            | FR9            |
| R018 | Contamination fraction of plant food             | -1        | -1        | 0.500E+00                      | FPLANT         |
| R018 | Contamination fraction of meat                   | not used  | -1        | ---                            | FMEAT          |
| R018 | Contamination fraction of milk                   | not used  | -1        | ---                            | FMILK          |
|      |                                                  |           |           |                                |                |
| R019 | Livestock fodder intake for meat (kg/day)        | not used  | 6.800E+01 | ---                            | LFI5           |
| R019 | Livestock fodder intake for milk (kg/day)        | not used  | 5.500E+01 | ---                            | LFI6           |
| R019 | Livestock water intake for meat (L/day)          | not used  | 5.000E+01 | ---                            | LWI5           |
| R019 | Livestock water intake for milk (L/day)          | not used  | 1.600E+02 | ---                            | LWI6           |
| R019 | Livestock soil intake (kg/day)                   | not used  | 5.000E-01 | ---                            | LSI            |
| R019 | Mass loading for foliar deposition (g/m**3)      | 1.000E-05 | 1.000E-04 | ---                            | MLFD           |
| R019 | Depth of soil mixing layer (m)                   | 1.500E-01 | 1.500E-01 | ---                            | DM             |
| R019 | Depth of roots (m)                               | 9.000E-01 | 9.000E-01 | ---                            | DROOT          |
| R019 | Drinking water fraction from ground water        | 1.000E+00 | 1.000E+00 | ---                            | FGWDW          |
| R019 | Household water fraction from ground water       | not used  | 1.000E+00 | ---                            | FGWHH          |
| R019 | Livestock water fraction from ground water       | not used  | 1.000E+00 | ---                            | FGWLW          |
| R019 | Irrigation fraction from ground water            | 1.000E+00 | 1.000E+00 | ---                            | FGWIR          |
|      |                                                  |           |           |                                |                |
| R19B | Wet weight crop yield for Non-Leafy (kg/m**2)    | 7.000E-01 | 7.000E-01 | ---                            | YV(1)          |
| R19B | Wet weight crop yield for Leafy (kg/m**2)        | 1.500E+00 | 1.500E+00 | ---                            | YV(2)          |
| R19B | Wet weight crop yield for Fodder (kg/m**2)       | not used  | 1.100E+00 | ---                            | YV(3)          |
| R19B | Growing Season for Non-Leafy (years)             | 1.700E-01 | 1.700E-01 | ---                            | TE(1)          |
| R19B | Growing Season for Leafy (years)                 | 2.500E-01 | 2.500E-01 | ---                            | TE(2)          |
| R19B | Growing Season for Fodder (years)                | not used  | 8.000E-02 | ---                            | TE(3)          |
| R19B | Translocation Factor for Non-Leafy               | 1.000E-01 | 1.000E-01 | ---                            | TIV(1)         |
| R19B | Translocation Factor for Leafy                   | 1.000E+00 | 1.000E+00 | ---                            | TIV(2)         |
| R19B | Translocation Factor for Fodder                  | not used  | 1.000E+00 | ---                            | TIV(3)         |
| R19B | Dry Foliar Interception Fraction for Non-Leafy   | 2.500E-01 | 2.500E-01 | ---                            | RDRY(1)        |
| R19B | Dry Foliar Interception Fraction for Leafy       | 2.500E-01 | 2.500E-01 | ---                            | RDRY(2)        |
| R19B | Dry Foliar Interception Fraction for Fodder      | not used  | 2.500E-01 | ---                            | RDRY(3)        |
| R19B | Wet Foliar Interception Fraction for Non-Leafy   | 2.500E-01 | 2.500E-01 | ---                            | RWET(1)        |
| R19B | Wet Foliar Interception Fraction for Leafy       | 2.500E-01 | 2.500E-01 | ---                            | RWET(2)        |
| R19B | Wet Foliar Interception Fraction for Fodder      | not used  | 2.500E-01 | ---                            | RWET(3)        |
| R19B | Weathering Removal Constant for Vegetation       | 2.000E+01 | 2.000E+01 | ---                            | WLAM           |
|      |                                                  |           |           |                                |                |
| C14  | C-12 concentration in water (g/cm**3)            | not used  | 2.000E-05 | ---                            | C12WTR         |
| C14  | C-12 concentration in contaminated soil (g/g)    | not used  | 3.000E-02 | ---                            | C12CZ          |
| C14  | Fraction of vegetation carbon from soil          | not used  | 2.000E-02 | ---                            | CSOIL          |

Summary : 811 area-Resident-surface-No Bkgd subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User<br>Input | Default    | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|------|--------------------------------------------------|---------------|------------|--------------------------------------------------|-------------------|
| C14  | Fraction of vegetation carbon from air           | not used      | 9.800E-01  | ---                                              | CAIR              |
| C14  | C-14 evasion layer thickness in soil (m)         | not used      | 3.000E-01  | ---                                              | DMC               |
| C14  | C-14 evasion flux rate from soil (l/sec)         | not used      | 7.000E-07  | ---                                              | EVSN              |
| C14  | C-12 evasion flux rate from soil (l/sec)         | not used      | 1.000E-10  | ---                                              | REVSN             |
| C14  | Fraction of grain in beef cattle feed            | not used      | 8.000E-01  | ---                                              | AVFG4             |
| C14  | Fraction of grain in milk cow feed               | not used      | 2.000E-01  | ---                                              | AVFG5             |
| STOR | Storage times of contaminated foodstuffs (days): |               |            |                                                  |                   |
| STOR | Fruits, non-leafy vegetables, and grain          | 1.400E+01     | 1.400E+01  | ---                                              | STOR_T(1)         |
| STOR | Leafy vegetables                                 | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T(2)         |
| STOR | Milk                                             | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T(3)         |
| STOR | Meat and poultry                                 | 2.000E+01     | 2.000E+01  | ---                                              | STOR_T(4)         |
| STOR | Fish                                             | 7.000E+00     | 7.000E+00  | ---                                              | STOR_T(5)         |
| STOR | Crustacea and mollusks                           | 7.000E+00     | 7.000E+00  | ---                                              | STOR_T(6)         |
| STOR | Well water                                       | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T(7)         |
| STOR | Surface water                                    | 1.000E+00     | 1.000E+00  | ---                                              | STOR_T(8)         |
| STOR | Livestock fodder                                 | 4.500E+01     | 4.500E+01  | ---                                              | STOR_T(9)         |
| R021 | Thickness of building foundation (m)             | not used      | 1.500E-01  | ---                                              | FLOOR1            |
| R021 | Bulk density of building foundation (g/cm**3)    | not used      | 2.400E+00  | ---                                              | DENSFL            |
| R021 | Total porosity of the cover material             | not used      | 4.000E-01  | ---                                              | TPCV              |
| R021 | Total porosity of the building foundation        | not used      | 1.000E-01  | ---                                              | TPFL              |
| R021 | Volumetric water content of the cover material   | not used      | 5.000E-02  | ---                                              | PH2OCV            |
| R021 | Volumetric water content of the foundation       | not used      | 3.000E-02  | ---                                              | PH2OFL            |
| R021 | Diffusion coefficient for radon gas (m/sec):     |               |            |                                                  |                   |
| R021 | in cover material                                | not used      | 2.000E-06  | ---                                              | DIFCV             |
| R021 | in foundation material                           | not used      | 3.000E-07  | ---                                              | DIFFL             |
| R021 | in contaminated zone soil                        | not used      | 2.000E-06  | ---                                              | DIFCZ             |
| R021 | Radon vertical dimension of mixing (m)           | not used      | 2.000E+00  | ---                                              | HMIX              |
| R021 | Average building air exchange rate (1/hr)        | not used      | 5.000E-01  | ---                                              | REXG              |
| R021 | Height of the building (room) (m)                | not used      | 2.500E+00  | ---                                              | HRM               |
| R021 | Building interior area factor                    | not used      | 0.000E+00  | ---                                              | FAI               |
| R021 | Building depth below ground surface (m)          | not used      | -1.000E+00 | ---                                              | DMFL              |
| R021 | Emanating power of Rn-222 gas                    | not used      | 2.500E-01  | ---                                              | EMANA(1)          |
| R021 | Emanating power of Rn-220 gas                    | not used      | 1.500E-01  | ---                                              | EMANA(2)          |
| TITL | Number of graphical time points                  | 32            | ---        | ---                                              | NPTS              |
| TITL | Maximum number of integration points for dose    | 17            | ---        | ---                                              | LYMAX             |
| TITL | Maximum number of integration points for risk    | 65            | ---        | ---                                              | KYMAX             |

Summary : 811 area-Resident-surface-No Bkdg subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

Summary of Pathway Selections

| Pathway                     | User Selection |
|-----------------------------|----------------|
| 1 -- external gamma         | active         |
| 2 -- inhalation (w/o radon) | active         |
| 3 -- plant ingestion        | active         |
| 4 -- meat ingestion         | suppressed     |
| 5 -- milk ingestion         | suppressed     |
| 6 -- aquatic foods          | suppressed     |
| 7 -- drinking water         | active         |
| 8 -- soil ingestion         | active         |
| 9 -- radon                  | suppressed     |
| Find peak pathway doses     | active         |

Summary : 811 area-Resident-surface-No Bkg subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

| Contaminated Zone Dimensions |                       | Initial Soil Concentrations, pCi/g |           |
|------------------------------|-----------------------|------------------------------------|-----------|
| Area:                        | 1860.00 square meters | Cs-137                             | 3.854E+00 |
| Thickness:                   | 5.00 meters           | Ra-226                             | 4.960E-01 |
| Cover Depth:                 | 0.00 meters           | Sr-90                              | 2.140E-01 |
|                              |                       | U-238                              | 4.470E-01 |

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 1.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

|            |           |           |           |           |           |           |           |           |
|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| t (years): | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| TDOSE(t):  | 1.336E+01 | 1.326E+01 | 1.286E+01 | 1.241E+01 | 9.967E+00 | 8.488E+00 | 4.155E+00 | 1.875E+00 |
| M(t):      | 8.907E-01 | 8.839E-01 | 8.575E-01 | 8.271E-01 | 6.645E-01 | 5.659E-01 | 2.770E-01 | 1.250E-01 |

Maximum TDOSE(t): 1.336E+01 mrem/yr at t = 0.000E+00 years

Summary : 811 area-Resident-surface-No Bkdg subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 7.091E+00 | 0.5308 | 9.774E-06  | 0.0000 | 0.000E+00 | 0.0000 | 6.671E-01 | 0.0499 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.297E-03 | 0.0005 |
| Ra-226            | 3.045E+00 | 0.2279 | 3.129E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.844E+00 | 0.1380 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.866E-02 | 0.0014 |
| Sr-90             | 5.058E-03 | 0.0004 | 2.172E-06  | 0.0000 | 0.000E+00 | 0.0000 | 6.175E-01 | 0.0462 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.772E-04 | 0.0001 |
| U-238             | 4.269E-02 | 0.0032 | 2.340E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.725E-02 | 0.0013 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.605E-03 | 0.0002 |
| Total             | 1.018E+01 | 0.7622 | 5.589E-04  | 0.0000 | 0.000E+00 | 0.0000 | 3.146E+00 | 0.2355 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.834E-02 | 0.0021 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.295E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.600E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.765E+00     | 0.5812 |
| Ra-226            | 1.062E-03 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.402E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.909E+00     | 0.3674 |
| Sr-90             | 2.637E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.964E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.236E-01     | 0.0467 |
| U-238             | 3.087E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.131E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.311E-02     | 0.0047 |
| Total             | 1.647E-03 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.158E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.336E+01     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-surface-No Bkdg subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.928E+00 | 0.5225 | 9.549E-06  | 0.0000 | 0.000E+00 | 0.0000 | 6.518E-01 | 0.0492 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.152E-03 | 0.0005 |
| Ra-226            | 3.040E+00 | 0.2293 | 3.222E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.935E+00 | 0.1459 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.210E-02 | 0.0017 |
| Sr-90             | 4.924E-03 | 0.0004 | 2.115E-06  | 0.0000 | 0.000E+00 | 0.0000 | 6.012E-01 | 0.0453 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.566E-04 | 0.0001 |
| U-238             | 4.263E-02 | 0.0032 | 2.337E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.722E-02 | 0.0013 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.601E-03 | 0.0002 |
| Total             | 1.002E+01 | 0.7554 | 5.675E-04  | 0.0000 | 0.000E+00 | 0.0000 | 3.205E+00 | 0.2417 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.161E-02 | 0.0024 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 3.828E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.710E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.586E+00     | 0.5722 |
| Ra-226            | 3.508E-03 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.528E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.001E+00     | 0.3772 |
| Sr-90             | 7.757E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.969E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.077E-01     | 0.0458 |
| U-238             | 9.282E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.625E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.368E-02     | 0.0048 |
| Total             | 5.250E-03 | 0.0004 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.814E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.326E+01     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-surface-No Bkdg subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.312E+00 | 0.4908 | 8.700E-06  | 0.0000 | 0.000E+00 | 0.0000 | 5.938E-01 | 0.0462 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.606E-03 | 0.0004 |
| Ra-226            | 3.021E+00 | 0.2349 | 3.562E-04  | 0.0000 | 0.000E+00 | 0.0000 | 2.262E+00 | 0.1758 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.477E-02 | 0.0027 |
| Sr-90             | 4.424E-03 | 0.0003 | 1.900E-06  | 0.0000 | 0.000E+00 | 0.0000 | 5.402E-01 | 0.0420 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.798E-04 | 0.0001 |
| U-238             | 4.235E-02 | 0.0033 | 2.322E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.711E-02 | 0.0013 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.584E-03 | 0.0002 |
| Total             | 9.380E+00 | 0.7293 | 5.990E-04  | 0.0000 | 0.000E+00 | 0.0000 | 3.413E+00 | 0.2653 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.364E-02 | 0.0034 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.284E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.352E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.912E+00     | 0.5374 |
| Ra-226            | 1.761E-02 | 0.0014 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.286E-03 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.337E+00     | 0.4149 |
| Sr-90             | 2.575E-03 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.011E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.481E-01     | 0.0426 |
| U-238             | 3.397E-03 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.462E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.592E-02     | 0.0051 |
| Total             | 2.371E-02 | 0.0018 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.743E-03 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.286E+01     | 1.0000 |

\*Sum of all water independent and dependent pathways.



Summary : 811 area-Resident-surface-No Bkdg subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 5.619E+00 | 0.4529 | 7.745E-06  | 0.0000 | 0.000E+00 | 0.0000 | 5.286E-01 | 0.0426 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.990E-03 | 0.0004 |
| Ra-226            | 2.997E+00 | 0.2416 | 3.924E-04  | 0.0000 | 0.000E+00 | 0.0000 | 2.611E+00 | 0.2104 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.834E-02 | 0.0039 |
| Sr-90             | 3.870E-03 | 0.0003 | 1.662E-06  | 0.0000 | 0.000E+00 | 0.0000 | 4.725E-01 | 0.0381 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.947E-04 | 0.0000 |
| U-238             | 4.201E-02 | 0.0034 | 2.303E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.698E-02 | 0.0014 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.564E-03 | 0.0002 |
| Total             | 8.663E+00 | 0.6982 | 6.321E-04  | 0.0001 | 0.000E+00 | 0.0000 | 3.629E+00 | 0.2925 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.649E-02 | 0.0046 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 2.186E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.599E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.153E+00     | 0.4959 |
| Ra-226            | 4.355E-02 | 0.0035 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.185E-03 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.704E+00     | 0.4597 |
| Sr-90             | 4.331E-03 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.391E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.817E-01     | 0.0388 |
| U-238             | 6.461E-03 | 0.0005 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.694E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.871E-02     | 0.0055 |
| Total             | 5.456E-02 | 0.0044 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.009E-03 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.241E+01     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-surface-No Bkdg subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.216E+00 | 0.2223 | 3.054E-06  | 0.0000 | 0.000E+00 | 0.0000 | 2.084E-01 | 0.0209 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.968E-03 | 0.0002 |
| Ra-226            | 2.814E+00 | 0.2824 | 5.251E-04  | 0.0001 | 0.000E+00 | 0.0000 | 3.924E+00 | 0.3938 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.010E-01 | 0.0101 |
| Sr-90             | 1.327E-03 | 0.0001 | 5.698E-07  | 0.0000 | 0.000E+00 | 0.0000 | 1.620E-01 | 0.0163 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.039E-04 | 0.0000 |
| U-238             | 3.938E-02 | 0.0040 | 2.159E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.592E-02 | 0.0016 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.404E-03 | 0.0002 |
| Total             | 5.071E+00 | 0.5088 | 7.446E-04  | 0.0001 | 0.000E+00 | 0.0000 | 4.311E+00 | 0.4325 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.056E-01 | 0.0106 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 4.175E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.068E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.427E+00     | 0.2435 |
| Ra-226            | 4.114E-01 | 0.0413 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.008E-02 | 0.0030 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.282E+00     | 0.7306 |
| Sr-90             | 4.431E-03 | 0.0004 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.479E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.683E-01     | 0.0169 |
| U-238             | 3.008E-02 | 0.0030 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.191E-03 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.019E-02     | 0.0090 |
| Total             | 4.463E-01 | 0.0448 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.265E-02 | 0.0033 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.967E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.923E-01 | 0.0816 | 9.542E-07  | 0.0000 | 0.000E+00 | 0.0000 | 6.513E-02 | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.148E-04 | 0.0001 |
| Ra-226            | 2.600E+00 | 0.3063 | 5.326E-04  | 0.0001 | 0.000E+00 | 0.0000 | 4.073E+00 | 0.4798 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.102E-01 | 0.0130 |
| Sr-90             | 3.481E-04 | 0.0000 | 1.495E-07  | 0.0000 | 0.000E+00 | 0.0000 | 4.251E-02 | 0.0050 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.349E-05 | 0.0000 |
| U-238             | 3.633E-02 | 0.0043 | 1.992E-04  | 0.0000 | 0.000E+00 | 0.0000 | 1.468E-02 | 0.0017 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.218E-03 | 0.0003 |
| Total             | 3.329E+00 | 0.3922 | 7.329E-04  | 0.0001 | 0.000E+00 | 0.0000 | 4.195E+00 | 0.4942 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.131E-01 | 0.0133 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 2.618E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.925E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.583E-01     | 0.0893 |
| Ra-226            | 7.625E-01 | 0.0898 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.576E-02 | 0.0066 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.601E+00     | 0.8955 |
| Sr-90             | 1.160E-03 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.106E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.416E-02     | 0.0052 |
| U-238             | 2.898E-02 | 0.0034 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.112E-03 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.452E-02     | 0.0100 |
| Total             | 7.929E-01 | 0.0934 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.798E-02 | 0.0068 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.488E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-surface-No Bkdg subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.289E-05 | 0.0000 | 8.668E-11  | 0.0000 | 0.000E+00 | 0.0000 | 5.917E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.585E-08 | 0.0000 |
| Ra-226            | 1.378E+00 | 0.3316 | 2.893E-04  | 0.0001 | 0.000E+00 | 0.0000 | 2.225E+00 | 0.5354 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.092E-02 | 0.0147 |
| Sr-90             | 7.815E-09 | 0.0000 | 3.356E-12  | 0.0000 | 0.000E+00 | 0.0000 | 9.541E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.201E-09 | 0.0000 |
| U-238             | 1.905E-02 | 0.0046 | 1.046E-04  | 0.0000 | 0.000E+00 | 0.0000 | 7.709E-03 | 0.0019 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.164E-03 | 0.0003 |
| Total             | 1.397E+00 | 0.3362 | 3.939E-04  | 0.0001 | 0.000E+00 | 0.0000 | 2.232E+00 | 0.5373 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.209E-02 | 0.0149 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.267E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.320E-09 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.900E-05     | 0.0000 |
| Ra-226            | 4.166E-01 | 0.1003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.046E-02 | 0.0073 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.111E+00     | 0.9894 |
| Sr-90             | 2.547E-08 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.000E-09 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.906E-07     | 0.0000 |
| U-238             | 1.493E-02 | 0.0036 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.088E-03 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.405E-02     | 0.0106 |
| Total             | 4.315E-01 | 0.1039 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.155E-02 | 0.0076 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.155E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-surface-No Bkdg subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 5.578E-10 | 0.0000 | 7.688E-16  | 0.0000 | 0.000E+00 | 0.0000 | 5.248E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.954E-13 | 0.0000 |
| Ra-226            | 6.232E-01 | 0.3324 | 1.309E-04  | 0.0001 | 0.000E+00 | 0.0000 | 1.006E+00 | 0.5366 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.755E-02 | 0.0147 |
| Sr-90             | 1.207E-14 | 0.0000 | 5.185E-18  | 0.0000 | 0.000E+00 | 0.0000 | 1.474E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.855E-15 | 0.0000 |
| U-238             | 8.501E-03 | 0.0045 | 4.676E-05  | 0.0000 | 0.000E+00 | 0.0000 | 3.447E-03 | 0.0018 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.203E-04 | 0.0003 |
| Total             | 6.317E-01 | 0.3369 | 1.776E-04  | 0.0001 | 0.000E+00 | 0.0000 | 1.010E+00 | 0.5385 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.807E-02 | 0.0150 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.242E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.138E-14 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.121E-10     | 0.0000 |
| Ra-226            | 1.849E-01 | 0.0986 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.352E-02 | 0.0072 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.855E+00     | 0.9896 |
| Sr-90             | 3.791E-14 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.977E-15 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.529E-12     | 0.0000 |
| U-238             | 6.462E-03 | 0.0034 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.709E-04 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.945E-02     | 0.0104 |
| Total             | 1.914E-01 | 0.1021 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.399E-02 | 0.0075 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.875E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

| Parent<br>(i) | Product<br>(j) | Thread<br>Fraction | DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) |           |           |           |           |           |           |           |
|---------------|----------------|--------------------|---------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               |                |                    | 0.000E+00                                   | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137+D      | Cs-137+D       | 1.000E+00          | 2.015E+00                                   | 1.968E+00 | 1.793E+00 | 1.597E+00 | 6.296E-01 | 1.968E-01 | 1.790E-05 | 1.588E-10 |
| Ra-226+D      | Ra-226+D       | 1.000E+00          | 9.781E+00                                   | 9.770E+00 | 9.725E+00 | 9.670E+00 | 9.238E+00 | 8.636E+00 | 4.575E+00 | 2.067E+00 |
| Ra-226+D      | Pb-210+D       | 1.000E+00          | 1.160E-01                                   | 3.125E-01 | 1.034E+00 | 1.830E+00 | 5.443E+00 | 6.689E+00 | 3.714E+00 | 1.674E+00 |
| Ra-226+D      | ΣDSR(j)        |                    | 9.897E+00                                   | 1.008E+01 | 1.076E+01 | 1.150E+01 | 1.468E+01 | 1.533E+01 | 8.289E+00 | 3.741E+00 |
| Sr-90+D       | Sr-90+D        | 1.000E+00          | 2.914E+00                                   | 2.840E+00 | 2.561E+00 | 2.251E+00 | 7.866E-01 | 2.063E-01 | 4.629E-06 | 7.145E-12 |
| U-238         | U-238          | 5.450E-07          | 2.322E-08                                   | 2.393E-08 | 2.679E-08 | 3.033E-08 | 5.764E-08 | 5.466E-08 | 2.832E-08 | 1.238E-08 |
| U-238+D       | U-238+D        | 1.000E+00          | 1.412E-01                                   | 1.425E-01 | 1.475E-01 | 1.537E-01 | 2.018E-01 | 1.891E-01 | 9.846E-02 | 4.343E-02 |
| U-238+D       | U-234          | 1.000E+00          | 6.728E-08                                   | 2.073E-07 | 8.496E-07 | 1.835E-06 | 1.675E-05 | 3.161E-05 | 8.153E-05 | 7.119E-05 |
| U-238+D       | Th-230         | 1.000E+00          | 5.188E-13                                   | 3.344E-12 | 4.088E-11 | 1.466E-10 | 3.218E-09 | 1.206E-08 | 1.976E-07 | 4.875E-07 |
| U-238+D       | Ra-226+D       | 1.000E+00          | 3.772E-11                                   | 1.264E-10 | 4.044E-10 | 9.029E-10 | 6.366E-09 | 2.105E-08 | 1.315E-06 | 5.971E-06 |
| U-238+D       | Pb-210+D       | 1.000E+00          | 1.806E-10                                   | 6.108E-10 | 1.942E-09 | 4.225E-09 | 1.994E-08 | 2.805E-08 | 8.729E-07 | 4.301E-06 |
| U-238+D       | ΣDSR(j)        |                    | 1.412E-01                                   | 1.425E-01 | 1.475E-01 | 1.537E-01 | 2.018E-01 | 1.891E-01 | 9.855E-02 | 4.351E-02 |

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

| Nuclide<br>(i) | t=        | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Cs-137         | 7.445E+00 | 7.621E+00 | 8.364E+00 | 9.395E+00 | 2.382E+01 | 7.623E+01 | 8.378E+05 | 9.444E+10 |           |
| Ra-226         | 1.516E+00 | 1.488E+00 | 1.394E+00 | 1.304E+00 | 1.022E+00 | 9.788E-01 | 1.810E+00 | 4.010E+00 |           |
| Sr-90          | 5.147E+00 | 5.282E+00 | 5.857E+00 | 6.664E+00 | 1.907E+01 | 7.269E+01 | 3.240E+06 | 2.099E+12 |           |
| U-238          | 1.062E+02 | 1.053E+02 | 1.017E+02 | 9.758E+01 | 7.434E+01 | 7.933E+01 | 1.522E+02 | 3.448E+02 |           |

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
at tmin = time of minimum single radionuclide soil guideline  
and at tmax = time of maximum total dose = 0.000E+00 years

| Nuclide<br>(i) | Initial<br>(pCi/g) | tmin<br>(years) | DSR(i,tmin) | G(i,tmin)<br>(pCi/g) | DSR(i,tmax) | G(i,tmax)<br>(pCi/g) |
|----------------|--------------------|-----------------|-------------|----------------------|-------------|----------------------|
| Cs-137         | 3.854E+00          | 0.000E+00       | 2.015E+00   | 7.445E+00            | 2.015E+00   | 7.445E+00            |
| Ra-226         | 4.960E-01          | 81.7 ± 0.2      | 1.546E+01   | 9.704E-01            | 9.897E+00   | 1.516E+00            |
| Sr-90          | 2.140E-01          | 0.000E+00       | 2.914E+00   | 5.147E+00            | 2.914E+00   | 5.147E+00            |
| U-238          | 4.470E-01          | 52.5 ± 0.1      | 2.042E-01   | 7.344E+01            | 1.412E-01   | 1.062E+02            |

Summary : 811 area-Resident-surface-No Bkgd subtract-A

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-A.RAD

## Individual Nuclide Dose Summed Over All Pathways

Parent Nuclide and Branch Fraction Indicated

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | DOSE(j,t), mrem/yr |           |           |           |           |           |           |           |
|----------------|---------------|-----------|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t=                 | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 |
| Cs-137         | Cs-137        | 1.000E+00 | 7.765E+00          | 7.586E+00 | 6.912E+00 | 6.153E+00 | 2.427E+00 | 7.583E-01 | 6.900E-05 | 6.121E-10 |
| Ra-226         | Ra-226        | 1.000E+00 | 4.852E+00          | 4.846E+00 | 4.824E+00 | 4.796E+00 | 4.582E+00 | 4.284E+00 | 2.269E+00 | 1.025E+00 |
| Ra-226         | U-238         | 1.000E+00 | 1.686E-11          | 5.652E-11 | 1.808E-10 | 4.036E-10 | 2.846E-09 | 9.410E-09 | 5.876E-07 | 2.669E-06 |
| Ra-226         | ΣDOSE(j)      |           | 4.852E+00          | 4.846E+00 | 4.824E+00 | 4.796E+00 | 4.582E+00 | 4.284E+00 | 2.269E+00 | 1.025E+00 |
| Pb-210         | Ra-226        | 1.000E+00 | 5.754E-02          | 1.550E-01 | 5.130E-01 | 9.074E-01 | 2.700E+00 | 3.318E+00 | 1.842E+00 | 8.302E-01 |
| Pb-210         | U-238         | 1.000E+00 | 8.075E-11          | 2.730E-10 | 8.683E-10 | 1.889E-09 | 8.915E-09 | 1.254E-08 | 3.902E-07 | 1.923E-06 |
| Pb-210         | ΣDOSE(j)      |           | 5.754E-02          | 1.550E-01 | 5.130E-01 | 9.074E-01 | 2.700E+00 | 3.318E+00 | 1.842E+00 | 8.302E-01 |
| Sr-90          | Sr-90         | 1.000E+00 | 6.236E-01          | 6.077E-01 | 5.481E-01 | 4.817E-01 | 1.683E-01 | 4.416E-02 | 9.906E-07 | 1.529E-12 |
| U-238          | U-238         | 5.450E-07 | 1.038E-08          | 1.070E-08 | 1.197E-08 | 1.356E-08 | 2.576E-08 | 2.443E-08 | 1.266E-08 | 5.534E-09 |
| U-238          | U-238         | 1.000E+00 | 6.311E-02          | 6.368E-02 | 6.592E-02 | 6.871E-02 | 9.019E-02 | 8.451E-02 | 4.401E-02 | 1.941E-02 |
| U-238          | ΣDOSE(j)      |           | 6.311E-02          | 6.368E-02 | 6.592E-02 | 6.871E-02 | 9.019E-02 | 8.451E-02 | 4.401E-02 | 1.941E-02 |
| U-234          | U-238         | 1.000E+00 | 3.007E-08          | 9.267E-08 | 3.798E-07 | 8.204E-07 | 7.488E-06 | 1.413E-05 | 3.644E-05 | 3.182E-05 |
| Th-230         | U-238         | 1.000E+00 | 2.319E-13          | 1.495E-12 | 1.827E-11 | 6.551E-11 | 1.439E-09 | 5.392E-09 | 8.834E-08 | 2.179E-07 |

THF(i) is the thread fraction of the parent nuclide.

## Individual Nuclide Soil Concentration

Parent Nuclide and Branch Fraction Indicated

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | S(j,t), pCi/g |           |           |           |           |           |           |           |
|----------------|---------------|-----------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t=            | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 |
| Cs-137         | Cs-137        | 1.000E+00 | 3.854E+00     | 3.765E+00 | 3.431E+00 | 3.054E+00 | 1.204E+00 | 3.763E-01 | 3.418E-05 | 3.032E-10 |
| Ra-226         | Ra-226        | 1.000E+00 | 4.960E-01     | 4.952E-01 | 4.921E-01 | 4.882E-01 | 4.582E-01 | 4.232E-01 | 2.243E-01 | 1.014E-01 |
| Ra-226         | U-238         | 1.000E+00 | 0.000E+00     | 8.369E-16 | 1.041E-13 | 8.279E-13 | 9.862E-11 | 7.430E-10 | 5.800E-08 | 2.639E-07 |
| Ra-226         | ΣS(j):        |           | 4.960E-01     | 4.952E-01 | 4.921E-01 | 4.882E-01 | 4.582E-01 | 4.232E-01 | 2.243E-01 | 1.014E-01 |
| Pb-210         | Ra-226        | 1.000E+00 | 0.000E+00     | 1.523E-02 | 7.126E-02 | 1.314E-01 | 3.673E-01 | 4.134E-01 | 2.301E-01 | 1.040E-01 |
| Pb-210         | U-238         | 1.000E+00 | 0.000E+00     | 6.493E-18 | 3.941E-15 | 6.083E-14 | 2.911E-11 | 3.482E-10 | 4.864E-08 | 2.422E-07 |
| Pb-210         | ΣS(j):        |           | 0.000E+00     | 1.523E-02 | 7.126E-02 | 1.314E-01 | 3.673E-01 | 4.134E-01 | 2.301E-01 | 1.040E-01 |
| Sr-90          | Sr-90         | 1.000E+00 | 2.140E-01     | 2.083E-01 | 1.872E-01 | 1.638E-01 | 5.614E-02 | 1.473E-02 | 3.306E-07 | 5.109E-13 |
| U-238          | U-238         | 5.450E-07 | 2.436E-07     | 2.432E-07 | 2.417E-07 | 2.397E-07 | 2.247E-07 | 2.073E-07 | 1.087E-07 | 4.850E-08 |
| U-238          | U-238         | 1.000E+00 | 4.470E-01     | 4.463E-01 | 4.434E-01 | 4.398E-01 | 4.123E-01 | 3.804E-01 | 1.994E-01 | 8.899E-02 |
| U-238          | ΣS(j):        |           | 4.470E-01     | 4.463E-01 | 4.434E-01 | 4.398E-01 | 4.123E-01 | 3.804E-01 | 1.994E-01 | 8.899E-02 |
| U-234          | U-238         | 1.000E+00 | 0.000E+00     | 1.260E-06 | 6.260E-06 | 1.242E-05 | 5.821E-05 | 1.074E-04 | 2.814E-04 | 2.509E-04 |
| Th-230         | U-238         | 1.000E+00 | 0.000E+00     | 5.796E-12 | 1.443E-10 | 5.740E-10 | 1.375E-08 | 5.212E-08 | 8.609E-07 | 2.125E-06 |

THF(i) is the thread fraction of the parent nuclide.

RESICALC.EXE execution time = 10.82 seconds





Summary : Bldg 811 Area-Deep-Industrial-Bkgd subtract-H

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-BKD SUBTR-DEEP-H.RAD

Individual Nuclide Dose Summed Over All Pathways  
Parent Nuclide and Branch Fraction Indicated

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | DOSE(j,t), mrem/yr |           |           |           |           |           |           |           |
|----------------|---------------|-----------|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t= 0.000E+00       | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 7.277E-03          | 7.375E-03 | 7.698E-03 | 7.968E-03 | 7.201E-03 | 4.487E-03 | 6.063E-05 | 2.467E-09 |
| Sr-90          | Sr-90         | 1.000E+00 | 1.249E-02          | 3.653E-02 | 6.484E-02 | 5.306E-02 | 1.068E-02 | 1.441E-03 | 1.578E-10 | 3.044E-19 |
| U-238          | U-238         | 5.450E-07 | 7.107E-10          | 2.136E-09 | 7.798E-09 | 1.478E-08 | 2.150E-08 | 1.864E-08 | 5.961E-09 | 1.379E-09 |
| U-238          | U-238         | 1.000E+00 | 1.407E-03          | 4.220E-03 | 1.540E-02 | 2.919E-02 | 4.246E-02 | 3.681E-02 | 1.233E-02 | 3.394E-03 |
| U-238          | ΣDOSE(j)      |           | 1.407E-03          | 4.220E-03 | 1.540E-02 | 2.919E-02 | 4.246E-02 | 3.681E-02 | 1.233E-02 | 3.394E-03 |
| U-234          | U-238         | 1.000E+00 | 6.257E-10          | 4.356E-09 | 5.620E-08 | 2.033E-07 | 2.243E-06 | 4.071E-06 | 9.981E-06 | 8.647E-06 |
| Th-230         | U-238         | 1.000E+00 | 2.911E-14          | 8.406E-14 | 3.033E-13 | 5.894E-13 | 5.799E-12 | 1.411E-11 | 1.947E-09 | 1.634E-08 |
| Ra-226         | U-238         | 1.000E+00 | 3.279E-11          | 9.434E-11 | 3.349E-10 | 6.250E-10 | 4.844E-09 | 8.119E-09 | 6.225E-08 | 5.684E-07 |
| Pb-210         | U-238         | 1.000E+00 | 1.564E-10          | 4.499E-10 | 1.597E-09 | 2.980E-09 | 2.306E-08 | 3.842E-08 | 1.486E-07 | 4.151E-07 |

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration  
Parent Nuclide and Branch Fraction Indicated

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | S(j,t), pCi/g |           |           |           |           |           |           |           |
|----------------|---------------|-----------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t= 0.000E+00  | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 5.050E+01     | 4.934E+01 | 4.498E+01 | 4.006E+01 | 1.586E+01 | 4.984E+00 | 4.728E-04 | 4.427E-09 |
| Sr-90          | Sr-90         | 1.000E+00 | 2.140E-01     | 2.056E-01 | 1.751E-01 | 1.432E-01 | 2.873E-02 | 3.856E-03 | 4.067E-10 | 7.730E-19 |
| U-238          | U-238         | 5.450E-07 | 2.436E-07     | 2.429E-07 | 2.400E-07 | 2.365E-07 | 2.102E-07 | 1.814E-07 | 5.572E-08 | 1.274E-08 |
| U-238          | U-238         | 1.000E+00 | 4.470E-01     | 4.457E-01 | 4.405E-01 | 4.340E-01 | 3.857E-01 | 3.328E-01 | 1.022E-01 | 2.339E-02 |
| U-238          | ΣS(j):        |           | 4.470E-01     | 4.457E-01 | 4.405E-01 | 4.340E-01 | 3.857E-01 | 3.328E-01 | 1.022E-01 | 2.339E-02 |
| U-234          | U-238         | 1.000E+00 | 0.000E+00     | 1.260E-06 | 6.248E-06 | 1.237E-05 | 5.717E-05 | 1.037E-04 | 2.436E-04 | 2.026E-04 |
| Th-230         | U-238         | 1.000E+00 | 0.000E+00     | 5.795E-12 | 1.441E-10 | 5.726E-10 | 1.358E-08 | 5.092E-08 | 7.827E-07 | 1.835E-06 |
| Ra-226         | U-238         | 1.000E+00 | 0.000E+00     | 8.369E-16 | 1.041E-13 | 8.273E-13 | 9.827E-11 | 7.380E-10 | 5.670E-08 | 2.584E-07 |
| Pb-210         | U-238         | 1.000E+00 | 0.000E+00     | 6.493E-18 | 3.941E-15 | 6.083E-14 | 2.910E-11 | 3.476E-10 | 4.797E-08 | 2.391E-07 |

THF(i) is the thread fraction of the parent nuclide.

RESRAD-ONSITE execution time = 19.65 seconds

## Attachment 1

### BROOKHAVEN NATIONAL LABORATORY

#### Data Usability Summary Report

|                        |                          |
|------------------------|--------------------------|
| Project:               | Bldg 811 Excavation      |
| Sampling Contractor:   | PW Grosser               |
| Analytical Laboratory: | General Engineering Labs |
| Analytical Method:     | DOE HASL 300 / EPA 905   |
| Sample Delivery Group: | 37205 (387066)           |
| COC No. / Sample IDs:  | 37205 / 001-007          |
| Date Sampled:          | 12/1/15                  |
| Parameter(s):          | Gamma Scans, Sr-90       |

| SAMPLE ID         | DATA<br>USABILITY<br>QUALIFIERS | EXPLANATION FOR QUALIFIERS |
|-------------------|---------------------------------|----------------------------|
| 37205-<br>001-007 | No<br>Qualifiers                | N/A                        |

**Summary:** Data useable as reported by GEL.

Reviewed by: C. L. Lockwood for  
Project Manager  
A. Lockwood

Date: 8/25/16

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

|                                                            |    |
|------------------------------------------------------------|----|
| Dose Conversion Factor (and Related) Parameter Summary ... | 2  |
| Site-Specific Parameter Summary .....                      | 5  |
| Summary of Pathway Selections .....                        | 10 |
| Contaminated Zone and Total Dose Summary .....             | 11 |
| Total Dose Components                                      |    |
| Time = 0.000E+00 .....                                     | 12 |
| Time = 1.000E+00 .....                                     | 13 |
| Time = 5.000E+00 .....                                     | 14 |
| Time = 1.000E+01 .....                                     | 15 |
| Time = 5.000E+01 .....                                     | 16 |
| Time = 1.000E+02 .....                                     | 17 |
| Time = 5.000E+02 .....                                     | 18 |
| Time = 1.000E+03 .....                                     | 19 |
| Dose/Source Ratios Summed Over All Pathways .....          | 20 |
| Single Radionuclide Soil Guidelines .....                  | 20 |
| Dose Per Nuclide Summed Over All Pathways .....            | 21 |
| Soil Concentration Per Nuclide .....                       | 21 |

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| A-1  | DCF's for external ground radiation, (mrem/yr)/(pCi/g)   |                |            |                |
| A-1  | At-218 (Source: DCFPAK3.02)                              | 5.567E-05      | 5.567E-05  | DCF1( 1)       |
| A-1  | Ba-137m (Source: DCFPAK3.02)                             | 3.381E+00      | 3.381E+00  | DCF1( 2)       |
| A-1  | Bi-210 (Source: DCFPAK3.02)                              | 5.473E-03      | 5.473E-03  | DCF1( 3)       |
| A-1  | Bi-214 (Source: DCFPAK3.02)                              | 9.135E+00      | 9.135E+00  | DCF1( 4)       |
| A-1  | Cs-137 (Source: DCFPAK3.02)                              | 8.686E-04      | 8.686E-04  | DCF1( 5)       |
| A-1  | Hg-206 (Source: DCFPAK3.02)                              | 6.127E-01      | 6.127E-01  | DCF1( 6)       |
| A-1  | Pa-234 (Source: DCFPAK3.02)                              | 8.275E+00      | 8.275E+00  | DCF1( 7)       |
| A-1  | Pa-234m (Source: DCFPAK3.02)                             | 1.257E-01      | 1.257E-01  | DCF1( 8)       |
| A-1  | Pb-210 (Source: DCFPAK3.02)                              | 2.092E-03      | 2.092E-03  | DCF1( 9)       |
| A-1  | Pb-214 (Source: DCFPAK3.02)                              | 1.257E+00      | 1.257E+00  | DCF1( 10)      |
| A-1  | Po-210 (Source: DCFPAK3.02)                              | 5.641E-05      | 5.641E-05  | DCF1( 11)      |
| A-1  | Po-214 (Source: DCFPAK3.02)                              | 4.801E-04      | 4.801E-04  | DCF1( 12)      |
| A-1  | Po-218 (Source: DCFPAK3.02)                              | 9.228E-09      | 9.228E-09  | DCF1( 13)      |
| A-1  | Ra-226 (Source: DCFPAK3.02)                              | 3.176E-02      | 3.176E-02  | DCF1( 14)      |
| A-1  | Rn-218 (Source: DCFPAK3.02)                              | 4.259E-03      | 4.259E-03  | DCF1( 15)      |
| A-1  | Rn-222 (Source: DCFPAK3.02)                              | 2.130E-03      | 2.130E-03  | DCF1( 16)      |
| A-1  | Sr-90 (Source: DCFPAK3.02)                               | 6.463E-04      | 6.463E-04  | DCF1( 17)      |
| A-1  | Th-230 (Source: DCFPAK3.02)                              | 1.106E-03      | 1.106E-03  | DCF1( 18)      |
| A-1  | Th-234 (Source: DCFPAK3.02)                              | 2.316E-02      | 2.316E-02  | DCF1( 19)      |
| A-1  | Tl-206 (Source: DCFPAK3.02)                              | 1.278E-02      | 1.278E-02  | DCF1( 20)      |
| A-1  | Tl-210 (Source: DCFPAK3.02)                              | 1.677E+01      | 1.677E+01  | DCF1( 21)      |
| A-1  | U-234 (Source: DCFPAK3.02)                               | 3.456E-04      | 3.456E-04  | DCF1( 22)      |
| A-1  | U-238 (Source: DCFPAK3.02)                               | 1.713E-04      | 1.713E-04  | DCF1( 23)      |
| A-1  | Y-90 (Source: DCFPAK3.02)                                | 4.016E-02      | 4.016E-02  | DCF1( 24)      |
| B-1  | Dose conversion factors for inhalation, mrem/pCi:        |                |            |                |
| B-1  | Cs-137+D                                                 | 1.457E-04      | 1.457E-04  | DCF2( 1)       |
| B-1  | Pb-210+D                                                 | 3.708E-02      | 2.077E-02  | DCF2( 2)       |
| B-1  | Ra-226+D                                                 | 3.528E-02      | 3.517E-02  | DCF2( 3)       |
| B-1  | Sr-90+D                                                  | 5.841E-04      | 5.786E-04  | DCF2( 4)       |
| B-1  | Th-230                                                   | 3.759E-01      | 3.759E-01  | DCF2( 5)       |
| B-1  | U-234                                                    | 3.479E-02      | 3.479E-02  | DCF2( 6)       |
| B-1  | U-238                                                    | 2.973E-02      | 2.973E-02  | DCF2( 7)       |
| B-1  | U-238+D                                                  | 2.976E-02      | 2.973E-02  | DCF2( 8)       |
| D-1  | Dose conversion factors for ingestion, mrem/pCi:         |                |            |                |
| D-1  | Cs-137+D                                                 | 5.032E-05      | 5.032E-05  | DCF3( 1)       |
| D-1  | Pb-210+D                                                 | 7.057E-03      | 2.575E-03  | DCF3( 2)       |
| D-1  | Ra-226+D                                                 | 1.037E-03      | 1.036E-03  | DCF3( 3)       |
| D-1  | Sr-90+D                                                  | 1.120E-04      | 1.021E-04  | DCF3( 4)       |
| D-1  | Th-230                                                   | 7.918E-04      | 7.918E-04  | DCF3( 5)       |
| D-1  | U-234                                                    | 1.831E-04      | 1.831E-04  | DCF3( 6)       |
| D-1  | U-238                                                    | 1.650E-04      | 1.650E-04  | DCF3( 7)       |
| D-1  | U-238+D                                                  | 1.776E-04      | 1.650E-04  | DCF3( 8)       |
| D-34 | Food transfer factors:                                   |                |            |                |
| D-34 | Cs-137+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 1,1)      |
| D-34 | Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.000E-02      | 3.000E-02  | RTF( 1,2)      |
| D-34 | Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 1,3)      |

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| D-34 | Pb-210+D , plant/soil concentration ratio, dimensionless | 1.000E-02      | 1.000E-02  | RTF( 2,1)      |
| D-34 | Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-04      | 8.000E-04  | RTF( 2,2)      |
| D-34 | Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 3.000E-04      | 3.000E-04  | RTF( 2,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Ra-226+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 3,1)      |
| D-34 | Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-03      | 1.000E-03  | RTF( 3,2)      |
| D-34 | Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 1.000E-03      | 1.000E-03  | RTF( 3,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Sr-90+D , plant/soil concentration ratio, dimensionless  | 3.000E-01      | 3.000E-01  | RTF( 4,1)      |
| D-34 | Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 4,2)      |
| D-34 | Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 2.000E-03      | 2.000E-03  | RTF( 4,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Th-230 , plant/soil concentration ratio, dimensionless   | 1.000E-03      | 1.000E-03  | RTF( 5,1)      |
| D-34 | Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 1.000E-04      | 1.000E-04  | RTF( 5,2)      |
| D-34 | Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06      | 5.000E-06  | RTF( 5,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-234 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 6,1)      |
| D-34 | U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 6,2)      |
| D-34 | U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 6,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 7,1)      |
| D-34 | U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 7,2)      |
| D-34 | U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 7,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238+D , plant/soil concentration ratio, dimensionless  | 2.500E-03      | 2.500E-03  | RTF( 8,1)      |
| D-34 | U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04      | 3.400E-04  | RTF( 8,2)      |
| D-34 | U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04      | 6.000E-04  | RTF( 8,3)      |
| D-34 |                                                          |                |            |                |
| D-5  | Bioaccumulation factors, fresh water, L/kg:              |                |            |                |
| D-5  | Cs-137+D , fish                                          | 2.000E+03      | 2.000E+03  | BIOFAC( 1,1)   |
| D-5  | Cs-137+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 1,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Pb-210+D , fish                                          | 3.000E+02      | 3.000E+02  | BIOFAC( 2,1)   |
| D-5  | Pb-210+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 2,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Ra-226+D , fish                                          | 5.000E+01      | 5.000E+01  | BIOFAC( 3,1)   |
| D-5  | Ra-226+D , crustacea and mollusks                        | 2.500E+02      | 2.500E+02  | BIOFAC( 3,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Sr-90+D , fish                                           | 6.000E+01      | 6.000E+01  | BIOFAC( 4,1)   |
| D-5  | Sr-90+D , crustacea and mollusks                         | 1.000E+02      | 1.000E+02  | BIOFAC( 4,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Th-230 , fish                                            | 1.000E+02      | 1.000E+02  | BIOFAC( 5,1)   |
| D-5  | Th-230 , crustacea and mollusks                          | 5.000E+02      | 5.000E+02  | BIOFAC( 5,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-234 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 6,1)   |
| D-5  | U-234 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 6,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-238 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 7,1)   |
| D-5  | U-238 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 7,2)   |
| D-5  |                                                          |                |            |                |

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)  
Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter |                          | Current   | Base      | Parameter    |
|------|-----------|--------------------------|-----------|-----------|--------------|
|      |           |                          | Value#    | Case*     | Name         |
| D-5  | U-238D    | , fish                   | 1.000E+01 | 1.000E+01 | BIOFAC( 8,1) |
| D-5  | U-238D    | , crustacea and mollusks | 6.000E+01 | 6.000E+01 | BIOFAC( 8,2) |

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.  
\*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Site-Specific Parameter Summary

| Menu | Parameter                                       | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|-------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R011 | Area of contaminated zone (m**2)                | 1.860E+03  | 1.000E+04 | ---                                              | AREA           |
| R011 | Thickness of contaminated zone (m)              | 5.000E+00  | 2.000E+00 | ---                                              | THICK0         |
| R011 | Fraction of contamination that is submerged     | 0.000E+00  | 0.000E+00 | ---                                              | SUBMFRACT      |
| R011 | Length parallel to aquifer flow (m)             | 7.600E+01  | 1.000E+02 | ---                                              | LCZPAQ         |
| R011 | Basic radiation dose limit (mrem/yr)            | 1.500E+01  | 3.000E+01 | ---                                              | BRDL           |
| R011 | Time since placement of material (yr)           | 0.000E+00  | 0.000E+00 | ---                                              | TI             |
| R011 | Times for calculations (yr)                     | 1.000E+00  | 1.000E+00 | ---                                              | T( 2)          |
| R011 | Times for calculations (yr)                     | 5.000E+00  | 3.000E+00 | ---                                              | T( 3)          |
| R011 | Times for calculations (yr)                     | 1.000E+01  | 1.000E+01 | ---                                              | T( 4)          |
| R011 | Times for calculations (yr)                     | 5.000E+01  | 3.000E+01 | ---                                              | T( 5)          |
| R011 | Times for calculations (yr)                     | 1.000E+02  | 1.000E+02 | ---                                              | T( 6)          |
| R011 | Times for calculations (yr)                     | 5.000E+02  | 3.000E+02 | ---                                              | T( 7)          |
| R011 | Times for calculations (yr)                     | 1.000E+03  | 1.000E+03 | ---                                              | T( 8)          |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T( 9)          |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T(10)          |
| R012 | Initial principal radionuclide (pCi/g): Cs-137  | 3.854E+00  | 0.000E+00 | ---                                              | S1(1)          |
| R012 | Initial principal radionuclide (pCi/g): Ra-226  | 4.960E-01  | 0.000E+00 | ---                                              | S1(3)          |
| R012 | Initial principal radionuclide (pCi/g): Sr-90   | 2.140E-01  | 0.000E+00 | ---                                              | S1(4)          |
| R012 | Initial principal radionuclide (pCi/g): U-238   | 4.470E-01  | 0.000E+00 | ---                                              | S1(7)          |
| R012 | Concentration in groundwater (pCi/L): Cs-137    | not used   | 0.000E+00 | ---                                              | W1( 1)         |
| R012 | Concentration in groundwater (pCi/L): Ra-226    | not used   | 0.000E+00 | ---                                              | W1( 3)         |
| R012 | Concentration in groundwater (pCi/L): Sr-90     | not used   | 0.000E+00 | ---                                              | W1( 4)         |
| R012 | Concentration in groundwater (pCi/L): U-238     | not used   | 0.000E+00 | ---                                              | W1( 7)         |
| R013 | Cover depth (m)                                 | 0.000E+00  | 0.000E+00 | ---                                              | COVER0         |
| R013 | Density of cover material (g/cm**3)             | not used   | 1.500E+00 | ---                                              | DENSCV         |
| R013 | Cover depth erosion rate (m/yr)                 | not used   | 1.000E-03 | ---                                              | VCV            |
| R013 | Density of contaminated zone (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSCZ         |
| R013 | Contaminated zone erosion rate (m/yr)           | 1.000E-03  | 1.000E-03 | ---                                              | VCZ            |
| R013 | Contaminated zone total porosity                | 3.300E-01  | 4.000E-01 | ---                                              | TPCZ           |
| R013 | Contaminated zone field capacity                | 2.400E-01  | 2.000E-01 | ---                                              | FCCZ           |
| R013 | Contaminated zone hydraulic conductivity (m/yr) | 5.000E+03  | 1.000E+01 | ---                                              | HCCZ           |
| R013 | Contaminated zone b parameter                   | 4.900E+00  | 5.300E+00 | ---                                              | BCZ            |
| R013 | Average annual wind speed (m/sec)               | 6.230E+00  | 2.000E+00 | ---                                              | WIND           |
| R013 | Humidity in air (g/m**3)                        | not used   | 8.000E+00 | ---                                              | HUMID          |
| R013 | Evapotranspiration coefficient                  | 4.600E-01  | 5.000E-01 | ---                                              | EVAPTR         |
| R013 | Precipitation (m/yr)                            | 1.230E+00  | 1.000E+00 | ---                                              | PRECIP         |
| R013 | Irrigation (m/yr)                               | 2.600E-01  | 2.000E-01 | ---                                              | RI             |
| R013 | Irrigation mode                                 | overhead   | overhead  | ---                                              | IDITCH         |
| R013 | Runoff coefficient                              | 2.000E-01  | 2.000E-01 | ---                                              | RUNOFF         |
| R013 | Watershed area for nearby stream or pond (m**2) | 1.000E+06  | 1.000E+06 | ---                                              | WAREA          |
| R013 | Accuracy for water/soil computations            | 1.000E-03  | 1.000E-03 | ---                                              | EPS            |
| R014 | Density of saturated zone (g/cm**3)             | 1.660E+00  | 1.500E+00 | ---                                              | DENSAQ         |
| R014 | Saturated zone total porosity                   | 3.300E-01  | 4.000E-01 | ---                                              | TPSZ           |
| R014 | Saturated zone effective porosity               | 2.400E-01  | 2.000E-01 | ---                                              | EPSZ           |
| R014 | Saturated zone field capacity                   | 2.000E-01  | 2.000E-01 | ---                                              | FCSZ           |
| R014 | Saturated zone hydraulic conductivity (m/yr)    | 2.000E+04  | 1.000E+02 | ---                                              | HCSZ           |
| R014 | Saturated zone hydraulic gradient               | 4.800E-03  | 2.000E-02 | ---                                              | HGWT           |

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R014 | Saturated zone b parameter                     | 4.900E+00  | 5.300E+00 | ---                                              | BSZ            |
| R014 | Water table drop rate (m/yr)                   | 1.000E-03  | 1.000E-03 | ---                                              | VWT            |
| R014 | Well pump intake depth (m below water table)   | 1.800E+01  | 1.000E+01 | ---                                              | DWIBWT         |
| R014 | Model: Nondispersion (ND) or Mass-Balance (MB) | ND         | ND        | ---                                              | MODEL          |
| R014 | Well pumping rate (m**3/yr)                    | 2.500E+02  | 2.500E+02 | ---                                              | UW             |
| R015 | Number of unsaturated zone strata              | 1          | 1         | ---                                              | NS             |
| R015 | Unsat. zone 1, thickness (m)                   | 0.000E+00  | 4.000E+00 | ---                                              | H (1)          |
| R015 | Unsat. zone 1, soil density (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSUZ (1)     |
| R015 | Unsat. zone 1, total porosity                  | 3.300E-01  | 4.000E-01 | ---                                              | TPUZ (1)       |
| R015 | Unsat. zone 1, effective porosity              | 2.400E-01  | 2.000E-01 | ---                                              | EPUZ (1)       |
| R015 | Unsat. zone 1, field capacity                  | 2.000E-01  | 2.000E-01 | ---                                              | FCUZ (1)       |
| R015 | Unsat. zone 1, soil-specific b parameter       | 4.900E+00  | 5.300E+00 | ---                                              | BUZ (1)        |
| R015 | Unsat. zone 1, hydraulic conductivity (m/yr)   | 5.000E+03  | 1.000E+01 | ---                                              | HCUZ (1)       |
| R016 | Distribution coefficients for Cs-137           |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCC ( 1)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCU ( 1,1)  |
| R016 | Saturated zone (cm**3/g)                       | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCS ( 1)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 2.889E-04                                        | ALEACH ( 1)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 1)    |
| R016 | Distribution coefficients for Ra-226           |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+02  | 7.000E+01 | ---                                              | DCNUCC ( 3)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 5.000E+02  | 7.000E+01 | ---                                              | DCNUCU ( 3,1)  |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+02  | 7.000E+01 | ---                                              | DCNUCS ( 3)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.618E-04                                        | ALEACH ( 3)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 3)    |
| R016 | Distribution coefficients for Sr-90            |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 3.000E+00  | 3.000E+01 | ---                                              | DCNUCC ( 4)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 3.000E+00  | 3.000E+01 | ---                                              | DCNUCU ( 4,1)  |
| R016 | Saturated zone (cm**3/g)                       | 3.000E+00  | 3.000E+01 | ---                                              | DCNUCS ( 4)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 2.574E-02                                        | ALEACH ( 4)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 4)    |
| R016 | Distribution coefficients for U-238            |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 1.700E+01  | 5.000E+01 | ---                                              | DCNUCC ( 7)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 1.700E+01  | 5.000E+01 | ---                                              | DCNUCU ( 7,1)  |
| R016 | Saturated zone (cm**3/g)                       | 1.700E+01  | 5.000E+01 | ---                                              | DCNUCS ( 7)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 4.721E-03                                        | ALEACH ( 7)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 7)    |
| R016 | Distribution coefficients for daughter Pb-210  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCC ( 2)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCU ( 2,1)  |
| R016 | Saturated zone (cm**3/g)                       | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCS ( 2)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 8.082E-04                                        | ALEACH ( 2)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 2)    |



Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R016 | Distribution coefficients for daughter Th-230  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCC ( 5)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCU ( 5,1)  |
| R016 | Saturated zone (cm**3/g)                       | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCS ( 5)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.349E-06                                        | ALEACH ( 5)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 5)    |
| R016 | Distribution coefficients for daughter U-234   |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCC ( 6)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCU ( 6,1)  |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCS ( 6)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.614E-03                                        | ALEACH ( 6)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 6)    |
| R017 | Inhalation rate (m**3/yr)                      | 7.300E+03  | 8.400E+03 | ---                                              | INHALR         |
| R017 | Mass loading for inhalation (g/m**3)           | 1.000E-04  | 1.000E-04 | ---                                              | MLINH          |
| R017 | Exposure duration                              | 2.500E+01  | 3.000E+01 | ---                                              | ED             |
| R017 | Shielding factor, inhalation                   | 4.000E-01  | 4.000E-01 | ---                                              | SHF3           |
| R017 | Shielding factor, external gamma               | 8.000E-01  | 7.000E-01 | ---                                              | SHF1           |
| R017 | Fraction of time spent indoors                 | 1.700E-01  | 5.000E-01 | ---                                              | FIND           |
| R017 | Fraction of time spent outdoors (on site)      | 6.000E-02  | 2.500E-01 | ---                                              | FOTD           |
| R017 | Shape factor flag, external gamma              | 1.000E+00  | 1.000E+00 | >0 shows circular AREA.                          | FS             |
| R017 | Radii of shape factor array (used if FS = -1): |            |           |                                                  |                |
| R017 | Outer annular radius (m), ring 1:              | not used   | 5.000E+01 | ---                                              | RAD_SHAPE ( 1) |
| R017 | Outer annular radius (m), ring 2:              | not used   | 7.071E+01 | ---                                              | RAD_SHAPE ( 2) |
| R017 | Outer annular radius (m), ring 3:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 3) |
| R017 | Outer annular radius (m), ring 4:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 4) |
| R017 | Outer annular radius (m), ring 5:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 5) |
| R017 | Outer annular radius (m), ring 6:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 6) |
| R017 | Outer annular radius (m), ring 7:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 7) |
| R017 | Outer annular radius (m), ring 8:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 8) |
| R017 | Outer annular radius (m), ring 9:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 9) |
| R017 | Outer annular radius (m), ring 10:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(10)  |
| R017 | Outer annular radius (m), ring 11:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(11)  |
| R017 | Outer annular radius (m), ring 12:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(12)  |
| R017 | Fractions of annular areas within AREA:        |            |           |                                                  |                |
| R017 | Ring 1                                         | not used   | 1.000E+00 | ---                                              | FRACA ( 1)     |
| R017 | Ring 2                                         | not used   | 2.732E-01 | ---                                              | FRACA ( 2)     |
| R017 | Ring 3                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 3)     |
| R017 | Ring 4                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 4)     |
| R017 | Ring 5                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 5)     |
| R017 | Ring 6                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 6)     |
| R017 | Ring 7                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 7)     |
| R017 | Ring 8                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 8)     |
| R017 | Ring 9                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 9)     |
| R017 | Ring 10                                        | not used   | 0.000E+00 | ---                                              | FRACA(10)      |
| R017 | Ring 11                                        | not used   | 0.000E+00 | ---                                              | FRACA(11)      |
| R017 | Ring 12                                        | not used   | 0.000E+00 | ---                                              | FRACA(12)      |

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|--------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R018 | Fruits, vegetables and grain consumption (kg/yr) | not used   | 1.600E+02 | ---                                              | DIET (1)       |
| R018 | Leafy vegetable consumption (kg/yr)              | not used   | 1.400E+01 | ---                                              | DIET (2)       |
| R018 | Milk consumption (L/yr)                          | not used   | 9.200E+01 | ---                                              | DIET (3)       |
| R018 | Meat and poultry consumption (kg/yr)             | not used   | 6.300E+01 | ---                                              | DIET (4)       |
| R018 | Fish consumption (kg/yr)                         | not used   | 5.400E+00 | ---                                              | DIET (5)       |
| R018 | Other seafood consumption (kg/yr)                | not used   | 9.000E-01 | ---                                              | DIET (6)       |
| R018 | Soil ingestion rate (g/yr)                       | 3.650E+01  | 3.650E+01 | ---                                              | SOIL           |
| R018 | Drinking water intake (L/yr)                     | 3.500E+02  | 5.100E+02 | ---                                              | DWI            |
| R018 | Contamination fraction of drinking water         | 1.000E+00  | 1.000E+00 | ---                                              | FDW            |
| R018 | Contamination fraction of household water        | not used   | 1.000E+00 | ---                                              | FHHW           |
| R018 | Contamination fraction of livestock water        | not used   | 1.000E+00 | ---                                              | FLW            |
| R018 | Contamination fraction of irrigation water       | not used   | 1.000E+00 | ---                                              | FIRW           |
| R018 | Contamination fraction of aquatic food           | not used   | 5.000E-01 | ---                                              | FR9            |
| R018 | Contamination fraction of plant food             | not used   | -1        | ---                                              | FPLANT         |
| R018 | Contamination fraction of meat                   | not used   | -1        | ---                                              | FMEAT          |
| R018 | Contamination fraction of milk                   | not used   | -1        | ---                                              | FMILK          |
|      |                                                  |            |           |                                                  |                |
| R019 | Livestock fodder intake for meat (kg/day)        | not used   | 6.800E+01 | ---                                              | LFI5           |
| R019 | Livestock fodder intake for milk (kg/day)        | not used   | 5.500E+01 | ---                                              | LFI6           |
| R019 | Livestock water intake for meat (L/day)          | not used   | 5.000E+01 | ---                                              | LWI5           |
| R019 | Livestock water intake for milk (L/day)          | not used   | 1.600E+02 | ---                                              | LWI6           |
| R019 | Livestock soil intake (kg/day)                   | not used   | 5.000E-01 | ---                                              | LSI            |
| R019 | Mass loading for foliar deposition (g/m**3)      | not used   | 1.000E-04 | ---                                              | MLFD           |
| R019 | Depth of soil mixing layer (m)                   | 1.500E-01  | 1.500E-01 | ---                                              | DM             |
| R019 | Depth of roots (m)                               | not used   | 9.000E-01 | ---                                              | DROOT          |
| R019 | Drinking water fraction from ground water        | 1.000E+00  | 1.000E+00 | ---                                              | FGWDW          |
| R019 | Household water fraction from ground water       | not used   | 1.000E+00 | ---                                              | FGWHH          |
| R019 | Livestock water fraction from ground water       | not used   | 1.000E+00 | ---                                              | FGWLW          |
| R019 | Irrigation fraction from ground water            | not used   | 1.000E+00 | ---                                              | FGWIR          |
|      |                                                  |            |           |                                                  |                |
| R19B | Wet weight crop yield for Non-Leafy (kg/m**2)    | not used   | 7.000E-01 | ---                                              | YV (1)         |
| R19B | Wet weight crop yield for Leafy (kg/m**2)        | not used   | 1.500E+00 | ---                                              | YV (2)         |
| R19B | Wet weight crop yield for Fodder (kg/m**2)       | not used   | 1.100E+00 | ---                                              | YV (3)         |
| R19B | Growing Season for Non-Leafy (years)             | not used   | 1.700E-01 | ---                                              | TE (1)         |
| R19B | Growing Season for Leafy (years)                 | not used   | 2.500E-01 | ---                                              | TE (2)         |
| R19B | Growing Season for Fodder (years)                | not used   | 8.000E-02 | ---                                              | TE (3)         |
| R19B | Translocation Factor for Non-Leafy               | not used   | 1.000E-01 | ---                                              | TIV (1)        |
| R19B | Translocation Factor for Leafy                   | not used   | 1.000E+00 | ---                                              | TIV (2)        |
| R19B | Translocation Factor for Fodder                  | not used   | 1.000E+00 | ---                                              | TIV (3)        |
| R19B | Dry Foliar Interception Fraction for Non-Leafy   | not used   | 2.500E-01 | ---                                              | RDRY (1)       |
| R19B | Dry Foliar Interception Fraction for Leafy       | not used   | 2.500E-01 | ---                                              | RDRY (2)       |
| R19B | Dry Foliar Interception Fraction for Fodder      | not used   | 2.500E-01 | ---                                              | RDRY (3)       |
| R19B | Wet Foliar Interception Fraction for Non-Leafy   | not used   | 2.500E-01 | ---                                              | RWET (1)       |
| R19B | Wet Foliar Interception Fraction for Leafy       | not used   | 2.500E-01 | ---                                              | RWET (2)       |
| R19B | Wet Foliar Interception Fraction for Fodder      | not used   | 2.500E-01 | ---                                              | RWET (3)       |
| R19B | Weathering Removal Constant for Vegetation       | not used   | 2.000E+01 | ---                                              | WLAM           |
|      |                                                  |            |           |                                                  |                |
| C14  | C-12 concentration in water (g/cm**3)            | not used   | 2.000E-05 | ---                                              | C12WTR         |
| C14  | C-12 concentration in contaminated soil (g/g)    | not used   | 3.000E-02 | ---                                              | C12CZ          |
| C14  | Fraction of vegetation carbon from soil          | not used   | 2.000E-02 | ---                                              | CSOIL          |

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User Input | Default    | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|--------------------------------------------------|------------|------------|--------------------------------------------------|----------------|
| C14  | Fraction of vegetation carbon from air           | not used   | 9.800E-01  | ---                                              | CAIR           |
| C14  | C-14 evasion layer thickness in soil (m)         | not used   | 3.000E-01  | ---                                              | DMC            |
| C14  | C-14 evasion flux rate from soil (1/sec)         | not used   | 7.000E-07  | ---                                              | EVSN           |
| C14  | C-12 evasion flux rate from soil (1/sec)         | not used   | 1.000E-10  | ---                                              | REVSN          |
| C14  | Fraction of grain in beef cattle feed            | not used   | 8.000E-01  | ---                                              | AVFG4          |
| C14  | Fraction of grain in milk cow feed               | not used   | 2.000E-01  | ---                                              | AVFG5          |
| STOR | Storage times of contaminated foodstuffs (days): |            |            |                                                  |                |
| STOR | Fruits, non-leafy vegetables, and grain          | 1.400E+01  | 1.400E+01  | ---                                              | STOR_T (1)     |
| STOR | Leafy vegetables                                 | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (2)     |
| STOR | Milk                                             | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (3)     |
| STOR | Meat and poultry                                 | 2.000E+01  | 2.000E+01  | ---                                              | STOR_T (4)     |
| STOR | Fish                                             | 7.000E+00  | 7.000E+00  | ---                                              | STOR_T (5)     |
| STOR | Crustacea and mollusks                           | 7.000E+00  | 7.000E+00  | ---                                              | STOR_T (6)     |
| STOR | Well water                                       | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (7)     |
| STOR | Surface water                                    | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (8)     |
| STOR | Livestock fodder                                 | 4.500E+01  | 4.500E+01  | ---                                              | STOR_T (9)     |
| R021 | Thickness of building foundation (m)             | not used   | 1.500E-01  | ---                                              | FLOOR1         |
| R021 | Bulk density of building foundation (g/cm**3)    | not used   | 2.400E+00  | ---                                              | DENSFL         |
| R021 | Total porosity of the cover material             | not used   | 4.000E-01  | ---                                              | TPCV           |
| R021 | Total porosity of the building foundation        | not used   | 1.000E-01  | ---                                              | TPFL           |
| R021 | Volumetric water content of the cover material   | not used   | 5.000E-02  | ---                                              | PH2OCV         |
| R021 | Volumetric water content of the foundation       | not used   | 3.000E-02  | ---                                              | PH2OFL         |
| R021 | Diffusion coefficient for radon gas (m/sec):     |            |            |                                                  |                |
| R021 | in cover material                                | not used   | 2.000E-06  | ---                                              | DIFCV          |
| R021 | in foundation material                           | not used   | 3.000E-07  | ---                                              | DIFFL          |
| R021 | in contaminated zone soil                        | not used   | 2.000E-06  | ---                                              | DIFCZ          |
| R021 | Radon vertical dimension of mixing (m)           | not used   | 2.000E+00  | ---                                              | HMIX           |
| R021 | Average building air exchange rate (1/hr)        | not used   | 5.000E-01  | ---                                              | REXG           |
| R021 | Height of the building (room) (m)                | not used   | 2.500E+00  | ---                                              | HRM            |
| R021 | Building interior area factor                    | not used   | 0.000E+00  | ---                                              | FAI            |
| R021 | Building depth below ground surface (m)          | not used   | -1.000E+00 | ---                                              | DMFL           |
| R021 | Emanating power of Rn-222 gas                    | not used   | 2.500E-01  | ---                                              | EMANA (1)      |
| R021 | Emanating power of Rn-220 gas                    | not used   | 1.500E-01  | ---                                              | EMANA (2)      |
| TITL | Number of graphical time points                  | 32         | ---        | ---                                              | NPTS           |
| TITL | Maximum number of integration points for dose    | 17         | ---        | ---                                              | LYMAX          |
| TITL | Maximum number of integration points for risk    | 257        | ---        | ---                                              | KYMAX          |

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Summary of Pathway Selections

| Pathway                     | User Selection |
|-----------------------------|----------------|
| 1 -- external gamma         | active         |
| 2 -- inhalation (w/o radon) | active         |
| 3 -- plant ingestion        | suppressed     |
| 4 -- meat ingestion         | suppressed     |
| 5 -- milk ingestion         | suppressed     |
| 6 -- aquatic foods          | suppressed     |
| 7 -- drinking water         | active         |
| 8 -- soil ingestion         | active         |
| 9 -- radon                  | suppressed     |
| Find peak pathway doses     | active         |

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

| Contaminated Zone Dimensions |                       | Initial Soil Concentrations, pCi/g |           |
|------------------------------|-----------------------|------------------------------------|-----------|
| Area:                        | 1860.00 square meters | Cs-137                             | 3.854E+00 |
| Thickness:                   | 5.00 meters           | Ra-226                             | 4.960E-01 |
| Cover Depth:                 | 0.00 meters           | Sr-90                              | 2.140E-01 |
|                              |                       | U-238                              | 4.470E-01 |

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 1.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

|            |           |           |           |           |           |           |           |           |
|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| t (years): | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| TDOSE(t):  | 3.093E+00 | 3.070E+00 | 2.924E+00 | 2.718E+00 | 1.692E+00 | 1.228E+00 | 8.176E-01 | 6.323E-01 |
| M(t):      | 2.062E-01 | 2.047E-01 | 1.949E-01 | 1.812E-01 | 1.128E-01 | 8.189E-02 | 5.451E-02 | 4.215E-02 |

Maximum TDOSE(t): 3.093E+00 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.138E+00 | 0.6914 | 2.780E-06  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.609E-03 | 0.0005 |
| Ra-226            | 9.186E-01 | 0.2970 | 8.905E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.770E-03 | 0.0015 |
| Sr-90             | 1.508E-03 | 0.0005 | 6.108E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.963E-04 | 0.0001 |
| U-238             | 1.285E-02 | 0.0042 | 6.647E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.648E-04 | 0.0002 |
| Total             | 3.071E+00 | 0.9931 | 1.589E-04  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.241E-03 | 0.0023 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 6.474E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.140E+00     | 0.6920 |
| Ra-226            | 1.717E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.235E-01     | 0.2986 |
| Sr-90             | 1.245E-02 | 0.0040 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.416E-02     | 0.0046 |
| U-238             | 1.402E-03 | 0.0005 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.499E-02     | 0.0048 |
| Total             | 1.388E-02 | 0.0045 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.093E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.089E+00 | 0.6804 | 2.716E-06  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.572E-03 | 0.0005 |
| Ra-226            | 9.181E-01 | 0.2990 | 9.178E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.656E-03 | 0.0018 |
| Sr-90             | 1.434E-03 | 0.0005 | 5.811E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.868E-04 | 0.0001 |
| U-238             | 1.279E-02 | 0.0042 | 6.616E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.616E-04 | 0.0002 |
| Total             | 3.021E+00 | 0.9841 | 1.612E-04  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.076E-03 | 0.0026 |

## Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.914E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.091E+00     | 0.6810 |
| Ra-226            | 1.145E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.239E-01     | 0.3009 |
| Sr-90             | 3.625E-02 | 0.0118 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.788E-02     | 0.0123 |
| U-238             | 4.211E-03 | 0.0014 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.773E-02     | 0.0058 |
| Total             | 4.060E-02 | 0.0132 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.070E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 1.903E+00 | 0.6511 | 2.475E-06  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.433E-03 | 0.0005 |
| Ra-226            | 9.160E-01 | 0.3133 | 1.018E-04  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.921E-03 | 0.0031 |
| Sr-90             | 1.175E-03 | 0.0004 | 4.761E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.531E-04 | 0.0001 |
| U-238             | 1.255E-02 | 0.0043 | 6.492E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.493E-04 | 0.0002 |
| Total             | 2.833E+00 | 0.9691 | 1.697E-04  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.116E-02 | 0.0038 |

## Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 6.421E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.905E+00     | 0.6516 |
| Ra-226            | 1.349E-03 | 0.0005 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.263E-01     | 0.3168 |
| Sr-90             | 6.238E-02 | 0.0213 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.371E-02     | 0.0218 |
| U-238             | 1.532E-02 | 0.0052 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.858E-02     | 0.0098 |
| Total             | 7.911E-02 | 0.0271 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.924E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.



Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 1.694E+00 | 0.6235 | 2.203E-06  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.275E-03 | 0.0005 |
| Ra-226            | 9.133E-01 | 0.3361 | 1.127E-04  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.244E-02 | 0.0046 |
| Sr-90             | 9.162E-04 | 0.0003 | 3.711E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.193E-04 | 0.0000 |
| U-238             | 1.226E-02 | 0.0045 | 6.341E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.341E-04 | 0.0002 |
| Total             | 2.621E+00 | 0.9644 | 1.786E-04  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.447E-02 | 0.0053 |

## Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.093E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.696E+00     | 0.6240 |
| Ra-226            | 4.414E-03 | 0.0016 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.303E-01     | 0.3423 |
| Sr-90             | 4.861E-02 | 0.0179 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.965E-02     | 0.0183 |
| U-238             | 2.890E-02 | 0.0106 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.186E-02     | 0.0154 |
| Total             | 8.204E-02 | 0.0302 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.718E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.681E-01 | 0.3949 | 8.686E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.028E-04 | 0.0003 |
| Ra-226            | 8.922E-01 | 0.5274 | 1.557E-04  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.672E-02 | 0.0158 |
| Sr-90             | 1.249E-04 | 0.0001 | 5.060E-08  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.627E-05 | 0.0000 |
| U-238             | 1.015E-02 | 0.0060 | 5.250E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.251E-04 | 0.0003 |
| Total             | 1.571E+00 | 0.9284 | 2.091E-04  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.777E-02 | 0.0164 |

## Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 2.088E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.688E-01     | 0.3953 |
| Ra-226            | 4.722E-02 | 0.0279 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.663E-01     | 0.5712 |
| Sr-90             | 6.614E-03 | 0.0039 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.755E-03     | 0.0040 |
| U-238             | 3.919E-02 | 0.0232 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.992E-02     | 0.0295 |
| Total             | 9.323E-02 | 0.0551 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.692E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.088E-01 | 0.1699 | 2.714E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.571E-04 | 0.0001 |
| Ra-226            | 8.661E-01 | 0.7051 | 1.651E-04  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.039E-02 | 0.0247 |
| Sr-90             | 1.035E-05 | 0.0000 | 4.193E-09  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.348E-06 | 0.0000 |
| U-238             | 8.017E-03 | 0.0065 | 4.147E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.148E-04 | 0.0003 |
| Total             | 1.083E+00 | 0.8816 | 2.068E-04  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.096E-02 | 0.0252 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.309E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.090E-01     | 0.1702 |
| Ra-226            | 8.275E-02 | 0.0674 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.794E-01     | 0.7973 |
| Sr-90             | 5.464E-04 | 0.0004 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.581E-04     | 0.0005 |
| U-238             | 3.087E-02 | 0.0251 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.935E-02     | 0.0320 |
| Total             | 1.143E-01 | 0.0931 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.228E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 1.896E-05 | 0.0000 | 2.466E-11  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.427E-08 | 0.0000 |
| Ra-226            | 6.827E-01 | 0.8350 | 1.330E-04  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.487E-02 | 0.0304 |
| Sr-90             | 2.298E-14 | 0.0000 | 9.310E-18  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.993E-15 | 0.0000 |
| U-238             | 1.213E-03 | 0.0015 | 6.300E-06  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.297E-05 | 0.0001 |
| Total             | 6.839E-01 | 0.8365 | 1.393E-04  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.494E-02 | 0.0305 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 6.335E-08 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.904E-05     | 0.0000 |
| Ra-226            | 1.040E-01 | 0.1272 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.117E-01     | 0.9928 |
| Sr-90             | 1.181E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.207E-12     | 0.0000 |
| U-238             | 4.566E-03 | 0.0056 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.848E-03     | 0.0072 |
| Total             | 1.086E-01 | 0.1328 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.176E-01     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Industrial-No Bkgd subtract-C

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-C.RAD

## Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 1.682E-10 | 0.0000 | 2.187E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.266E-13 | 0.0000 |
| Ra-226            | 5.070E-01 | 0.8018 | 9.878E-05  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.847E-02 | 0.0292 |
| Sr-90             | 3.503E-25 | 0.0000 | 1.419E-28  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.562E-26 | 0.0000 |
| U-238             | 1.149E-04 | 0.0002 | 6.076E-07  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.060E-06 | 0.0000 |
| Total             | 5.071E-01 | 0.8020 | 9.939E-05  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.848E-02 | 0.0292 |

## Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 6.210E-13 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.690E-10     | 0.0000 |
| Ra-226            | 1.062E-01 | 0.1679 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.318E-01     | 0.9991 |
| Sr-90             | 1.721E-23 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.761E-23     | 0.0000 |
| U-238             | 4.164E-04 | 0.0007 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.380E-04     | 0.0009 |
| Total             | 1.066E-01 | 0.1686 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.323E-01     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

| Parent<br>(i) | Product<br>(j) | Thread<br>Fraction | DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) |           |           |           |           |           |           |           |
|---------------|----------------|--------------------|---------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               |                |                    | 0.000E+00                                   | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137+D      | Cs-137+D       | 1.000E+00          | 5.552E-01                                   | 5.425E-01 | 4.943E-01 | 4.400E-01 | 1.735E-01 | 5.424E-02 | 4.941E-06 | 4.384E-11 |
| Ra-226+D      | Ra-226+D       | 1.000E+00          | 1.861E+00                                   | 1.860E+00 | 1.855E+00 | 1.850E+00 | 1.807E+00 | 1.754E+00 | 1.384E+00 | 1.029E+00 |
| Ra-226+D      | Pb-210+D       | 1.000E+00          | 9.718E-04                                   | 3.002E-03 | 1.225E-02 | 2.573E-02 | 1.416E-01 | 2.209E-01 | 2.528E-01 | 2.445E-01 |
| Ra-226+D      | ΣDSR(j)        |                    | 1.862E+00                                   | 1.863E+00 | 1.868E+00 | 1.876E+00 | 1.948E+00 | 1.975E+00 | 1.637E+00 | 1.274E+00 |
| Sr-90+D       | Sr-90+D        | 1.000E+00          | 6.615E-02                                   | 1.770E-01 | 2.977E-01 | 2.320E-01 | 3.156E-02 | 2.608E-03 | 5.640E-12 | 8.228E-23 |
| U-238         | U-238          | 5.450E-07          | 2.441E-09                                   | 5.618E-09 | 1.819E-08 | 3.356E-08 | 4.508E-08 | 3.551E-08 | 5.248E-09 | 4.758E-10 |
| U-238+D       | U-238+D        | 1.000E+00          | 3.353E-02                                   | 3.967E-02 | 6.394E-02 | 9.365E-02 | 1.117E-01 | 8.802E-02 | 1.307E-02 | 1.195E-03 |
| U-238+D       | U-234          | 1.000E+00          | 3.906E-09                                   | 1.723E-08 | 1.524E-07 | 5.025E-07 | 5.005E-06 | 8.518E-06 | 1.289E-05 | 6.746E-06 |
| U-238+D       | Th-230         | 1.000E+00          | 1.028E-13                                   | 4.514E-13 | 4.077E-12 | 1.354E-11 | 2.726E-10 | 9.591E-10 | 1.124E-08 | 2.117E-08 |
| U-238+D       | Ra-226+D       | 1.000E+00          | 1.032E-11                                   | 2.966E-11 | 1.041E-10 | 1.987E-10 | 1.855E-09 | 5.322E-09 | 2.056E-07 | 8.307E-07 |
| U-238+D       | Pb-210+D       | 1.000E+00          | 3.505E-10                                   | 1.007E-09 | 3.517E-09 | 6.617E-09 | 4.914E-08 | 7.892E-08 | 2.537E-07 | 6.411E-07 |
| U-238+D       | ΣDSR(j)        |                    | 3.353E-02                                   | 3.967E-02 | 6.394E-02 | 9.365E-02 | 1.117E-01 | 8.803E-02 | 1.308E-02 | 1.203E-03 |

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

| Nuclide<br>(i) | t=        | 0.000E+00 1.000E+00 5.000E+00 1.000E+01 5.000E+01 1.000E+02 5.000E+02 1.000E+03 |           |           |           |           |           |            |  |
|----------------|-----------|---------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|------------|--|
|                |           |                                                                                 |           |           |           |           |           |            |  |
| Cs-137         | 2.702E+01 | 2.765E+01                                                                       | 3.035E+01 | 3.409E+01 | 8.643E+01 | 2.765E+02 | 3.036E+06 | 3.422E+11  |  |
| Ra-226         | 8.057E+00 | 8.053E+00                                                                       | 8.032E+00 | 7.997E+00 | 7.700E+00 | 7.596E+00 | 9.166E+00 | 1.178E+01  |  |
| Sr-90          | 2.268E+02 | 8.475E+01                                                                       | 5.038E+01 | 6.465E+01 | 4.752E+02 | 5.752E+03 | 2.659E+12 | *1.366E+14 |  |
| U-238          | 4.474E+02 | 3.781E+02                                                                       | 2.346E+02 | 1.602E+02 | 1.343E+02 | 1.704E+02 | 1.146E+03 | 1.246E+04  |  |

\*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)  
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
at tmin = time of minimum single radionuclide soil guideline  
and at tmax = time of maximum total dose = 0.000E+00 years

| Nuclide<br>(i) | Initial<br>(pCi/g) | tmin<br>(years) | DSR(i,tmin) | G(i,tmin)<br>(pCi/g) | DSR(i,tmax) | G(i,tmax)<br>(pCi/g) |
|----------------|--------------------|-----------------|-------------|----------------------|-------------|----------------------|
| Cs-137         | 3.854E+00          | 0.000E+00       | 5.552E-01   | 2.702E+01            | 5.552E-01   | 2.702E+01            |
| Ra-226         | 4.960E-01          | 93.8 ± 0.2      | 1.975E+00   | 7.595E+00            | 1.862E+00   | 8.057E+00            |
| Sr-90          | 2.140E-01          | 2.825 ± 0.006   | 3.294E-01   | 4.554E+01            | 6.615E-02   | 2.268E+02            |
| U-238          | 4.470E-01          | 16.89 ± 0.03    | 1.307E-01   | 1.147E+02            | 3.353E-02   | 4.474E+02            |

Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

|                                                            |    |
|------------------------------------------------------------|----|
| Dose Conversion Factor (and Related) Parameter Summary ... | 2  |
| Site-Specific Parameter Summary .....                      | 5  |
| Summary of Pathway Selections .....                        | 10 |
| Contaminated Zone and Total Dose Summary .....             | 11 |
| Total Dose Components                                      |    |
| Time = 0.000E+00 .....                                     | 12 |
| Time = 1.000E+00 .....                                     | 13 |
| Time = 5.000E+00 .....                                     | 14 |
| Time = 1.000E+01 .....                                     | 15 |
| Time = 5.000E+01 .....                                     | 16 |
| Time = 1.000E+02 .....                                     | 17 |
| Time = 5.000E+02 .....                                     | 18 |
| Time = 1.000E+03 .....                                     | 19 |
| Dose/Source Ratios Summed Over All Pathways .....          | 20 |
| Single Radionuclide Soil Guidelines .....                  | 20 |
| Dose Per Nuclide Summed Over All Pathways .....            | 21 |
| Soil Concentration Per Nuclide .....                       | 21 |

Summary : 811 area-Resident-deep-No Bkdg subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| A-1  | DCF's for external ground radiation, (mrem/yr)/(pCi/g)   |                |            |                |
| A-1  | At-218 (Source: DCFPAK3.02)                              | 5.567E-05      | 5.567E-05  | DCF1( 1)       |
| A-1  | Ba-137m (Source: DCFPAK3.02)                             | 3.381E+00      | 3.381E+00  | DCF1( 2)       |
| A-1  | Bi-210 (Source: DCFPAK3.02)                              | 5.473E-03      | 5.473E-03  | DCF1( 3)       |
| A-1  | Bi-214 (Source: DCFPAK3.02)                              | 9.135E+00      | 9.135E+00  | DCF1( 4)       |
| A-1  | Cs-137 (Source: DCFPAK3.02)                              | 8.686E-04      | 8.686E-04  | DCF1( 5)       |
| A-1  | Hg-206 (Source: DCFPAK3.02)                              | 6.127E-01      | 6.127E-01  | DCF1( 6)       |
| A-1  | Pa-234 (Source: DCFPAK3.02)                              | 8.275E+00      | 8.275E+00  | DCF1( 7)       |
| A-1  | Pa-234m (Source: DCFPAK3.02)                             | 1.257E-01      | 1.257E-01  | DCF1( 8)       |
| A-1  | Pb-210 (Source: DCFPAK3.02)                              | 2.092E-03      | 2.092E-03  | DCF1( 9)       |
| A-1  | Pb-214 (Source: DCFPAK3.02)                              | 1.257E+00      | 1.257E+00  | DCF1( 10)      |
| A-1  | Po-210 (Source: DCFPAK3.02)                              | 5.641E-05      | 5.641E-05  | DCF1( 11)      |
| A-1  | Po-214 (Source: DCFPAK3.02)                              | 4.801E-04      | 4.801E-04  | DCF1( 12)      |
| A-1  | Po-218 (Source: DCFPAK3.02)                              | 9.228E-09      | 9.228E-09  | DCF1( 13)      |
| A-1  | Ra-226 (Source: DCFPAK3.02)                              | 3.176E-02      | 3.176E-02  | DCF1( 14)      |
| A-1  | Rn-218 (Source: DCFPAK3.02)                              | 4.259E-03      | 4.259E-03  | DCF1( 15)      |
| A-1  | Rn-222 (Source: DCFPAK3.02)                              | 2.130E-03      | 2.130E-03  | DCF1( 16)      |
| A-1  | Sr-90 (Source: DCFPAK3.02)                               | 6.463E-04      | 6.463E-04  | DCF1( 17)      |
| A-1  | Th-230 (Source: DCFPAK3.02)                              | 1.106E-03      | 1.106E-03  | DCF1( 18)      |
| A-1  | Th-234 (Source: DCFPAK3.02)                              | 2.316E-02      | 2.316E-02  | DCF1( 19)      |
| A-1  | Tl-206 (Source: DCFPAK3.02)                              | 1.278E-02      | 1.278E-02  | DCF1( 20)      |
| A-1  | Tl-210 (Source: DCFPAK3.02)                              | 1.677E+01      | 1.677E+01  | DCF1( 21)      |
| A-1  | U-234 (Source: DCFPAK3.02)                               | 3.456E-04      | 3.456E-04  | DCF1( 22)      |
| A-1  | U-238 (Source: DCFPAK3.02)                               | 1.713E-04      | 1.713E-04  | DCF1( 23)      |
| A-1  | Y-90 (Source: DCFPAK3.02)                                | 4.016E-02      | 4.016E-02  | DCF1( 24)      |
| B-1  | Dose conversion factors for inhalation, mrem/pCi:        |                |            |                |
| B-1  | Cs-137+D                                                 | 1.457E-04      | 1.457E-04  | DCF2( 1)       |
| B-1  | Pb-210+D                                                 | 3.708E-02      | 2.077E-02  | DCF2( 2)       |
| B-1  | Ra-226+D                                                 | 3.528E-02      | 3.517E-02  | DCF2( 3)       |
| B-1  | Sr-90+D                                                  | 5.841E-04      | 5.786E-04  | DCF2( 4)       |
| B-1  | Th-230                                                   | 3.759E-01      | 3.759E-01  | DCF2( 5)       |
| B-1  | U-234                                                    | 3.479E-02      | 3.479E-02  | DCF2( 6)       |
| B-1  | U-238                                                    | 2.973E-02      | 2.973E-02  | DCF2( 7)       |
| B-1  | U-238+D                                                  | 2.976E-02      | 2.973E-02  | DCF2( 8)       |
| D-1  | Dose conversion factors for ingestion, mrem/pCi:         |                |            |                |
| D-1  | Cs-137+D                                                 | 5.032E-05      | 5.032E-05  | DCF3( 1)       |
| D-1  | Pb-210+D                                                 | 7.057E-03      | 2.575E-03  | DCF3( 2)       |
| D-1  | Ra-226+D                                                 | 1.037E-03      | 1.036E-03  | DCF3( 3)       |
| D-1  | Sr-90+D                                                  | 1.120E-04      | 1.021E-04  | DCF3( 4)       |
| D-1  | Th-230                                                   | 7.918E-04      | 7.918E-04  | DCF3( 5)       |
| D-1  | U-234                                                    | 1.831E-04      | 1.831E-04  | DCF3( 6)       |
| D-1  | U-238                                                    | 1.650E-04      | 1.650E-04  | DCF3( 7)       |
| D-1  | U-238+D                                                  | 1.776E-04      | 1.650E-04  | DCF3( 8)       |
| D-34 | Food transfer factors:                                   |                |            |                |
| D-34 | Cs-137+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 1,1)      |
| D-34 | Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.000E-02      | 3.000E-02  | RTF( 1,2)      |
| D-34 | Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 1,3)      |



Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

## Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| D-34 | Pb-210+D , plant/soil concentration ratio, dimensionless | 1.000E-02      | 1.000E-02  | RTF( 2,1)      |
| D-34 | Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-04      | 8.000E-04  | RTF( 2,2)      |
| D-34 | Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 3.000E-04      | 3.000E-04  | RTF( 2,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Ra-226+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 3,1)      |
| D-34 | Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-03      | 1.000E-03  | RTF( 3,2)      |
| D-34 | Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 1.000E-03      | 1.000E-03  | RTF( 3,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Sr-90+D , plant/soil concentration ratio, dimensionless  | 3.000E-01      | 3.000E-01  | RTF( 4,1)      |
| D-34 | Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 4,2)      |
| D-34 | Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 2.000E-03      | 2.000E-03  | RTF( 4,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Th-230 , plant/soil concentration ratio, dimensionless   | 1.000E-03      | 1.000E-03  | RTF( 5,1)      |
| D-34 | Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 1.000E-04      | 1.000E-04  | RTF( 5,2)      |
| D-34 | Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06      | 5.000E-06  | RTF( 5,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-234 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 6,1)      |
| D-34 | U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 6,2)      |
| D-34 | U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 6,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 7,1)      |
| D-34 | U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 7,2)      |
| D-34 | U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 7,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238+D , plant/soil concentration ratio, dimensionless  | 2.500E-03      | 2.500E-03  | RTF( 8,1)      |
| D-34 | U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04      | 3.400E-04  | RTF( 8,2)      |
| D-34 | U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04      | 6.000E-04  | RTF( 8,3)      |
| D-34 |                                                          |                |            |                |
| D-5  | Bioaccumulation factors, fresh water, L/kg:              |                |            |                |
| D-5  | Cs-137+D , fish                                          | 2.000E+03      | 2.000E+03  | BIOFAC( 1,1)   |
| D-5  | Cs-137+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 1,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Pb-210+D , fish                                          | 3.000E+02      | 3.000E+02  | BIOFAC( 2,1)   |
| D-5  | Pb-210+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 2,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Ra-226+D , fish                                          | 5.000E+01      | 5.000E+01  | BIOFAC( 3,1)   |
| D-5  | Ra-226+D , crustacea and mollusks                        | 2.500E+02      | 2.500E+02  | BIOFAC( 3,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Sr-90+D , fish                                           | 6.000E+01      | 6.000E+01  | BIOFAC( 4,1)   |
| D-5  | Sr-90+D , crustacea and mollusks                         | 1.000E+02      | 1.000E+02  | BIOFAC( 4,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Th-230 , fish                                            | 1.000E+02      | 1.000E+02  | BIOFAC( 5,1)   |
| D-5  | Th-230 , crustacea and mollusks                          | 5.000E+02      | 5.000E+02  | BIOFAC( 5,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-234 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 6,1)   |
| D-5  | U-234 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 6,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-238 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 7,1)   |
| D-5  | U-238 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 7,2)   |
| D-5  |                                                          |                |            |                |

Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter |                          | Current   | Base      | Parameter    |
|------|-----------|--------------------------|-----------|-----------|--------------|
|      |           |                          | Value#    | Case*     | Name         |
| D-5  | U-238+D   | , fish                   | 1.000E+01 | 1.000E+01 | BIOFAC( 8,1) |
| D-5  | U-238+D   | , crustacea and mollusks | 6.000E+01 | 6.000E+01 | BIOFAC( 8,2) |

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.

\*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

## Site-Specific Parameter Summary

| Menu | Parameter                                       | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|-------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R011 | Area of contaminated zone (m**2)                | 1.860E+03  | 1.000E+04 | ---                                              | AREA           |
| R011 | Thickness of contaminated zone (m)              | 8.000E+00  | 2.000E+00 | ---                                              | THICK0         |
| R011 | Fraction of contamination that is submerged     | 0.000E+00  | 0.000E+00 | ---                                              | SUBMFRACT      |
| R011 | Length parallel to aquifer flow (m)             | 7.600E+01  | 1.000E+02 | ---                                              | LCZPAQ         |
| R011 | Basic radiation dose limit (mrem/yr)            | 1.500E+01  | 3.000E+01 | ---                                              | BRDL           |
| R011 | Time since placement of material (yr)           | 0.000E+00  | 0.000E+00 | ---                                              | TI             |
| R011 | Times for calculations (yr)                     | 1.000E+00  | 1.000E+00 | ---                                              | T( 2)          |
| R011 | Times for calculations (yr)                     | 5.000E+00  | 3.000E+00 | ---                                              | T( 3)          |
| R011 | Times for calculations (yr)                     | 1.000E+01  | 1.000E+01 | ---                                              | T( 4)          |
| R011 | Times for calculations (yr)                     | 5.000E+01  | 3.000E+01 | ---                                              | T( 5)          |
| R011 | Times for calculations (yr)                     | 1.000E+02  | 1.000E+02 | ---                                              | T( 6)          |
| R011 | Times for calculations (yr)                     | 5.000E+02  | 3.000E+02 | ---                                              | T( 7)          |
| R011 | Times for calculations (yr)                     | 1.000E+03  | 1.000E+03 | ---                                              | T( 8)          |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T( 9)          |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T(10)          |
| R012 | Initial principal radionuclide (pCi/g): Cs-137  | 5.050E+01  | 0.000E+00 | ---                                              | S1(1)          |
| R012 | Initial principal radionuclide (pCi/g): Ra-226  | 4.960E-01  | 0.000E+00 | ---                                              | S1(3)          |
| R012 | Initial principal radionuclide (pCi/g): Sr-90   | 2.140E-01  | 0.000E+00 | ---                                              | S1(4)          |
| R012 | Initial principal radionuclide (pCi/g): U-238   | 4.470E-01  | 0.000E+00 | ---                                              | S1(7)          |
| R012 | Concentration in groundwater (pCi/L): Cs-137    | not used   | 0.000E+00 | ---                                              | W1( 1)         |
| R012 | Concentration in groundwater (pCi/L): Ra-226    | not used   | 0.000E+00 | ---                                              | W1( 3)         |
| R012 | Concentration in groundwater (pCi/L): Sr-90     | not used   | 0.000E+00 | ---                                              | W1( 4)         |
| R012 | Concentration in groundwater (pCi/L): U-238     | not used   | 0.000E+00 | ---                                              | W1( 7)         |
| R013 | Cover depth (m)                                 | 6.100E-01  | 0.000E+00 | ---                                              | COVER0         |
| R013 | Density of cover material (g/cm**3)             | 1.500E+00  | 1.500E+00 | ---                                              | DENSCV         |
| R013 | Cover depth erosion rate (m/yr)                 | 1.000E-03  | 1.000E-03 | ---                                              | VCV            |
| R013 | Density of contaminated zone (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSCZ         |
| R013 | Contaminated zone erosion rate (m/yr)           | 1.000E-03  | 1.000E-03 | ---                                              | VCZ            |
| R013 | Contaminated zone total porosity                | 3.300E-01  | 4.000E-01 | ---                                              | TPCZ           |
| R013 | Contaminated zone field capacity                | 2.400E-01  | 2.000E-01 | ---                                              | FCCZ           |
| R013 | Contaminated zone hydraulic conductivity (m/yr) | 5.000E+03  | 1.000E+01 | ---                                              | HCCZ           |
| R013 | Contaminated zone b parameter                   | 4.900E+00  | 5.300E+00 | ---                                              | BCZ            |
| R013 | Average annual wind speed (m/sec)               | 6.230E+00  | 2.000E+00 | ---                                              | WIND           |
| R013 | Humidity in air (g/m**3)                        | not used   | 8.000E+00 | ---                                              | HUMID          |
| R013 | Evapotranspiration coefficient                  | 4.600E-01  | 5.000E-01 | ---                                              | EVAPTR         |
| R013 | Precipitation (m/yr)                            | 1.230E+00  | 1.000E+00 | ---                                              | PRECIP         |
| R013 | Irrigation (m/yr)                               | 2.600E-01  | 2.000E-01 | ---                                              | RI             |
| R013 | Irrigation mode                                 | overhead   | overhead  | ---                                              | IDITCH         |
| R013 | Runoff coefficient                              | 2.000E-01  | 2.000E-01 | ---                                              | RUNOFF         |
| R013 | Watershed area for nearby stream or pond (m**2) | 1.000E+06  | 1.000E+06 | ---                                              | WAREA          |
| R013 | Accuracy for water/soil computations            | 1.000E-03  | 1.000E-03 | ---                                              | EPS            |
| R014 | Density of saturated zone (g/cm**3)             | 1.660E+00  | 1.500E+00 | ---                                              | DENSAQ         |
| R014 | Saturated zone total porosity                   | 3.300E-01  | 4.000E-01 | ---                                              | TPSZ           |
| R014 | Saturated zone effective porosity               | 2.400E-01  | 2.000E-01 | ---                                              | EPSZ           |
| R014 | Saturated zone field capacity                   | 2.000E-01  | 2.000E-01 | ---                                              | FCSZ           |
| R014 | Saturated zone hydraulic conductivity (m/yr)    | 2.000E+04  | 1.000E+02 | ---                                              | HCSZ           |
| R014 | Saturated zone hydraulic gradient               | 4.800E-03  | 2.000E-02 | ---                                              | HGWT           |

Summary : 811 area-Resident-deep-No Bkdg subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R014 | Saturated zone b parameter                     | 4.900E+00  | 5.300E+00 | ---                                              | BSZ            |
| R014 | Water table drop rate (m/yr)                   | 1.000E-03  | 1.000E-03 | ---                                              | VWT            |
| R014 | Well pump intake depth (m below water table)   | 1.800E+01  | 1.000E+01 | ---                                              | DWIBWT         |
| R014 | Model: Nondispersion (ND) or Mass-Balance (MB) | ND         | ND        | ---                                              | MODEL          |
| R014 | Well pumping rate (m**3/yr)                    | 2.500E+02  | 2.500E+02 | ---                                              | UW             |
| R015 | Number of unsaturated zone strata              | 1          | 1         | ---                                              | NS             |
| R015 | Unsat. zone 1, thickness (m)                   | 0.000E+00  | 4.000E+00 | ---                                              | H (1)          |
| R015 | Unsat. zone 1, soil density (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSUZ (1)     |
| R015 | Unsat. zone 1, total porosity                  | 3.300E-01  | 4.000E-01 | ---                                              | TPUZ (1)       |
| R015 | Unsat. zone 1, effective porosity              | 2.400E-01  | 2.000E-01 | ---                                              | EPUZ (1)       |
| R015 | Unsat. zone 1, field capacity                  | 2.000E-01  | 2.000E-01 | ---                                              | FCUZ (1)       |
| R015 | Unsat. zone 1, soil-specific b parameter       | 4.900E+00  | 5.300E+00 | ---                                              | BUZ (1)        |
| R015 | Unsat. zone 1, hydraulic conductivity (m/yr)   | 5.000E+03  | 1.000E+01 | ---                                              | HCUZ (1)       |
| R016 | Distribution coefficients for Cs-137           |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCC ( 1)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCU ( 1,1)  |
| R016 | Saturated zone (cm**3/g)                       | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCS ( 1)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.806E-04                                        | ALEACH ( 1)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 1)    |
| R016 | Distribution coefficients for Ra-226           |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 7.000E+01  | 7.000E+01 | ---                                              | DCNUCC ( 3)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 7.000E+01  | 7.000E+01 | ---                                              | DCNUCU ( 3,1)  |
| R016 | Saturated zone (cm**3/g)                       | 7.000E+01  | 7.000E+01 | ---                                              | DCNUCS ( 3)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 7.211E-04                                        | ALEACH ( 3)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 3)    |
| R016 | Distribution coefficients for Sr-90            |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 3.000E+01  | 3.000E+01 | ---                                              | DCNUCC ( 4)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 3.000E+01  | 3.000E+01 | ---                                              | DCNUCU ( 4,1)  |
| R016 | Saturated zone (cm**3/g)                       | 3.000E+01  | 3.000E+01 | ---                                              | DCNUCS ( 4)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.678E-03                                        | ALEACH ( 4)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 4)    |
| R016 | Distribution coefficients for U-238            |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCC ( 7)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCU ( 7,1)  |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCS ( 7)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.009E-03                                        | ALEACH ( 7)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 7)    |
| R016 | Distribution coefficients for daughter Pb-210  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCC ( 2)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCU ( 2,1)  |
| R016 | Saturated zone (cm**3/g)                       | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCS ( 2)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 5.051E-04                                        | ALEACH ( 2)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 2)    |

Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R016 | Distribution coefficients for daughter Th-230  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCC ( 5)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCU ( 5,1)  |
| R016 | Saturated zone (cm**3/g)                       | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCS ( 5)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 8.431E-07                                        | ALEACH ( 5)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 5)    |
| R016 | Distribution coefficients for daughter U-234   |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCC ( 6)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCU ( 6,1)  |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCS ( 6)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.009E-03                                        | ALEACH ( 6)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 6)    |
| R017 | Inhalation rate (m**3/yr)                      | 7.300E+03  | 8.400E+03 | ---                                              | INHALR         |
| R017 | Mass loading for inhalation (g/m**3)           | 1.000E-04  | 1.000E-04 | ---                                              | MLINH          |
| R017 | Exposure duration                              | 3.000E+01  | 3.000E+01 | ---                                              | ED             |
| R017 | Shielding factor, inhalation                   | 4.000E-01  | 4.000E-01 | ---                                              | SHF3           |
| R017 | Shielding factor, external gamma               | 8.000E-01  | 7.000E-01 | ---                                              | SHF1           |
| R017 | Fraction of time spent indoors                 | 5.000E-01  | 5.000E-01 | ---                                              | FIND           |
| R017 | Fraction of time spent outdoors (on site)      | 2.500E-01  | 2.500E-01 | ---                                              | FOTD           |
| R017 | Shape factor flag, external gamma              | 1.000E+00  | 1.000E+00 | >0 shows circular AREA.                          | FS             |
| R017 | Radii of shape factor array (used if FS = -1): |            |           |                                                  |                |
| R017 | Outer annular radius (m), ring 1:              | not used   | 5.000E+01 | ---                                              | RAD_SHAPE ( 1) |
| R017 | Outer annular radius (m), ring 2:              | not used   | 7.071E+01 | ---                                              | RAD_SHAPE ( 2) |
| R017 | Outer annular radius (m), ring 3:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 3) |
| R017 | Outer annular radius (m), ring 4:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 4) |
| R017 | Outer annular radius (m), ring 5:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 5) |
| R017 | Outer annular radius (m), ring 6:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 6) |
| R017 | Outer annular radius (m), ring 7:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 7) |
| R017 | Outer annular radius (m), ring 8:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 8) |
| R017 | Outer annular radius (m), ring 9:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 9) |
| R017 | Outer annular radius (m), ring 10:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(10)  |
| R017 | Outer annular radius (m), ring 11:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(11)  |
| R017 | Outer annular radius (m), ring 12:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(12)  |
| R017 | Fractions of annular areas within AREA:        |            |           |                                                  |                |
| R017 | Ring 1                                         | not used   | 1.000E+00 | ---                                              | FRACA ( 1)     |
| R017 | Ring 2                                         | not used   | 2.732E-01 | ---                                              | FRACA ( 2)     |
| R017 | Ring 3                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 3)     |
| R017 | Ring 4                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 4)     |
| R017 | Ring 5                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 5)     |
| R017 | Ring 6                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 6)     |
| R017 | Ring 7                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 7)     |
| R017 | Ring 8                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 8)     |
| R017 | Ring 9                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 9)     |
| R017 | Ring 10                                        | not used   | 0.000E+00 | ---                                              | FRACA(10)      |
| R017 | Ring 11                                        | not used   | 0.000E+00 | ---                                              | FRACA(11)      |
| R017 | Ring 12                                        | not used   | 0.000E+00 | ---                                              | FRACA(12)      |

Summary : 811 area-Resident-deep-No Bkdg subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|--------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R018 | Fruits, vegetables and grain consumption (kg/yr) | 1.600E+02  | 1.600E+02 | ---                                              | DIET (1)       |
| R018 | Leafy vegetable consumption (kg/yr)              | 1.400E+01  | 1.400E+01 | ---                                              | DIET (2)       |
| R018 | Milk consumption (L/yr)                          | not used   | 9.200E+01 | ---                                              | DIET (3)       |
| R018 | Meat and poultry consumption (kg/yr)             | not used   | 6.300E+01 | ---                                              | DIET (4)       |
| R018 | Fish consumption (kg/yr)                         | not used   | 5.400E+00 | ---                                              | DIET (5)       |
| R018 | Other seafood consumption (kg/yr)                | not used   | 9.000E-01 | ---                                              | DIET (6)       |
| R018 | Soil ingestion rate (g/yr)                       | 4.380E+01  | 3.650E+01 | ---                                              | SOIL           |
| R018 | Drinking water intake (L/yr)                     | 7.000E+02  | 5.100E+02 | ---                                              | DWI            |
| R018 | Contamination fraction of drinking water         | 1.000E+00  | 1.000E+00 | ---                                              | FDW            |
| R018 | Contamination fraction of household water        | not used   | 1.000E+00 | ---                                              | FHHW           |
| R018 | Contamination fraction of livestock water        | not used   | 1.000E+00 | ---                                              | FLW            |
| R018 | Contamination fraction of irrigation water       | 1.000E+00  | 1.000E+00 | ---                                              | FIRW           |
| R018 | Contamination fraction of aquatic food           | not used   | 5.000E-01 | ---                                              | FR9            |
| R018 | Contamination fraction of plant food             | -1         | -1        | 0.500E+00                                        | FPLANT         |
| R018 | Contamination fraction of meat                   | not used   | -1        | ---                                              | FMEAT          |
| R018 | Contamination fraction of milk                   | not used   | -1        | ---                                              | FMILK          |
|      |                                                  |            |           |                                                  |                |
| R019 | Livestock fodder intake for meat (kg/day)        | not used   | 6.800E+01 | ---                                              | LFI5           |
| R019 | Livestock fodder intake for milk (kg/day)        | not used   | 5.500E+01 | ---                                              | LFI6           |
| R019 | Livestock water intake for meat (L/day)          | not used   | 5.000E+01 | ---                                              | LWI5           |
| R019 | Livestock water intake for milk (L/day)          | not used   | 1.600E+02 | ---                                              | LWI6           |
| R019 | Livestock soil intake (kg/day)                   | not used   | 5.000E-01 | ---                                              | LSI            |
| R019 | Mass loading for foliar deposition (g/m**3)      | 1.000E-05  | 1.000E-04 | ---                                              | MLFD           |
| R019 | Depth of soil mixing layer (m)                   | 1.500E-01  | 1.500E-01 | ---                                              | DM             |
| R019 | Depth of roots (m)                               | 9.000E-01  | 9.000E-01 | ---                                              | DROOT          |
| R019 | Drinking water fraction from ground water        | 1.000E+00  | 1.000E+00 | ---                                              | FGWDW          |
| R019 | Household water fraction from ground water       | not used   | 1.000E+00 | ---                                              | FGWHH          |
| R019 | Livestock water fraction from ground water       | not used   | 1.000E+00 | ---                                              | FGWLW          |
| R019 | Irrigation fraction from ground water            | 1.000E+00  | 1.000E+00 | ---                                              | FGWIR          |
|      |                                                  |            |           |                                                  |                |
| R19B | Wet weight crop yield for Non-Leafy (kg/m**2)    | 7.000E-01  | 7.000E-01 | ---                                              | YV (1)         |
| R19B | Wet weight crop yield for Leafy (kg/m**2)        | 1.500E+00  | 1.500E+00 | ---                                              | YV (2)         |
| R19B | Wet weight crop yield for Fodder (kg/m**2)       | not used   | 1.100E+00 | ---                                              | YV (3)         |
| R19B | Growing Season for Non-Leafy (years)             | 1.700E-01  | 1.700E-01 | ---                                              | TE (1)         |
| R19B | Growing Season for Leafy (years)                 | 2.500E-01  | 2.500E-01 | ---                                              | TE (2)         |
| R19B | Growing Season for Fodder (years)                | not used   | 8.000E-02 | ---                                              | TE (3)         |
| R19B | Translocation Factor for Non-Leafy               | 1.000E-01  | 1.000E-01 | ---                                              | TIV (1)        |
| R19B | Translocation Factor for Leafy                   | 1.000E+00  | 1.000E+00 | ---                                              | TIV (2)        |
| R19B | Translocation Factor for Fodder                  | not used   | 1.000E+00 | ---                                              | TIV (3)        |
| R19B | Dry Foliar Interception Fraction for Non-Leafy   | 2.500E-01  | 2.500E-01 | ---                                              | RDRY (1)       |
| R19B | Dry Foliar Interception Fraction for Leafy       | 2.500E-01  | 2.500E-01 | ---                                              | RDRY (2)       |
| R19B | Dry Foliar Interception Fraction for Fodder      | not used   | 2.500E-01 | ---                                              | RDRY (3)       |
| R19B | Wet Foliar Interception Fraction for Non-Leafy   | 2.500E-01  | 2.500E-01 | ---                                              | RWET (1)       |
| R19B | Wet Foliar Interception Fraction for Leafy       | 2.500E-01  | 2.500E-01 | ---                                              | RWET (2)       |
| R19B | Wet Foliar Interception Fraction for Fodder      | not used   | 2.500E-01 | ---                                              | RWET (3)       |
| R19B | Weathering Removal Constant for Vegetation       | 2.000E+01  | 2.000E+01 | ---                                              | WLAM           |
|      |                                                  |            |           |                                                  |                |
| C14  | C-12 concentration in water (g/cm**3)            | not used   | 2.000E-05 | ---                                              | C12WTR         |
| C14  | C-12 concentration in contaminated soil (g/g)    | not used   | 3.000E-02 | ---                                              | C12CZ          |
| C14  | Fraction of vegetation carbon from soil          | not used   | 2.000E-02 | ---                                              | CSOIL          |

Summary : 811 area-Resident-deep-No Bkdg subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User Input | Default    | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|--------------------------------------------------|------------|------------|--------------------------------------------------|----------------|
| C14  | Fraction of vegetation carbon from air           | not used   | 9.800E-01  | ---                                              | CAIR           |
| C14  | C-14 evasion layer thickness in soil (m)         | not used   | 3.000E-01  | ---                                              | DMC            |
| C14  | C-14 evasion flux rate from soil (1/sec)         | not used   | 7.000E-07  | ---                                              | EVSN           |
| C14  | C-12 evasion flux rate from soil (1/sec)         | not used   | 1.000E-10  | ---                                              | REVSN          |
| C14  | Fraction of grain in beef cattle feed            | not used   | 8.000E-01  | ---                                              | AVFG4          |
| C14  | Fraction of grain in milk cow feed               | not used   | 2.000E-01  | ---                                              | AVFG5          |
| STOR | Storage times of contaminated foodstuffs (days): |            |            |                                                  |                |
| STOR | Fruits, non-leafy vegetables, and grain          | 1.400E+01  | 1.400E+01  | ---                                              | STOR_T (1)     |
| STOR | Leafy vegetables                                 | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (2)     |
| STOR | Milk                                             | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (3)     |
| STOR | Meat and poultry                                 | 2.000E+01  | 2.000E+01  | ---                                              | STOR_T (4)     |
| STOR | Fish                                             | 7.000E+00  | 7.000E+00  | ---                                              | STOR_T (5)     |
| STOR | Crustacea and mollusks                           | 7.000E+00  | 7.000E+00  | ---                                              | STOR_T (6)     |
| STOR | Well water                                       | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (7)     |
| STOR | Surface water                                    | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (8)     |
| STOR | Livestock fodder                                 | 4.500E+01  | 4.500E+01  | ---                                              | STOR_T (9)     |
| R021 | Thickness of building foundation (m)             | not used   | 1.500E-01  | ---                                              | FLOOR1         |
| R021 | Bulk density of building foundation (g/cm**3)    | not used   | 2.400E+00  | ---                                              | DENSFL         |
| R021 | Total porosity of the cover material             | not used   | 4.000E-01  | ---                                              | TPCV           |
| R021 | Total porosity of the building foundation        | not used   | 1.000E-01  | ---                                              | TPFL           |
| R021 | Volumetric water content of the cover material   | not used   | 5.000E-02  | ---                                              | PH2OCV         |
| R021 | Volumetric water content of the foundation       | not used   | 3.000E-02  | ---                                              | PH2OFL         |
| R021 | Diffusion coefficient for radon gas (m/sec):     |            |            |                                                  |                |
| R021 | in cover material                                | not used   | 2.000E-06  | ---                                              | DIFCV          |
| R021 | in foundation material                           | not used   | 3.000E-07  | ---                                              | DIFFL          |
| R021 | in contaminated zone soil                        | not used   | 2.000E-06  | ---                                              | DIFCZ          |
| R021 | Radon vertical dimension of mixing (m)           | not used   | 2.000E+00  | ---                                              | HMIX           |
| R021 | Average building air exchange rate (1/hr)        | not used   | 5.000E-01  | ---                                              | REXG           |
| R021 | Height of the building (room) (m)                | not used   | 2.500E+00  | ---                                              | HRM            |
| R021 | Building interior area factor                    | not used   | 0.000E+00  | ---                                              | FAI            |
| R021 | Building depth below ground surface (m)          | not used   | -1.000E+00 | ---                                              | DMFL           |
| R021 | Emanating power of Rn-222 gas                    | not used   | 2.500E-01  | ---                                              | EMANA (1)      |
| R021 | Emanating power of Rn-220 gas                    | not used   | 1.500E-01  | ---                                              | EMANA (2)      |
| TITL | Number of graphical time points                  | 32         | ---        | ---                                              | NPTS           |
| TITL | Maximum number of integration points for dose    | 17         | ---        | ---                                              | LYMAX          |
| TITL | Maximum number of integration points for risk    | 65         | ---        | ---                                              | KYMAX          |

Summary : 811 area-Resident-deep-No Bkdg subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

## Summary of Pathway Selections

| Pathway                     | User Selection |
|-----------------------------|----------------|
| 1 -- external gamma         | active         |
| 2 -- inhalation (w/o radon) | active         |
| 3 -- plant ingestion        | active         |
| 4 -- meat ingestion         | suppressed     |
| 5 -- milk ingestion         | suppressed     |
| 6 -- aquatic foods          | suppressed     |
| 7 -- drinking water         | active         |
| 8 -- soil ingestion         | active         |
| 9 -- radon                  | suppressed     |
| Find peak pathway doses     | active         |



Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

| Contaminated Zone Dimensions |                       | Initial Soil Concentrations, pCi/g |           |
|------------------------------|-----------------------|------------------------------------|-----------|
| Area:                        | 1860.00 square meters | Cs-137                             | 5.050E+01 |
| Thickness:                   | 8.00 meters           | Ra-226                             | 4.960E-01 |
| Cover Depth:                 | 0.61 meters           | Sr-90                              | 2.140E-01 |
|                              |                       | U-238                              | 4.470E-01 |

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 1.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

|            |           |           |           |           |           |           |           |           |
|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| t (years): | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| TDOSE(t):  | 3.651E+00 | 3.627E+00 | 3.538E+00 | 3.443E+00 | 3.137E+00 | 3.143E+00 | 3.536E+00 | 2.919E+00 |
| M(t):      | 2.434E-01 | 2.418E-01 | 2.359E-01 | 2.295E-01 | 2.091E-01 | 2.095E-01 | 2.358E-01 | 1.946E-01 |

Maximum TDOSE(t): 4.573E+00 mrem/yr at t = 608 ± 1 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 6.083E+02 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137        | 7.123E-05 | 0.0000 | 9.685E-11  | 0.0000 | 0.000E+00 | 0.0000 | 6.654E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.240E-08 | 0.0000 |
| Ra-226        | 1.515E+00 | 0.3314 | 3.139E-04  | 0.0001 | 0.000E+00 | 0.0000 | 2.428E+00 | 0.5310 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.599E-02 | 0.0144 |
| Sr-90         | 5.442E-10 | 0.0000 | 3.386E-13  | 0.0000 | 0.000E+00 | 0.0000 | 9.692E-08 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.212E-10 | 0.0000 |
| U-238         | 2.141E-02 | 0.0047 | 1.260E-04  | 0.0000 | 0.000E+00 | 0.0000 | 9.347E-03 | 0.0020 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.402E-03 | 0.0003 |
| Total         | 1.537E+00 | 0.3361 | 4.399E-04  | 0.0001 | 0.000E+00 | 0.0000 | 2.437E+00 | 0.5331 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.739E-02 | 0.0147 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 6.083E+02 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|               | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137        | 1.531E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.126E-08 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.811E-05     | 0.0000 |
| Ra-226        | 4.750E-01 | 0.1039 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.473E-02 | 0.0076 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.520E+00     | 0.9884 |
| Sr-90         | 2.762E-09 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.169E-10 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.006E-07     | 0.0000 |
| U-238         | 1.922E-02 | 0.0042 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.400E-03 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.290E-02     | 0.0116 |
| Total         | 4.942E-01 | 0.1081 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.613E-02 | 0.0079 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.573E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.385E-02 | 0.0065 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.821E+00 | 0.7727 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226            | 3.832E-03 | 0.0010 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 5.953E-01 | 0.1630 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 5.990E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.994E-01 | 0.0546 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 1.145E-05 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 5.569E-03 | 0.0015 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 2.770E-02 | 0.0076 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 3.622E+00 | 0.9919 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.697E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.127E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.845E+00     | 0.7793 |
| Ra-226            | 1.062E-03 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.403E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.003E-01     | 0.1644 |
| Sr-90             | 2.638E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.965E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.997E-01     | 0.0547 |
| U-238             | 3.087E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.131E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.911E-03     | 0.0016 |
| Total             | 1.804E-03 | 0.0005 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.263E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.651E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.363E-02 | 0.0065 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.766E+00 | 0.7626 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226            | 3.869E-03 | 0.0011 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 6.269E-01 | 0.1728 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 5.942E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.950E-01 | 0.0538 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 1.159E-05 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 5.583E-03 | 0.0015 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 2.751E-02 | 0.0076 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 3.594E+00 | 0.9907 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 5.016E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.551E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.790E+00     | 0.7693 |
| Ra-226            | 3.509E-03 | 0.0010 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.529E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.346E-01     | 0.1749 |
| Sr-90             | 7.764E-04 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.974E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.958E-01     | 0.0540 |
| U-238             | 9.288E-04 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.629E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.589E-03     | 0.0018 |
| Total             | 5.716E-03 | 0.0016 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.144E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.627E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.274E-02 | 0.0064 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.556E+00 | 0.7224 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226            | 4.020E-03 | 0.0011 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 7.442E-01 | 0.2103 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 5.751E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.783E-01 | 0.0504 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 1.216E-05 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 5.636E-03 | 0.0016 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 2.677E-02 | 0.0076 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 3.484E+00 | 0.9848 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.683E-03 | 0.0005 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.226E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.581E+00     | 0.7294 |
| Ra-226            | 1.763E-02 | 0.0050 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.288E-03 | 0.0004 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.671E-01     | 0.2168 |
| Sr-90             | 2.584E-03 | 0.0007 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.017E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.811E-01     | 0.0512 |
| U-238             | 3.404E-03 | 0.0010 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.467E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.299E-03     | 0.0026 |
| Total             | 2.531E-02 | 0.0072 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.859E-03 | 0.0005 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.538E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.167E-02 | 0.0063 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.315E+00 | 0.6724 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226            | 4.216E-03 | 0.0012 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 8.753E-01 | 0.2542 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 5.522E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.594E-01 | 0.0463 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 1.291E-05 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 5.703E-03 | 0.0017 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 2.590E-02 | 0.0075 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 3.356E+00 | 0.9746 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 2.866E-03 | 0.0008 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.097E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.340E+00     | 0.6796 |
| Ra-226            | 4.367E-02 | 0.0127 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.193E-03 | 0.0009 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.264E-01     | 0.2691 |
| Sr-90             | 4.357E-03 | 0.0013 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.411E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.641E-01     | 0.0477 |
| U-238             | 6.486E-03 | 0.0019 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.712E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.267E-02     | 0.0037 |
| Total             | 5.738E-02 | 0.0167 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.216E-03 | 0.0012 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.443E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 1.477E-02 | 0.0047 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.039E+00 | 0.3312 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226            | 6.180E-03 | 0.0020 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.515E+00 | 0.4831 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 3.987E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 6.448E-02 | 0.0206 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 2.092E-05 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 6.207E-03 | 0.0020 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 2.097E-02 | 0.0067 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.625E+00 | 0.8368 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 5.492E-03 | 0.0018 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.036E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.060E+00     | 0.3378 |
| Ra-226            | 4.167E-01 | 0.1328 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.047E-02 | 0.0097 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.969E+00     | 0.6276 |
| Sr-90             | 4.612E-03 | 0.0015 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.621E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.946E-02     | 0.0221 |
| U-238             | 3.064E-02 | 0.0098 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.231E-03 | 0.0007 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.910E-02     | 0.0125 |
| Total             | 4.574E-01 | 0.1458 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.347E-02 | 0.0107 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.137E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 9.149E-03 | 0.0029 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 3.743E-01 | 0.1191 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226            | 9.970E-03 | 0.0032 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 1.841E+00 | 0.5858 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 2.654E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.040E-02 | 0.0065 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 3.824E-05 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 6.770E-03 | 0.0022 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 1.916E-02 | 0.0061 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 2.243E+00 | 0.7135 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 3.457E-03 | 0.0011 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.542E-04 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.872E-01     | 0.1232 |
| Ra-226            | 7.859E-01 | 0.2500 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.747E-02 | 0.0183 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.695E+00     | 0.8573 |
| Sr-90             | 1.278E-03 | 0.0004 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.004E-04 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.178E-02     | 0.0069 |
| U-238             | 3.059E-02 | 0.0097 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.229E-03 | 0.0007 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.963E-02     | 0.0126 |
| Total             | 8.212E-01 | 0.2613 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.005E-02 | 0.0191 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.143E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 1.980E-04 | 0.0001 | 3.238E-10  | 0.0000 | 0.000E+00 | 0.0000 | 7.189E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.086E-07 | 0.0000 |
| Ra-226            | 4.824E-01 | 0.1364 | 9.680E-05  | 0.0000 | 0.000E+00 | 0.0000 | 2.420E+00 | 0.6843 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.035E-02 | 0.0058 |
| Sr-90             | 1.032E-09 | 0.0000 | 1.500E-12  | 0.0000 | 0.000E+00 | 0.0000 | 1.387E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.366E-10 | 0.0000 |
| U-238             | 4.893E-03 | 0.0014 | 3.824E-05  | 0.0000 | 0.000E+00 | 0.0000 | 9.166E-03 | 0.0026 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.255E-04 | 0.0001 |
| Total             | 4.875E-01 | 0.1379 | 1.350E-04  | 0.0000 | 0.000E+00 | 0.0000 | 2.429E+00 | 0.6869 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.078E-02 | 0.0059 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.725E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.269E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.720E-04     | 0.0001 |
| Ra-226            | 5.368E-01 | 0.1518 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.925E-02 | 0.0111 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.499E+00     | 0.9894 |
| Sr-90             | 4.451E-08 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.495E-09 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.437E-06     | 0.0000 |
| U-238             | 2.122E-02 | 0.0060 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.546E-03 | 0.0004 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.729E-02     | 0.0105 |
| Total             | 5.580E-01 | 0.1578 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.080E-02 | 0.0115 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.536E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.



Summary : 811 area-Resident-deep-No Bkgd subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 8.146E-09 | 0.0000 | 1.123E-14  | 0.0000 | 0.000E+00 | 0.0000 | 7.663E-10 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.234E-12 | 0.0000 |
| Ra-226            | 9.608E-01 | 0.3292 | 2.013E-04  | 0.0001 | 0.000E+00 | 0.0000 | 1.547E+00 | 0.5300 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.232E-02 | 0.0145 |
| Sr-90             | 3.306E-14 | 0.0000 | 1.420E-17  | 0.0000 | 0.000E+00 | 0.0000 | 4.037E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.080E-15 | 0.0000 |
| U-238             | 1.558E-02 | 0.0053 | 8.567E-05  | 0.0000 | 0.000E+00 | 0.0000 | 6.315E-03 | 0.0022 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.533E-04 | 0.0003 |
| Total             | 9.764E-01 | 0.3345 | 2.870E-04  | 0.0001 | 0.000E+00 | 0.0000 | 1.553E+00 | 0.5322 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.327E-02 | 0.0148 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.824E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.342E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.939E-09     | 0.0000 |
| Ra-226            | 3.091E-01 | 0.1059 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.260E-02 | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.882E+00     | 0.9874 |
| Sr-90             | 1.143E-13 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.972E-15 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.198E-12     | 0.0000 |
| U-238             | 1.296E-02 | 0.0044 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.446E-04 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.684E-02     | 0.0126 |
| Total             | 3.221E-01 | 0.1103 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.355E-02 | 0.0081 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.919E+00     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : 811 area-Resident-deep-No Bkdg subtract-E

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-RES-NO-BKD SUBTR-DEEP-E.RAD

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

| Parent<br>(i) | Product<br>(j) | Thread<br>Fraction | DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) |           |           |           |           |           |           |           |
|---------------|----------------|--------------------|---------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               |                |                    | 0.000E+00                                   | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137+D      | Cs-137+D       | 1.000E+00          | 5.634E-02                                   | 5.525E-02 | 5.110E-02 | 4.633E-02 | 2.098E-02 | 7.666E-03 | 5.386E-06 | 1.770E-10 |
| Ra-226+D      | Ra-226+D       | 1.000E+00          | 1.174E+00                                   | 1.181E+00 | 1.209E+00 | 1.243E+00 | 1.508E+00 | 1.716E+00 | 2.954E+00 | 3.196E+00 |
| Ra-226+D      | Pb-210+D       | 1.000E+00          | 3.641E-02                                   | 9.859E-02 | 3.379E-01 | 6.245E-01 | 2.461E+00 | 3.716E+00 | 4.100E+00 | 2.614E+00 |
| Ra-226+D      | ΣDSR(j)        |                    | 1.210E+00                                   | 1.279E+00 | 1.547E+00 | 1.868E+00 | 3.969E+00 | 5.433E+00 | 7.054E+00 | 5.811E+00 |
| Sr-90+D       | Sr-90+D        | 1.000E+00          | 9.331E-01                                   | 9.151E-01 | 8.463E-01 | 7.669E-01 | 3.246E-01 | 1.018E-01 | 6.713E-06 | 1.962E-11 |
| U-238         | U-238          | 5.450E-07          | 6.684E-09                                   | 7.453E-09 | 1.052E-08 | 1.434E-08 | 4.427E-08 | 4.485E-08 | 3.666E-08 | 2.405E-08 |
| U-238+D       | U-238+D        | 1.000E+00          | 1.322E-02                                   | 1.474E-02 | 2.080E-02 | 2.835E-02 | 8.746E-02 | 8.864E-02 | 8.331E-02 | 8.226E-02 |
| U-238+D       | U-234          | 1.000E+00          | 1.958E-08                                   | 6.465E-08 | 3.332E-07 | 8.664E-07 | 1.286E-05 | 2.591E-05 | 1.054E-04 | 1.383E-04 |
| U-238+D       | Th-230         | 1.000E+00          | 1.427E-13                                   | 8.346E-13 | 9.409E-12 | 3.392E-11 | 8.457E-10 | 3.694E-09 | 1.625E-07 | 6.965E-07 |
| U-238+D       | Ra-226+D       | 1.000E+00          | 3.601E-11                                   | 1.220E-10 | 3.847E-10 | 8.501E-10 | 4.322E-09 | 7.288E-09 | 8.320E-07 | 8.762E-06 |
| U-238+D       | Pb-210+D       | 1.000E+00          | 1.710E-10                                   | 5.792E-10 | 1.822E-09 | 4.022E-09 | 1.909E-08 | 2.274E-08 | 9.473E-07 | 6.377E-06 |
| U-238+D       | ΣDSR(j)        |                    | 1.322E-02                                   | 1.474E-02 | 2.080E-02 | 2.835E-02 | 8.747E-02 | 8.866E-02 | 8.341E-02 | 8.241E-02 |

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

## Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 1.500E+01 mrem/yr

| Nuclide<br>(i) | t =       | 0.000E+00 1.000E+00 5.000E+00 1.000E+01 5.000E+01 1.000E+02 5.000E+02 1.000E+03 |           |           |           |           |           |           |  |
|----------------|-----------|---------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|--|
|                |           |                                                                                 |           |           |           |           |           |           |  |
| Cs-137         | 2.662E+02 | 2.715E+02                                                                       | 2.935E+02 | 3.237E+02 | 7.149E+02 | 1.957E+03 | 2.785E+06 | 8.474E+10 |  |
| Ra-226         | 1.239E+01 | 1.172E+01                                                                       | 9.699E+00 | 8.031E+00 | 3.779E+00 | 2.761E+00 | 2.126E+00 | 2.581E+00 |  |
| Sr-90          | 1.608E+01 | 1.639E+01                                                                       | 1.772E+01 | 1.956E+01 | 4.622E+01 | 1.474E+02 | 2.234E+06 | 7.646E+11 |  |
| U-238          | 1.134E+03 | 1.018E+03                                                                       | 7.210E+02 | 5.291E+02 | 1.715E+02 | 1.692E+02 | 1.798E+02 | 1.820E+02 |  |

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)

and Single Radionuclide Soil Guidelines G(i,t) in pCi/g

at tmin = time of minimum single radionuclide soil guideline

and at tmax = time of maximum total dose = 608 ± 1 years

| Nuclide<br>(i) | Initial<br>(pCi/g) | tmin<br>(years) | DSR(i,tmin) | G(i,tmin)<br>(pCi/g) | DSR(i,tmax) | G(i,tmax)<br>(pCi/g) |
|----------------|--------------------|-----------------|-------------|----------------------|-------------|----------------------|
| Cs-137         | 5.050E+01          | 0.000E+00       | 5.634E-02   | 2.662E+02            | 1.547E-06   | 9.698E+06            |
| Ra-226         | 4.960E-01          | 608 ± 1         | 9.113E+00   | 1.646E+00            | 9.112E+00   | 1.646E+00            |
| Sr-90          | 2.140E-01          | 0.000E+00       | 9.331E-01   | 1.608E+01            | 4.699E-07   | 3.192E+07            |
| U-238          | 4.470E-01          | 610 ± 1         | 1.220E-01   | 1.229E+02            | 1.183E-01   | 1.268E+02            |

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | DOSE(j,t), mrem/yr |           |           |           |           |           |           |           |
|----------------|---------------|-----------|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t= 0.000E+00       | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 2.845E+00          | 2.790E+00 | 2.581E+00 | 2.340E+00 | 1.060E+00 | 3.872E-01 | 2.720E-04 | 8.939E-09 |
| Ra-226         | Ra-226        | 1.000E+00 | 5.822E-01          | 5.857E-01 | 5.995E-01 | 6.166E-01 | 7.480E-01 | 8.513E-01 | 1.465E+00 | 1.585E+00 |
| Ra-226         | U-238         | 1.000E+00 | 1.610E-11          | 5.453E-11 | 1.720E-10 | 3.800E-10 | 1.932E-09 | 3.258E-09 | 3.719E-07 | 3.917E-06 |
| Ra-226         | ΣDOSE(j)      |           | 5.822E-01          | 5.857E-01 | 5.995E-01 | 6.166E-01 | 7.480E-01 | 8.513E-01 | 1.465E+00 | 1.585E+00 |
| Pb-210         | Ra-226        | 1.000E+00 | 1.806E-02          | 4.890E-02 | 1.676E-01 | 3.098E-01 | 1.221E+00 | 1.843E+00 | 2.034E+00 | 1.297E+00 |
| Pb-210         | U-238         | 1.000E+00 | 7.643E-11          | 2.589E-10 | 8.143E-10 | 1.798E-09 | 8.534E-09 | 1.017E-08 | 4.235E-07 | 2.850E-06 |
| Pb-210         | ΣDOSE(j)      |           | 1.806E-02          | 4.890E-02 | 1.676E-01 | 3.098E-01 | 1.221E+00 | 1.843E+00 | 2.034E+00 | 1.297E+00 |
| Sr-90          | Sr-90         | 1.000E+00 | 1.997E-01          | 1.958E-01 | 1.811E-01 | 1.641E-01 | 6.946E-02 | 2.178E-02 | 1.437E-06 | 4.198E-12 |
| U-238          | U-238         | 5.450E-07 | 2.988E-09          | 3.331E-09 | 4.704E-09 | 6.412E-09 | 1.979E-08 | 2.005E-08 | 1.639E-08 | 1.075E-08 |
| U-238          | U-238         | 1.000E+00 | 5.911E-03          | 6.589E-03 | 9.299E-03 | 1.267E-02 | 3.909E-02 | 3.962E-02 | 3.724E-02 | 3.677E-02 |
| U-238          | ΣDOSE(j)      |           | 5.911E-03          | 6.589E-03 | 9.299E-03 | 1.267E-02 | 3.909E-02 | 3.962E-02 | 3.724E-02 | 3.677E-02 |
| U-234          | U-238         | 1.000E+00 | 8.754E-09          | 2.890E-08 | 1.489E-07 | 3.873E-07 | 5.746E-06 | 1.158E-05 | 4.712E-05 | 6.181E-05 |
| Th-230         | U-238         | 1.000E+00 | 6.377E-14          | 3.731E-13 | 4.206E-12 | 1.516E-11 | 3.780E-10 | 1.651E-09 | 7.264E-08 | 3.113E-07 |

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | S(j,t), pCi/g |           |           |           |           |           |           |           |
|----------------|---------------|-----------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t= 0.000E+00  | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 5.050E+01     | 4.934E+01 | 4.498E+01 | 4.006E+01 | 1.586E+01 | 4.984E+00 | 4.728E-04 | 4.427E-09 |
| Ra-226         | Ra-226        | 1.000E+00 | 4.960E-01     | 4.954E-01 | 4.931E-01 | 4.903E-01 | 4.682E-01 | 4.419E-01 | 2.785E-01 | 1.564E-01 |
| Ra-226         | U-238         | 1.000E+00 | 0.000E+00     | 8.373E-16 | 1.043E-13 | 8.313E-13 | 1.007E-10 | 7.740E-10 | 7.072E-08 | 3.864E-07 |
| Ra-226         | ΣS(j):        |           | 4.960E-01     | 4.954E-01 | 4.931E-01 | 4.903E-01 | 4.682E-01 | 4.419E-01 | 2.785E-01 | 1.564E-01 |
| Pb-210         | Ra-226        | 1.000E+00 | 0.000E+00     | 1.523E-02 | 7.139E-02 | 1.319E-01 | 3.745E-01 | 4.301E-01 | 2.844E-01 | 1.597E-01 |
| Pb-210         | U-238         | 1.000E+00 | 0.000E+00     | 6.495E-18 | 3.949E-15 | 6.107E-14 | 2.969E-11 | 3.622E-10 | 5.918E-08 | 3.541E-07 |
| Pb-210         | ΣS(j):        |           | 0.000E+00     | 1.523E-02 | 7.139E-02 | 1.319E-01 | 3.745E-01 | 4.301E-01 | 2.844E-01 | 1.597E-01 |
| Sr-90          | Sr-90         | 1.000E+00 | 2.140E-01     | 2.086E-01 | 1.881E-01 | 1.654E-01 | 5.904E-02 | 1.629E-02 | 5.470E-07 | 1.398E-12 |
| U-238          | U-238         | 5.450E-07 | 2.436E-07     | 2.434E-07 | 2.424E-07 | 2.412E-07 | 2.316E-07 | 2.202E-07 | 1.471E-07 | 8.884E-08 |
| U-238          | U-238         | 1.000E+00 | 4.470E-01     | 4.465E-01 | 4.448E-01 | 4.425E-01 | 4.250E-01 | 4.041E-01 | 2.699E-01 | 1.630E-01 |
| U-238          | ΣS(j):        |           | 4.470E-01     | 4.465E-01 | 4.448E-01 | 4.425E-01 | 4.250E-01 | 4.041E-01 | 2.699E-01 | 1.630E-01 |
| U-234          | U-238         | 1.000E+00 | 0.000E+00     | 1.261E-06 | 6.279E-06 | 1.249E-05 | 6.000E-05 | 1.141E-04 | 3.808E-04 | 4.596E-04 |
| Th-230         | U-238         | 1.000E+00 | 0.000E+00     | 5.799E-12 | 1.446E-10 | 5.763E-10 | 1.402E-08 | 5.424E-08 | 1.042E-06 | 3.036E-06 |

RESCALC.EXE execution time = 16.70 seconds



| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | DOSE(j,t), mrem/yr |           |           |           |           |           |           |           |
|----------------|---------------|-----------|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t = 0.000E+00      | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 2.140E+00          | 2.091E+00 | 1.905E+00 | 1.696E+00 | 6.688E-01 | 2.090E-01 | 1.904E-05 | 1.690E-10 |
| Ra-226         | Ra-226        | 1.000E+00 | 9.230E-01          | 9.224E-01 | 9.203E-01 | 9.175E-01 | 8.960E-01 | 8.699E-01 | 6.864E-01 | 5.105E-01 |
| Ra-226         | U-238         | 1.000E+00 | 4.612E-12          | 1.326E-11 | 4.653E-11 | 8.884E-11 | 8.294E-10 | 2.379E-09 | 9.191E-08 | 3.713E-07 |
| Ra-226         | ΣDOSE(j)      |           | 9.230E-01          | 9.224E-01 | 9.203E-01 | 9.175E-01 | 8.960E-01 | 8.699E-01 | 6.864E-01 | 5.105E-01 |
| Pb-210         | Ra-226        | 1.000E+00 | 4.820E-04          | 1.489E-03 | 6.078E-03 | 1.276E-02 | 7.024E-02 | 1.096E-01 | 1.254E-01 | 1.213E-01 |
| Pb-210         | U-238         | 1.000E+00 | 1.567E-10          | 4.503E-10 | 1.572E-09 | 2.958E-09 | 2.197E-08 | 3.528E-08 | 1.134E-07 | 2.866E-07 |
| Pb-210         | ΣDOSE(j)      |           | 4.820E-04          | 1.489E-03 | 6.078E-03 | 1.276E-02 | 7.024E-02 | 1.096E-01 | 1.254E-01 | 1.213E-01 |
| Sr-90          | Sr-90         | 1.000E+00 | 1.416E-02          | 3.788E-02 | 6.371E-02 | 4.965E-02 | 6.755E-03 | 5.581E-04 | 1.207E-12 | 1.761E-23 |
| U-238          | U-238         | 5.450E-07 | 1.091E-09          | 2.511E-09 | 8.129E-09 | 1.500E-08 | 2.015E-08 | 1.587E-08 | 2.346E-09 | 2.127E-10 |
| U-238          | U-238         | 1.000E+00 | 1.499E-02          | 1.773E-02 | 2.858E-02 | 4.186E-02 | 4.992E-02 | 3.934E-02 | 5.842E-03 | 5.343E-04 |
| U-238          | ΣDOSE(j)      |           | 1.499E-02          | 1.773E-02 | 2.858E-02 | 4.186E-02 | 4.992E-02 | 3.934E-02 | 5.843E-03 | 5.343E-04 |
| U-234          | U-238         | 1.000E+00 | 1.746E-09          | 7.703E-09 | 6.813E-08 | 2.246E-07 | 2.237E-06 | 3.808E-06 | 5.760E-06 | 3.016E-06 |
| Th-230         | U-238         | 1.000E+00 | 4.595E-14          | 2.018E-13 | 1.822E-12 | 6.051E-12 | 1.218E-10 | 4.287E-10 | 5.023E-09 | 9.465E-09 |

THF(i) is the thread fraction of the parent nuclide.

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | S(j,t), pCi/g |           |           |           |           |           |           |           |
|----------------|---------------|-----------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t = 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 3.854E+00     | 3.765E+00 | 3.431E+00 | 3.054E+00 | 1.204E+00 | 3.763E-01 | 3.418E-05 | 3.032E-10 |
| Ra-226         | Ra-226        | 1.000E+00 | 4.960E-01     | 4.957E-01 | 4.945E-01 | 4.931E-01 | 4.815E-01 | 4.673E-01 | 3.684E-01 | 2.736E-01 |
| Ra-226         | U-238         | 1.000E+00 | 0.000E+00     | 8.365E-16 | 1.038E-13 | 8.235E-13 | 9.611E-11 | 7.067E-10 | 4.743E-08 | 1.948E-07 |
| Ra-226         | ΣS(j):        |           | 4.960E-01     | 4.957E-01 | 4.945E-01 | 4.931E-01 | 4.815E-01 | 4.673E-01 | 3.684E-01 | 2.736E-01 |
| Pb-210         | Ra-226        | 1.000E+00 | 0.000E+00     | 1.524E-02 | 7.144E-02 | 1.321E-01 | 3.789E-01 | 4.442E-01 | 3.659E-01 | 2.717E-01 |
| Pb-210         | U-238         | 1.000E+00 | 0.000E+00     | 6.490E-18 | 3.933E-15 | 6.058E-14 | 2.849E-11 | 3.334E-10 | 4.009E-08 | 1.795E-07 |
| Pb-210         | ΣS(j):        |           | 0.000E+00     | 1.524E-02 | 7.144E-02 | 1.321E-01 | 3.789E-01 | 4.442E-01 | 3.659E-01 | 2.717E-01 |
| Sr-90          | Sr-90         | 1.000E+00 | 2.140E-01     | 2.036E-01 | 1.668E-01 | 1.300E-01 | 1.773E-02 | 1.469E-03 | 3.262E-12 | 4.972E-23 |
| U-238          | U-238         | 5.450E-07 | 2.436E-07     | 2.425E-07 | 2.379E-07 | 2.324E-07 | 1.924E-07 | 1.519E-07 | 2.299E-08 | 2.170E-09 |
| U-238          | U-238         | 1.000E+00 | 4.470E-01     | 4.449E-01 | 4.366E-01 | 4.264E-01 | 3.530E-01 | 2.788E-01 | 4.219E-02 | 3.982E-03 |
| U-238          | ΣS(j):        |           | 4.470E-01     | 4.449E-01 | 4.366E-01 | 4.264E-01 | 3.530E-01 | 2.788E-01 | 4.219E-02 | 3.982E-03 |
| U-234          | U-238         | 1.000E+00 | 0.000E+00     | 1.258E-06 | 6.211E-06 | 1.223E-05 | 5.391E-05 | 9.230E-05 | 1.428E-04 | 7.710E-05 |
| Th-230         | U-238         | 1.000E+00 | 0.000E+00     | 5.790E-12 | 1.435E-10 | 5.681E-10 | 1.307E-08 | 4.718E-08 | 5.636E-07 | 1.063E-06 |

THF(i) is the thread fraction of the parent nuclide.



Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

## Table of Contents

### Part I: Mixture Sums and Single Radionuclide Guidelines

|                                                            |    |
|------------------------------------------------------------|----|
| Dose Conversion Factor (and Related) Parameter Summary ... | 2  |
| Site-Specific Parameter Summary .....                      | 5  |
| Summary of Pathway Selections .....                        | 10 |
| Contaminated Zone and Total Dose Summary .....             | 11 |
| Total Dose Components                                      |    |
| Time = 0.000E+00 .....                                     | 12 |
| Time = 1.000E+00 .....                                     | 13 |
| Time = 5.000E+00 .....                                     | 14 |
| Time = 1.000E+01 .....                                     | 15 |
| Time = 5.000E+01 .....                                     | 16 |
| Time = 1.000E+02 .....                                     | 17 |
| Time = 5.000E+02 .....                                     | 18 |
| Time = 1.000E+03 .....                                     | 19 |
| Dose/Source Ratios Summed Over All Pathways .....          | 20 |
| Single Radionuclide Soil Guidelines .....                  | 20 |
| Dose Per Nuclide Summed Over All Pathways .....            | 21 |
| Soil Concentration Per Nuclide .....                       | 21 |

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| A-1  | DCF's for external ground radiation, (mrem/yr)/(pCi/g)   |                |            |                |
| A-1  | At-218 (Source: DCFPAK3.02)                              | 5.567E-05      | 5.567E-05  | DCF1( 1)       |
| A-1  | Ba-137m (Source: DCFPAK3.02)                             | 3.381E+00      | 3.381E+00  | DCF1( 2)       |
| A-1  | Bi-210 (Source: DCFPAK3.02)                              | 5.473E-03      | 5.473E-03  | DCF1( 3)       |
| A-1  | Bi-214 (Source: DCFPAK3.02)                              | 9.135E+00      | 9.135E+00  | DCF1( 4)       |
| A-1  | Cs-137 (Source: DCFPAK3.02)                              | 8.686E-04      | 8.686E-04  | DCF1( 5)       |
| A-1  | Hg-206 (Source: DCFPAK3.02)                              | 6.127E-01      | 6.127E-01  | DCF1( 6)       |
| A-1  | Pa-234 (Source: DCFPAK3.02)                              | 8.275E+00      | 8.275E+00  | DCF1( 7)       |
| A-1  | Pa-234m (Source: DCFPAK3.02)                             | 1.257E-01      | 1.257E-01  | DCF1( 8)       |
| A-1  | Pb-210 (Source: DCFPAK3.02)                              | 2.092E-03      | 2.092E-03  | DCF1( 9)       |
| A-1  | Pb-214 (Source: DCFPAK3.02)                              | 1.257E+00      | 1.257E+00  | DCF1( 10)      |
| A-1  | Po-210 (Source: DCFPAK3.02)                              | 5.641E-05      | 5.641E-05  | DCF1( 11)      |
| A-1  | Po-214 (Source: DCFPAK3.02)                              | 4.801E-04      | 4.801E-04  | DCF1( 12)      |
| A-1  | Po-218 (Source: DCFPAK3.02)                              | 9.228E-09      | 9.228E-09  | DCF1( 13)      |
| A-1  | Ra-226 (Source: DCFPAK3.02)                              | 3.176E-02      | 3.176E-02  | DCF1( 14)      |
| A-1  | Rn-218 (Source: DCFPAK3.02)                              | 4.259E-03      | 4.259E-03  | DCF1( 15)      |
| A-1  | Rn-222 (Source: DCFPAK3.02)                              | 2.130E-03      | 2.130E-03  | DCF1( 16)      |
| A-1  | Sr-90 (Source: DCFPAK3.02)                               | 6.463E-04      | 6.463E-04  | DCF1( 17)      |
| A-1  | Th-230 (Source: DCFPAK3.02)                              | 1.106E-03      | 1.106E-03  | DCF1( 18)      |
| A-1  | Th-234 (Source: DCFPAK3.02)                              | 2.316E-02      | 2.316E-02  | DCF1( 19)      |
| A-1  | Tl-206 (Source: DCFPAK3.02)                              | 1.278E-02      | 1.278E-02  | DCF1( 20)      |
| A-1  | Tl-210 (Source: DCFPAK3.02)                              | 1.677E+01      | 1.677E+01  | DCF1( 21)      |
| A-1  | U-234 (Source: DCFPAK3.02)                               | 3.456E-04      | 3.456E-04  | DCF1( 22)      |
| A-1  | U-238 (Source: DCFPAK3.02)                               | 1.713E-04      | 1.713E-04  | DCF1( 23)      |
| A-1  | Y-90 (Source: DCFPAK3.02)                                | 4.016E-02      | 4.016E-02  | DCF1( 24)      |
| B-1  | Dose conversion factors for inhalation, mrem/pCi:        |                |            |                |
| B-1  | Cs-137+D                                                 | 1.457E-04      | 1.457E-04  | DCF2( 1)       |
| B-1  | Pb-210+D                                                 | 3.708E-02      | 2.077E-02  | DCF2( 2)       |
| B-1  | Ra-226+D                                                 | 3.528E-02      | 3.517E-02  | DCF2( 3)       |
| B-1  | Sr-90+D                                                  | 5.841E-04      | 5.786E-04  | DCF2( 4)       |
| B-1  | Th-230                                                   | 3.759E-01      | 3.759E-01  | DCF2( 5)       |
| B-1  | U-234                                                    | 3.479E-02      | 3.479E-02  | DCF2( 6)       |
| B-1  | U-238                                                    | 2.973E-02      | 2.973E-02  | DCF2( 7)       |
| B-1  | U-238+D                                                  | 2.976E-02      | 2.973E-02  | DCF2( 8)       |
| D-1  | Dose conversion factors for ingestion, mrem/pCi:         |                |            |                |
| D-1  | Cs-137+D                                                 | 5.032E-05      | 5.032E-05  | DCF3( 1)       |
| D-1  | Pb-210+D                                                 | 7.057E-03      | 2.575E-03  | DCF3( 2)       |
| D-1  | Ra-226+D                                                 | 1.037E-03      | 1.036E-03  | DCF3( 3)       |
| D-1  | Sr-90+D                                                  | 1.120E-04      | 1.021E-04  | DCF3( 4)       |
| D-1  | Th-230                                                   | 7.918E-04      | 7.918E-04  | DCF3( 5)       |
| D-1  | U-234                                                    | 1.831E-04      | 1.831E-04  | DCF3( 6)       |
| D-1  | U-238                                                    | 1.650E-04      | 1.650E-04  | DCF3( 7)       |
| D-1  | U-238+D                                                  | 1.776E-04      | 1.650E-04  | DCF3( 8)       |
| D-34 | Food transfer factors:                                   |                |            |                |
| D-34 | Cs-137+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 1,1)      |
| D-34 | Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.000E-02      | 3.000E-02  | RTF( 1,2)      |
| D-34 | Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 1,3)      |



Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

## Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter                                                | Current Value# | Base Case* | Parameter Name |
|------|----------------------------------------------------------|----------------|------------|----------------|
| D-34 | Pb-210+D , plant/soil concentration ratio, dimensionless | 1.000E-02      | 1.000E-02  | RTF( 2,1)      |
| D-34 | Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-04      | 8.000E-04  | RTF( 2,2)      |
| D-34 | Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 3.000E-04      | 3.000E-04  | RTF( 2,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Ra-226+D , plant/soil concentration ratio, dimensionless | 4.000E-02      | 4.000E-02  | RTF( 3,1)      |
| D-34 | Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-03      | 1.000E-03  | RTF( 3,2)      |
| D-34 | Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 1.000E-03      | 1.000E-03  | RTF( 3,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Sr-90+D , plant/soil concentration ratio, dimensionless  | 3.000E-01      | 3.000E-01  | RTF( 4,1)      |
| D-34 | Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 8.000E-03      | 8.000E-03  | RTF( 4,2)      |
| D-34 | Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 2.000E-03      | 2.000E-03  | RTF( 4,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | Th-230 , plant/soil concentration ratio, dimensionless   | 1.000E-03      | 1.000E-03  | RTF( 5,1)      |
| D-34 | Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 1.000E-04      | 1.000E-04  | RTF( 5,2)      |
| D-34 | Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06      | 5.000E-06  | RTF( 5,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-234 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 6,1)      |
| D-34 | U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 6,2)      |
| D-34 | U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 6,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238 , plant/soil concentration ratio, dimensionless    | 2.500E-03      | 2.500E-03  | RTF( 7,1)      |
| D-34 | U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04      | 3.400E-04  | RTF( 7,2)      |
| D-34 | U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04      | 6.000E-04  | RTF( 7,3)      |
| D-34 |                                                          |                |            |                |
| D-34 | U-238+D , plant/soil concentration ratio, dimensionless  | 2.500E-03      | 2.500E-03  | RTF( 8,1)      |
| D-34 | U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04      | 3.400E-04  | RTF( 8,2)      |
| D-34 | U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04      | 6.000E-04  | RTF( 8,3)      |
| D-34 |                                                          |                |            |                |
| D-5  | Bioaccumulation factors, fresh water, L/kg:              |                |            |                |
| D-5  | Cs-137+D , fish                                          | 2.000E+03      | 2.000E+03  | BIOFAC( 1,1)   |
| D-5  | Cs-137+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 1,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Pb-210+D , fish                                          | 3.000E+02      | 3.000E+02  | BIOFAC( 2,1)   |
| D-5  | Pb-210+D , crustacea and mollusks                        | 1.000E+02      | 1.000E+02  | BIOFAC( 2,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Ra-226+D , fish                                          | 5.000E+01      | 5.000E+01  | BIOFAC( 3,1)   |
| D-5  | Ra-226+D , crustacea and mollusks                        | 2.500E+02      | 2.500E+02  | BIOFAC( 3,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Sr-90+D , fish                                           | 6.000E+01      | 6.000E+01  | BIOFAC( 4,1)   |
| D-5  | Sr-90+D , crustacea and mollusks                         | 1.000E+02      | 1.000E+02  | BIOFAC( 4,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | Th-230 , fish                                            | 1.000E+02      | 1.000E+02  | BIOFAC( 5,1)   |
| D-5  | Th-230 , crustacea and mollusks                          | 5.000E+02      | 5.000E+02  | BIOFAC( 5,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-234 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 6,1)   |
| D-5  | U-234 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 6,2)   |
| D-5  |                                                          |                |            |                |
| D-5  | U-238 , fish                                             | 1.000E+01      | 1.000E+01  | BIOFAC( 7,1)   |
| D-5  | U-238 , crustacea and mollusks                           | 6.000E+01      | 6.000E+01  | BIOFAC( 7,2)   |
| D-5  |                                                          |                |            |                |

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: DCFPAK3.02 (Adult)

| Menu | Parameter |                          | Current   | Base      | Parameter    |
|------|-----------|--------------------------|-----------|-----------|--------------|
|      |           |                          | Value#    | Case*     | Name         |
| D-5  | U-238+D   | , fish                   | 1.000E+01 | 1.000E+01 | BIOFAC( 8,1) |
| D-5  | U-238+D   | , crustacea and mollusks | 6.000E+01 | 6.000E+01 | BIOFAC( 8,2) |

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.

\*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

## Site-Specific Parameter Summary

| Menu | Parameter                                       | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|-------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R011 | Area of contaminated zone (m**2)                | 1.860E+03  | 1.000E+04 | ---                                              | AREA           |
| R011 | Thickness of contaminated zone (m)              | 8.000E+00  | 2.000E+00 | ---                                              | THICK0         |
| R011 | Fraction of contamination that is submerged     | 0.000E+00  | 0.000E+00 | ---                                              | SUBMFRACT      |
| R011 | Length parallel to aquifer flow (m)             | 7.600E+01  | 1.000E+02 | ---                                              | LCZPAQ         |
| R011 | Basic radiation dose limit (mrem/yr)            | 1.500E+01  | 3.000E+01 | ---                                              | BRDL           |
| R011 | Time since placement of material (yr)           | 0.000E+00  | 0.000E+00 | ---                                              | TI             |
| R011 | Times for calculations (yr)                     | 1.000E+00  | 1.000E+00 | ---                                              | T( 2)          |
| R011 | Times for calculations (yr)                     | 5.000E+00  | 3.000E+00 | ---                                              | T( 3)          |
| R011 | Times for calculations (yr)                     | 1.000E+01  | 1.000E+01 | ---                                              | T( 4)          |
| R011 | Times for calculations (yr)                     | 5.000E+01  | 3.000E+01 | ---                                              | T( 5)          |
| R011 | Times for calculations (yr)                     | 1.000E+02  | 1.000E+02 | ---                                              | T( 6)          |
| R011 | Times for calculations (yr)                     | 5.000E+02  | 3.000E+02 | ---                                              | T( 7)          |
| R011 | Times for calculations (yr)                     | 1.000E+03  | 1.000E+03 | ---                                              | T( 8)          |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T( 9)          |
| R011 | Times for calculations (yr)                     | not used   | 0.000E+00 | ---                                              | T(10)          |
| R012 | Initial principal radionuclide (pCi/g): Cs-137  | 5.050E+01  | 0.000E+00 | ---                                              | S1(1)          |
| R012 | Initial principal radionuclide (pCi/g): Ra-226  | 4.960E-01  | 0.000E+00 | ---                                              | S1(3)          |
| R012 | Initial principal radionuclide (pCi/g): Sr-90   | 2.140E-01  | 0.000E+00 | ---                                              | S1(4)          |
| R012 | Initial principal radionuclide (pCi/g): U-238   | 4.470E-01  | 0.000E+00 | ---                                              | S1(7)          |
| R012 | Concentration in groundwater (pCi/L): Cs-137    | not used   | 0.000E+00 | ---                                              | W1( 1)         |
| R012 | Concentration in groundwater (pCi/L): Ra-226    | not used   | 0.000E+00 | ---                                              | W1( 3)         |
| R012 | Concentration in groundwater (pCi/L): Sr-90     | not used   | 0.000E+00 | ---                                              | W1( 4)         |
| R012 | Concentration in groundwater (pCi/L): U-238     | not used   | 0.000E+00 | ---                                              | W1( 7)         |
| R013 | Cover depth (m)                                 | 6.100E-01  | 0.000E+00 | ---                                              | COVER0         |
| R013 | Density of cover material (g/cm**3)             | 1.500E+00  | 1.500E+00 | ---                                              | DENSCV         |
| R013 | Cover depth erosion rate (m/yr)                 | 1.000E-03  | 1.000E-03 | ---                                              | VCV            |
| R013 | Density of contaminated zone (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSCZ         |
| R013 | Contaminated zone erosion rate (m/yr)           | 1.000E-03  | 1.000E-03 | ---                                              | VCZ            |
| R013 | Contaminated zone total porosity                | 3.300E-01  | 4.000E-01 | ---                                              | TPCZ           |
| R013 | Contaminated zone field capacity                | 2.400E-01  | 2.000E-01 | ---                                              | FCCZ           |
| R013 | Contaminated zone hydraulic conductivity (m/yr) | 5.000E+03  | 1.000E+01 | ---                                              | HCCZ           |
| R013 | Contaminated zone b parameter                   | 4.900E+00  | 5.300E+00 | ---                                              | BCZ            |
| R013 | Average annual wind speed (m/sec)               | 6.230E+00  | 2.000E+00 | ---                                              | WIND           |
| R013 | Humidity in air (g/m**3)                        | not used   | 8.000E+00 | ---                                              | HUMID          |
| R013 | Evapotranspiration coefficient                  | 4.600E-01  | 5.000E-01 | ---                                              | EVAPTR         |
| R013 | Precipitation (m/yr)                            | 1.230E+00  | 1.000E+00 | ---                                              | PRECIP         |
| R013 | Irrigation (m/yr)                               | 2.600E-01  | 2.000E-01 | ---                                              | RI             |
| R013 | Irrigation mode                                 | overhead   | overhead  | ---                                              | IDITCH         |
| R013 | Runoff coefficient                              | 2.000E-01  | 2.000E-01 | ---                                              | RUNOFF         |
| R013 | Watershed area for nearby stream or pond (m**2) | 1.000E+06  | 1.000E+06 | ---                                              | WAREA          |
| R013 | Accuracy for water/soil computations            | 1.000E-03  | 1.000E-03 | ---                                              | EPS            |
| R014 | Density of saturated zone (g/cm**3)             | 1.660E+00  | 1.500E+00 | ---                                              | DENSAQ         |
| R014 | Saturated zone total porosity                   | 3.300E-01  | 4.000E-01 | ---                                              | TPSZ           |
| R014 | Saturated zone effective porosity               | 2.400E-01  | 2.000E-01 | ---                                              | EPSZ           |
| R014 | Saturated zone field capacity                   | 2.000E-01  | 2.000E-01 | ---                                              | FCSZ           |
| R014 | Saturated zone hydraulic conductivity (m/yr)    | 2.000E+04  | 1.000E+02 | ---                                              | HCSZ           |
| R014 | Saturated zone hydraulic gradient               | 4.800E-03  | 2.000E-02 | ---                                              | HGWT           |

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R014 | Saturated zone b parameter                     | 4.900E+00  | 5.300E+00 | ---                                              | BSZ            |
| R014 | Water table drop rate (m/yr)                   | 1.000E-03  | 1.000E-03 | ---                                              | VWT            |
| R014 | Well pump intake depth (m below water table)   | 1.800E+01  | 1.000E+01 | ---                                              | DWIBWT         |
| R014 | Model: Nondispersion (ND) or Mass-Balance (MB) | ND         | ND        | ---                                              | MODEL          |
| R014 | Well pumping rate (m**3/yr)                    | 2.500E+02  | 2.500E+02 | ---                                              | UW             |
| R015 | Number of unsaturated zone strata              | 1          | 1         | ---                                              | NS             |
| R015 | Unsat. zone 1, thickness (m)                   | 0.000E+00  | 4.000E+00 | ---                                              | H (1)          |
| R015 | Unsat. zone 1, soil density (g/cm**3)          | 1.660E+00  | 1.500E+00 | ---                                              | DENSUZ (1)     |
| R015 | Unsat. zone 1, total porosity                  | 3.300E-01  | 4.000E-01 | ---                                              | TPUZ (1)       |
| R015 | Unsat. zone 1, effective porosity              | 2.400E-01  | 2.000E-01 | ---                                              | EPUZ (1)       |
| R015 | Unsat. zone 1, field capacity                  | 2.000E-01  | 2.000E-01 | ---                                              | FCUZ (1)       |
| R015 | Unsat. zone 1, soil-specific b parameter       | 4.900E+00  | 5.300E+00 | ---                                              | BUZ (1)        |
| R015 | Unsat. zone 1, hydraulic conductivity (m/yr)   | 5.000E+03  | 1.000E+01 | ---                                              | HCUZ (1)       |
| R016 | Distribution coefficients for Cs-137           |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCC ( 1)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCU ( 1,1)  |
| R016 | Saturated zone (cm**3/g)                       | 2.800E+02  | 4.600E+03 | ---                                              | DCNUCS ( 1)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.806E-04                                        | ALEACH ( 1)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 1)    |
| R016 | Distribution coefficients for Ra-226           |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+02  | 7.000E+01 | ---                                              | DCNUCC ( 3)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 5.000E+02  | 7.000E+01 | ---                                              | DCNUCU ( 3,1)  |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+02  | 7.000E+01 | ---                                              | DCNUCS ( 3)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.011E-04                                        | ALEACH ( 3)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 3)    |
| R016 | Distribution coefficients for Sr-90            |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 3.000E+00  | 3.000E+01 | ---                                              | DCNUCC ( 4)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 3.000E+00  | 3.000E+01 | ---                                              | DCNUCU ( 4,1)  |
| R016 | Saturated zone (cm**3/g)                       | 3.000E+00  | 3.000E+01 | ---                                              | DCNUCS ( 4)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.609E-02                                        | ALEACH ( 4)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 4)    |
| R016 | Distribution coefficients for U-238            |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 1.700E+01  | 5.000E+01 | ---                                              | DCNUCC ( 7)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 1.700E+01  | 5.000E+01 | ---                                              | DCNUCU ( 7,1)  |
| R016 | Saturated zone (cm**3/g)                       | 1.700E+01  | 5.000E+01 | ---                                              | DCNUCS ( 7)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 2.950E-03                                        | ALEACH ( 7)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 7)    |
| R016 | Distribution coefficients for daughter Pb-210  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCC ( 2)    |
| R016 | Unsat. zone 1 (cm**3/g)                        | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCU ( 2,1)  |
| R016 | Saturated zone (cm**3/g)                       | 1.000E+02  | 1.000E+02 | ---                                              | DCNUCS ( 2)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 5.051E-04                                        | ALEACH ( 2)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 2)    |

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                      | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R016 | Distribution coefficients for daughter Th-230  |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCC ( 5)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCU ( 5,1)  |
| R016 | Saturated zone (cm**3/g)                       | 6.000E+04  | 6.000E+04 | ---                                              | DCNUCS ( 5)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 8.431E-07                                        | ALEACH ( 5)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 5)    |
| R016 | Distribution coefficients for daughter U-234   |            |           |                                                  |                |
| R016 | Contaminated zone (cm**3/g)                    | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCC ( 6)    |
| R016 | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCU ( 6,1)  |
| R016 | Saturated zone (cm**3/g)                       | 5.000E+01  | 5.000E+01 | ---                                              | DCNUCS ( 6)    |
| R016 | Leach rate (/yr)                               | 0.000E+00  | 0.000E+00 | 1.009E-03                                        | ALEACH ( 6)    |
| R016 | Solubility constant                            | 0.000E+00  | 0.000E+00 | not used                                         | SOLUBK ( 6)    |
| R017 | Inhalation rate (m**3/yr)                      | 7.300E+03  | 8.400E+03 | ---                                              | INHALR         |
| R017 | Mass loading for inhalation (g/m**3)           | 1.000E-04  | 1.000E-04 | ---                                              | MLINH          |
| R017 | Exposure duration                              | 2.500E+01  | 3.000E+01 | ---                                              | ED             |
| R017 | Shielding factor, inhalation                   | 4.000E-01  | 4.000E-01 | ---                                              | SHF3           |
| R017 | Shielding factor, external gamma               | 8.000E-01  | 7.000E-01 | ---                                              | SHF1           |
| R017 | Fraction of time spent indoors                 | 1.700E-01  | 5.000E-01 | ---                                              | FIND           |
| R017 | Fraction of time spent outdoors (on site)      | 6.000E-02  | 2.500E-01 | ---                                              | FOTD           |
| R017 | Shape factor flag, external gamma              | 1.000E+00  | 1.000E+00 | >0 shows circular AREA.                          | FS             |
| R017 | Radii of shape factor array (used if FS = -1): |            |           |                                                  |                |
| R017 | Outer annular radius (m), ring 1:              | not used   | 5.000E+01 | ---                                              | RAD_SHAPE ( 1) |
| R017 | Outer annular radius (m), ring 2:              | not used   | 7.071E+01 | ---                                              | RAD_SHAPE ( 2) |
| R017 | Outer annular radius (m), ring 3:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 3) |
| R017 | Outer annular radius (m), ring 4:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 4) |
| R017 | Outer annular radius (m), ring 5:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 5) |
| R017 | Outer annular radius (m), ring 6:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 6) |
| R017 | Outer annular radius (m), ring 7:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 7) |
| R017 | Outer annular radius (m), ring 8:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 8) |
| R017 | Outer annular radius (m), ring 9:              | not used   | 0.000E+00 | ---                                              | RAD_SHAPE ( 9) |
| R017 | Outer annular radius (m), ring 10:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(10)  |
| R017 | Outer annular radius (m), ring 11:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(11)  |
| R017 | Outer annular radius (m), ring 12:             | not used   | 0.000E+00 | ---                                              | RAD_SHAPE(12)  |
| R017 | Fractions of annular areas within AREA:        |            |           |                                                  |                |
| R017 | Ring 1                                         | not used   | 1.000E+00 | ---                                              | FRACA ( 1)     |
| R017 | Ring 2                                         | not used   | 2.732E-01 | ---                                              | FRACA ( 2)     |
| R017 | Ring 3                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 3)     |
| R017 | Ring 4                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 4)     |
| R017 | Ring 5                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 5)     |
| R017 | Ring 6                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 6)     |
| R017 | Ring 7                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 7)     |
| R017 | Ring 8                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 8)     |
| R017 | Ring 9                                         | not used   | 0.000E+00 | ---                                              | FRACA ( 9)     |
| R017 | Ring 10                                        | not used   | 0.000E+00 | ---                                              | FRACA(10)      |
| R017 | Ring 11                                        | not used   | 0.000E+00 | ---                                              | FRACA(11)      |
| R017 | Ring 12                                        | not used   | 0.000E+00 | ---                                              | FRACA(12)      |

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|--------------------------------------------------|------------|-----------|--------------------------------------------------|----------------|
| R018 | Fruits, vegetables and grain consumption (kg/yr) | not used   | 1.600E+02 | ---                                              | DIET (1)       |
| R018 | Leafy vegetable consumption (kg/yr)              | not used   | 1.400E+01 | ---                                              | DIET (2)       |
| R018 | Milk consumption (L/yr)                          | not used   | 9.200E+01 | ---                                              | DIET (3)       |
| R018 | Meat and poultry consumption (kg/yr)             | not used   | 6.300E+01 | ---                                              | DIET (4)       |
| R018 | Fish consumption (kg/yr)                         | not used   | 5.400E+00 | ---                                              | DIET (5)       |
| R018 | Other seafood consumption (kg/yr)                | not used   | 9.000E-01 | ---                                              | DIET (6)       |
| R018 | Soil ingestion rate (g/yr)                       | 3.650E+01  | 3.650E+01 | ---                                              | SOIL           |
| R018 | Drinking water intake (L/yr)                     | 3.500E+02  | 5.100E+02 | ---                                              | DWI            |
| R018 | Contamination fraction of drinking water         | 1.000E+00  | 1.000E+00 | ---                                              | FDW            |
| R018 | Contamination fraction of household water        | not used   | 1.000E+00 | ---                                              | FHHW           |
| R018 | Contamination fraction of livestock water        | not used   | 1.000E+00 | ---                                              | FLW            |
| R018 | Contamination fraction of irrigation water       | not used   | 1.000E+00 | ---                                              | FIRW           |
| R018 | Contamination fraction of aquatic food           | not used   | 5.000E-01 | ---                                              | FR9            |
| R018 | Contamination fraction of plant food             | not used   | -1        | ---                                              | FPLANT         |
| R018 | Contamination fraction of meat                   | not used   | -1        | ---                                              | FMEAT          |
| R018 | Contamination fraction of milk                   | not used   | -1        | ---                                              | FMILK          |
|      |                                                  |            |           |                                                  |                |
| R019 | Livestock fodder intake for meat (kg/day)        | not used   | 6.800E+01 | ---                                              | LFI5           |
| R019 | Livestock fodder intake for milk (kg/day)        | not used   | 5.500E+01 | ---                                              | LFI6           |
| R019 | Livestock water intake for meat (L/day)          | not used   | 5.000E+01 | ---                                              | LWI5           |
| R019 | Livestock water intake for milk (L/day)          | not used   | 1.600E+02 | ---                                              | LWI6           |
| R019 | Livestock soil intake (kg/day)                   | not used   | 5.000E-01 | ---                                              | LSI            |
| R019 | Mass loading for foliar deposition (g/m**3)      | not used   | 1.000E-04 | ---                                              | MLFD           |
| R019 | Depth of soil mixing layer (m)                   | 1.500E-01  | 1.500E-01 | ---                                              | DM             |
| R019 | Depth of roots (m)                               | not used   | 9.000E-01 | ---                                              | DROOT          |
| R019 | Drinking water fraction from ground water        | 1.000E+00  | 1.000E+00 | ---                                              | FGWDW          |
| R019 | Household water fraction from ground water       | not used   | 1.000E+00 | ---                                              | FGWHH          |
| R019 | Livestock water fraction from ground water       | not used   | 1.000E+00 | ---                                              | FGWLW          |
| R019 | Irrigation fraction from ground water            | not used   | 1.000E+00 | ---                                              | FGWIR          |
|      |                                                  |            |           |                                                  |                |
| R19B | Wet weight crop yield for Non-Leafy (kg/m**2)    | not used   | 7.000E-01 | ---                                              | YV (1)         |
| R19B | Wet weight crop yield for Leafy (kg/m**2)        | not used   | 1.500E+00 | ---                                              | YV (2)         |
| R19B | Wet weight crop yield for Fodder (kg/m**2)       | not used   | 1.100E+00 | ---                                              | YV (3)         |
| R19B | Growing Season for Non-Leafy (years)             | not used   | 1.700E-01 | ---                                              | TE (1)         |
| R19B | Growing Season for Leafy (years)                 | not used   | 2.500E-01 | ---                                              | TE (2)         |
| R19B | Growing Season for Fodder (years)                | not used   | 8.000E-02 | ---                                              | TE (3)         |
| R19B | Translocation Factor for Non-Leafy               | not used   | 1.000E-01 | ---                                              | TIV (1)        |
| R19B | Translocation Factor for Leafy                   | not used   | 1.000E+00 | ---                                              | TIV (2)        |
| R19B | Translocation Factor for Fodder                  | not used   | 1.000E+00 | ---                                              | TIV (3)        |
| R19B | Dry Foliar Interception Fraction for Non-Leafy   | not used   | 2.500E-01 | ---                                              | RDRY (1)       |
| R19B | Dry Foliar Interception Fraction for Leafy       | not used   | 2.500E-01 | ---                                              | RDRY (2)       |
| R19B | Dry Foliar Interception Fraction for Fodder      | not used   | 2.500E-01 | ---                                              | RDRY (3)       |
| R19B | Wet Foliar Interception Fraction for Non-Leafy   | not used   | 2.500E-01 | ---                                              | RWET (1)       |
| R19B | Wet Foliar Interception Fraction for Leafy       | not used   | 2.500E-01 | ---                                              | RWET (2)       |
| R19B | Wet Foliar Interception Fraction for Fodder      | not used   | 2.500E-01 | ---                                              | RWET (3)       |
| R19B | Weathering Removal Constant for Vegetation       | not used   | 2.000E+01 | ---                                              | WLAM           |
|      |                                                  |            |           |                                                  |                |
| C14  | C-12 concentration in water (g/cm**3)            | not used   | 2.000E-05 | ---                                              | C12WTR         |
| C14  | C-12 concentration in contaminated soil (g/g)    | not used   | 3.000E-02 | ---                                              | C12CZ          |
| C14  | Fraction of vegetation carbon from soil          | not used   | 2.000E-02 | ---                                              | CSOIL          |

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

## Site-Specific Parameter Summary (continued)

| Menu | Parameter                                        | User Input | Default    | Used by RESRAD<br>(If different from user input) | Parameter Name |
|------|--------------------------------------------------|------------|------------|--------------------------------------------------|----------------|
| C14  | Fraction of vegetation carbon from air           | not used   | 9.800E-01  | ---                                              | CAIR           |
| C14  | C-14 evasion layer thickness in soil (m)         | not used   | 3.000E-01  | ---                                              | DMC            |
| C14  | C-14 evasion flux rate from soil (1/sec)         | not used   | 7.000E-07  | ---                                              | EVSN           |
| C14  | C-12 evasion flux rate from soil (1/sec)         | not used   | 1.000E-10  | ---                                              | REVSN          |
| C14  | Fraction of grain in beef cattle feed            | not used   | 8.000E-01  | ---                                              | AVFG4          |
| C14  | Fraction of grain in milk cow feed               | not used   | 2.000E-01  | ---                                              | AVFG5          |
| STOR | Storage times of contaminated foodstuffs (days): |            |            |                                                  |                |
| STOR | Fruits, non-leafy vegetables, and grain          | 1.400E+01  | 1.400E+01  | ---                                              | STOR_T (1)     |
| STOR | Leafy vegetables                                 | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (2)     |
| STOR | Milk                                             | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (3)     |
| STOR | Meat and poultry                                 | 2.000E+01  | 2.000E+01  | ---                                              | STOR_T (4)     |
| STOR | Fish                                             | 7.000E+00  | 7.000E+00  | ---                                              | STOR_T (5)     |
| STOR | Crustacea and mollusks                           | 7.000E+00  | 7.000E+00  | ---                                              | STOR_T (6)     |
| STOR | Well water                                       | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (7)     |
| STOR | Surface water                                    | 1.000E+00  | 1.000E+00  | ---                                              | STOR_T (8)     |
| STOR | Livestock fodder                                 | 4.500E+01  | 4.500E+01  | ---                                              | STOR_T (9)     |
| R021 | Thickness of building foundation (m)             | not used   | 1.500E-01  | ---                                              | FLOOR1         |
| R021 | Bulk density of building foundation (g/cm**3)    | not used   | 2.400E+00  | ---                                              | DENSFL         |
| R021 | Total porosity of the cover material             | not used   | 4.000E-01  | ---                                              | TPCV           |
| R021 | Total porosity of the building foundation        | not used   | 1.000E-01  | ---                                              | TPFL           |
| R021 | Volumetric water content of the cover material   | not used   | 5.000E-02  | ---                                              | PH2OCV         |
| R021 | Volumetric water content of the foundation       | not used   | 3.000E-02  | ---                                              | PH2OFL         |
| R021 | Diffusion coefficient for radon gas (m/sec):     |            |            |                                                  |                |
| R021 | in cover material                                | not used   | 2.000E-06  | ---                                              | DIFCV          |
| R021 | in foundation material                           | not used   | 3.000E-07  | ---                                              | DIFFL          |
| R021 | in contaminated zone soil                        | not used   | 2.000E-06  | ---                                              | DIFCZ          |
| R021 | Radon vertical dimension of mixing (m)           | not used   | 2.000E+00  | ---                                              | HMIX           |
| R021 | Average building air exchange rate (1/hr)        | not used   | 5.000E-01  | ---                                              | REXG           |
| R021 | Height of the building (room) (m)                | not used   | 2.500E+00  | ---                                              | HRM            |
| R021 | Building interior area factor                    | not used   | 0.000E+00  | ---                                              | FAI            |
| R021 | Building depth below ground surface (m)          | not used   | -1.000E+00 | ---                                              | DMFL           |
| R021 | Emanating power of Rn-222 gas                    | not used   | 2.500E-01  | ---                                              | EMANA (1)      |
| R021 | Emanating power of Rn-220 gas                    | not used   | 1.500E-01  | ---                                              | EMANA (2)      |
| TITL | Number of graphical time points                  | 32         | ---        | ---                                              | NPTS           |
| TITL | Maximum number of integration points for dose    | 17         | ---        | ---                                              | LYMAX          |
| TITL | Maximum number of integration points for risk    | 257        | ---        | ---                                              | KYMAX          |

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

## Summary of Pathway Selections

| Pathway                     | User Selection |
|-----------------------------|----------------|
| 1 -- external gamma         | active         |
| 2 -- inhalation (w/o radon) | active         |
| 3 -- plant ingestion        | suppressed     |
| 4 -- meat ingestion         | suppressed     |
| 5 -- milk ingestion         | suppressed     |
| 6 -- aquatic foods          | suppressed     |
| 7 -- drinking water         | active         |
| 8 -- soil ingestion         | active         |
| 9 -- radon                  | suppressed     |
| Find peak pathway doses     | active         |



| Contaminated Zone Dimensions |                       | Initial Soil Concentrations, pCi/g |           |
|------------------------------|-----------------------|------------------------------------|-----------|
| Area:                        | 1860.00 square meters | Cs-137                             | 5.050E+01 |
| Thickness:                   | 8.00 meters           | Ra-226                             | 4.960E-01 |
| Cover Depth:                 | 0.61 meters           | Sr-90                              | 2.140E-01 |
|                              |                       | U-238                              | 4.470E-01 |

|                                                                            |           |           |           |           |           |           |           |           |
|----------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Total Dose TDOSE(t), mrem/yr                                               |           |           |           |           |           |           |           |           |
| Basic Radiation Dose Limit = 1.500E+01 mrem/yr                             |           |           |           |           |           |           |           |           |
| Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t) |           |           |           |           |           |           |           |           |
| t (years):                                                                 | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| TDOSE(t):                                                                  | 2.235E-02 | 4.941E-02 | 9.050E-02 | 9.593E-02 | 1.099E-01 | 1.300E-01 | 3.254E-01 | 6.724E-01 |
| M(t):                                                                      | 1.490E-03 | 3.294E-03 | 6.033E-03 | 6.395E-03 | 7.326E-03 | 8.665E-03 | 2.169E-02 | 4.483E-02 |
| Maximum TDOSE(t): 8.112E-01 mrem/yr at t = 609 ± 1 years                   |           |           |           |           |           |           |           |           |

| Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p) |           |        |            |        |           |        |           |        |           |        |           |        |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
| As mrem/yr and Fraction of Total Dose At t = 6.086E+02 years                            |           |        |            |        |           |        |           |        |           |        |           |        |           |        |
| Water Independent Pathways (Inhalation excludes radon)                                  |           |        |            |        |           |        |           |        |           |        |           |        |           |        |
|                                                                                         | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
| Radio-                                                                                  |           |        |            |        |           |        |           |        |           |        |           |        |           |        |
| Nuclide                                                                                 | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Nuclide                                                                                 |           |        |            |        |           |        |           |        |           |        |           |        |           |        |
| Cs-137                                                                                  | 2.136E-05 | 0.0000 | 2.743E-11  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.588E-08 | 0.0000 |
| Ra-226                                                                                  | 6.672E-01 | 0.8225 | 1.291E-04  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.421E-02 | 0.0298 |
| Sr-90                                                                                   | 2.695E-14 | 0.0000 | 1.480E-17  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.757E-15 | 0.0000 |
| U-238                                                                                   | 2.007E-03 | 0.0025 | 1.102E-05  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.102E-04 | 0.0001 |
| Total                                                                                   | 6.692E-01 | 0.8250 | 1.401E-04  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.432E-02 | 0.0300 |

| Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p) |           |        |           |        |           |        |           |        |           |        |           |        |               |        |
|-----------------------------------------------------------------------------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
| As mrem/yr and Fraction of Total Dose At t = 6.086E+02 years                            |           |        |           |        |           |        |           |        |           |        |           |        |               |        |
| Water Dependent Pathways                                                                |           |        |           |        |           |        |           |        |           |        |           |        |               |        |
|                                                                                         | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
| Radio-                                                                                  |           |        |           |        |           |        |           |        |           |        |           |        |               |        |
| Nuclide                                                                                 | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Nuclide                                                                                 |           |        |           |        |           |        |           |        |           |        |           |        |               |        |
| Cs-137                                                                                  | 7.606E-08 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.145E-05     | 0.0000 |
| Ra-226                                                                                  | 1.089E-01 | 0.1342 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.004E-01     | 0.9867 |
| Sr-90                                                                                   | 2.031E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.062E-12     | 0.0000 |
| U-238                                                                                   | 8.605E-03 | 0.0106 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.073E-02     | 0.0132 |
| Total                                                                                   | 1.175E-01 | 0.1448 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.112E-01     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 7.193E-03 | 0.3218 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226            | 1.156E-03 | 0.0517 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 1.793E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 3.448E-06 | 0.0002 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 8.352E-03 | 0.3737 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 8.483E-05 | 0.0038 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.277E-03     | 0.3256 |
| Ra-226            | 1.717E-05 | 0.0008 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.173E-03     | 0.0525 |
| Sr-90             | 1.249E-02 | 0.5590 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.249E-02     | 0.5590 |
| U-238             | 1.403E-03 | 0.0628 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.407E-03     | 0.0629 |
| Total             | 1.400E-02 | 0.6263 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.235E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 7.124E-03 | 0.1442 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226            | 1.168E-03 | 0.0236 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 1.753E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 3.483E-06 | 0.0001 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 8.295E-03 | 0.1679 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 2.508E-04 | 0.0051 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.375E-03     | 0.1493 |
| Ra-226            | 1.146E-04 | 0.0023 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.282E-03     | 0.0260 |
| Sr-90             | 3.653E-02 | 0.7394 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.653E-02     | 0.7394 |
| U-238             | 4.217E-03 | 0.0853 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.220E-03     | 0.0854 |
| Total             | 4.111E-02 | 0.8321 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.941E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.856E-03 | 0.0758 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226            | 1.216E-03 | 0.0134 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 1.602E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 3.627E-06 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 8.076E-03 | 0.0892 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+00 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 8.417E-04 | 0.0093 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.698E-03     | 0.0851 |
| Ra-226            | 1.350E-03 | 0.0149 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.566E-03     | 0.0284 |
| Sr-90             | 6.484E-02 | 0.7164 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.484E-02     | 0.7164 |
| U-238             | 1.540E-02 | 0.1701 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.540E-02     | 0.1702 |
| Total             | 8.242E-02 | 0.9108 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.050E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 6.535E-03 | 0.0681 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226            | 1.280E-03 | 0.0133 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 1.431E-08 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 3.815E-06 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 7.819E-03 | 0.0815 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.433E-03 | 0.0149 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.968E-03     | 0.0831 |
| Ra-226            | 4.422E-03 | 0.0461 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.701E-03     | 0.0594 |
| Sr-90             | 5.306E-02 | 0.5532 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.306E-02     | 0.5532 |
| U-238             | 2.919E-02 | 0.3043 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.919E-02     | 0.3043 |
| Total             | 8.811E-02 | 0.9185 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.593E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 4.455E-03 | 0.0405 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226            | 1.923E-03 | 0.0175 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 5.808E-09 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 5.719E-06 | 0.0001 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 6.383E-03 | 0.0581 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 2.746E-03 | 0.0250 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.201E-03     | 0.0655 |
| Ra-226            | 4.762E-02 | 0.4333 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.954E-02     | 0.4508 |
| Sr-90             | 1.068E-02 | 0.0972 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.068E-02     | 0.0972 |
| U-238             | 4.246E-02 | 0.3864 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.247E-02     | 0.3864 |
| Total             | 1.035E-01 | 0.9419 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.099E-01     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.759E-03 | 0.0212 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226            | 3.200E-03 | 0.0246 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Sr-90             | 1.881E-09 | 0.0000 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238             | 9.487E-06 | 0.0001 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total             | 5.968E-03 | 0.0459 | 0.000E+00  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 1.729E-03 | 0.0133 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.487E-03     | 0.0345 |
| Ra-226            | 8.404E-02 | 0.6466 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.724E-02     | 0.6712 |
| Sr-90             | 1.441E-03 | 0.0111 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.441E-03     | 0.0111 |
| U-238             | 3.680E-02 | 0.2832 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.681E-02     | 0.2832 |
| Total             | 1.240E-01 | 0.9541 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.300E-01     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 5.972E-05 | 0.0002 | 9.209E-11  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.331E-08 | 0.0000 |
| Ra-226            | 1.984E-01 | 0.6097 | 3.717E-05  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.970E-03 | 0.0214 |
| Sr-90             | 2.298E-13 | 0.0000 | 3.149E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.012E-13 | 0.0000 |
| U-238             | 5.583E-04 | 0.0017 | 4.120E-06  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.119E-05 | 0.0001 |
| Total             | 1.990E-01 | 0.6116 | 4.129E-05  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.011E-03 | 0.0215 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 8.624E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.063E-05     | 0.0002 |
| Ra-226            | 1.076E-01 | 0.3307 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.130E-01     | 0.9619 |
| Sr-90             | 1.575E-10 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.578E-10     | 0.0000 |
| U-238             | 1.173E-02 | 0.0361 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.234E-02     | 0.0379 |
| Total             | 1.193E-01 | 0.3667 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.254E-01     | 1.0000 |

\*Sum of all water independent and dependent pathways.



Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-<br>Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|-------------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                   | mrem/yr   | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| Cs-137            | 2.456E-09 | 0.0000 | 3.194E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.849E-12 | 0.0000 |
| Ra-226            | 5.388E-01 | 0.8012 | 1.054E-04  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.976E-02 | 0.0294 |
| Sr-90             | 5.473E-21 | 0.0000 | 2.217E-24  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.127E-22 | 0.0000 |
| U-238             | 6.736E-04 | 0.0010 | 3.519E-06  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.515E-05 | 0.0001 |
| Total             | 5.394E-01 | 0.8022 | 1.089E-04  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.980E-02 | 0.0294 |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

## Water Dependent Pathways

| Radio-<br>Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|-------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|                   | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| Cs-137            | 9.121E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.467E-09     | 0.0000 |
| Ra-226            | 1.104E-01 | 0.1642 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.690E-01     | 0.9949 |
| Sr-90             | 2.982E-19 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.044E-19     | 0.0000 |
| U-238             | 2.692E-03 | 0.0040 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.404E-03     | 0.0051 |
| Total             | 1.131E-01 | 0.1682 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.724E-01     | 1.0000 |

\*Sum of all water independent and dependent pathways.

Summary : Bldg 811 Area-Deep-Industrial-No Bkgd subtract-G

File : C:\USERS\DQUIN\DOCUMENTS\PROJECTS\BNL 811 BLDG FSS\RESRAD\BNL-811 AREA-IND-NO-BKD SUBTR-DEEP-G.RAD

Dose/Source Ratios Summed Over All Pathways  
Parent and Progeny Principal Radionuclide Contributions Indicated

| Parent<br>(i) | Product<br>(j) | Thread<br>Fraction | DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) |           |           |           |           |           |           |           |
|---------------|----------------|--------------------|---------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               |                |                    | 0.000E+00                                   | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137+D      | Cs-137+D       | 1.000E+00          | 1.441E-04                                   | 1.460E-04 | 1.524E-04 | 1.578E-04 | 1.426E-04 | 8.886E-05 | 1.201E-06 | 4.886E-11 |
| Ra-226+D      | Ra-226+D       | 1.000E+00          | 2.333E-03                                   | 2.361E-03 | 2.477E-03 | 2.627E-03 | 4.100E-03 | 6.887E-03 | 4.036E-01 | 1.094E+00 |
| Ra-226+D      | Pb-210+D       | 1.000E+00          | 3.245E-05                                   | 2.243E-04 | 2.697E-03 | 8.868E-03 | 9.579E-02 | 1.690E-01 | 2.275E-01 | 2.554E-01 |
| Ra-226+D      | ΣDSR(j)        |                    | 2.365E-03                                   | 2.585E-03 | 5.174E-03 | 1.149E-02 | 9.989E-02 | 1.759E-01 | 6.311E-01 | 1.349E+00 |
| Sr-90+D       | Sr-90+D        | 1.000E+00          | 5.837E-02                                   | 1.707E-01 | 3.030E-01 | 2.480E-01 | 4.992E-02 | 6.732E-03 | 7.376E-10 | 1.422E-18 |
| U-238         | U-238          | 5.450E-07          | 1.590E-09                                   | 4.778E-09 | 1.744E-08 | 3.308E-08 | 4.811E-08 | 4.170E-08 | 1.334E-08 | 3.085E-09 |
| U-238+D       | U-238+D        | 1.000E+00          | 3.147E-03                                   | 9.441E-03 | 3.445E-02 | 6.531E-02 | 9.500E-02 | 8.235E-02 | 2.758E-02 | 7.593E-03 |
| U-238+D       | U-234          | 1.000E+00          | 1.400E-09                                   | 9.745E-09 | 1.257E-07 | 4.548E-07 | 5.018E-06 | 9.107E-06 | 2.233E-05 | 1.935E-05 |
| U-238+D       | Th-230         | 1.000E+00          | 6.512E-14                                   | 1.881E-13 | 6.785E-13 | 1.319E-12 | 1.297E-11 | 3.156E-11 | 4.355E-09 | 3.656E-08 |
| U-238+D       | Ra-226+D       | 1.000E+00          | 1.032E-11                                   | 2.969E-11 | 1.054E-10 | 1.967E-10 | 1.521E-09 | 2.566E-09 | 8.271E-08 | 1.295E-06 |
| U-238+D       | Pb-210+D       | 1.000E+00          | 3.507E-10                                   | 1.009E-09 | 3.581E-09 | 6.684E-09 | 5.159E-08 | 8.624E-08 | 3.394E-07 | 1.012E-06 |
| U-238+D       | ΣDSR(j)        |                    | 3.147E-03                                   | 9.441E-03 | 3.445E-02 | 6.531E-02 | 9.500E-02 | 8.236E-02 | 2.760E-02 | 7.615E-03 |

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

## Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 1.500E+01 mrem/yr

| Nuclide<br>(i) | t =       |           |           |           |           |           |           |            |           |
|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|-----------|
|                |           | 0.000E+00 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02  | 1.000E+03 |
| Cs-137         | 1.041E+05 | 1.027E+05 | 9.840E+04 | 9.506E+04 | 1.052E+05 | 1.688E+05 | 1.249E+07 | 3.070E+11  |           |
| Ra-226         | 6.343E+03 | 5.802E+03 | 2.899E+03 | 1.305E+03 | 1.502E+02 | 8.528E+01 | 2.377E+01 | 1.112E+01  |           |
| Sr-90          | 2.570E+02 | 8.787E+01 | 4.951E+01 | 6.049E+01 | 3.005E+02 | 2.228E+03 | 2.034E+10 | *1.366E+14 |           |
| U-238          | 4.767E+03 | 1.589E+03 | 4.354E+02 | 2.297E+02 | 1.579E+02 | 1.821E+02 | 5.435E+02 | 1.970E+03  |           |

\*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)

and Single Radionuclide Soil Guidelines G(i,t) in pCi/g

at tmin = time of minimum single radionuclide soil guideline

and at tmax = time of maximum total dose = 609 ± 1 years

| Nuclide<br>(i) | Initial<br>(pCi/g) | tmin<br>(years) | DSR(i,tmin) | G(i,tmin)<br>(pCi/g) | DSR(i,tmax) | G(i,tmax)<br>(pCi/g) |
|----------------|--------------------|-----------------|-------------|----------------------|-------------|----------------------|
| Cs-137         | 5.050E+01          | 20.13 ± 0.04    | 1.616E-04   | 9.281E+04            | 4.249E-07   | 3.531E+07            |
| Ra-226         | 4.960E-01          | 609 ± 1         | 1.614E+00   | 9.295E+00            | 1.614E+00   | 9.295E+00            |
| Sr-90          | 2.140E-01          | 2.825 ± 0.006   | 3.281E-01   | 4.572E+01            | 9.637E-12   | 1.557E+12            |
| U-238          | 4.470E-01          | 16.91 ± 0.03    | 1.044E-01   | 1.437E+02            | 2.401E-02   | 6.247E+02            |

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | DOSE(j,t), mrem/yr |           |           |           |           |           |           |           |
|----------------|---------------|-----------|--------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t= 0.000E+00       | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 7.277E-03          | 7.375E-03 | 7.698E-03 | 7.968E-03 | 7.201E-03 | 4.487E-03 | 6.063E-05 | 2.467E-09 |
| Ra-226         | Ra-226        | 1.000E+00 | 1.157E-03          | 1.171E-03 | 1.228E-03 | 1.303E-03 | 2.034E-03 | 3.416E-03 | 2.002E-01 | 5.424E-01 |
| Ra-226         | U-238         | 1.000E+00 | 4.614E-12          | 1.327E-11 | 4.712E-11 | 8.794E-11 | 6.799E-10 | 1.147E-09 | 3.697E-08 | 5.790E-07 |
| Ra-226         | ΣDOSE(j)      |           | 1.157E-03          | 1.171E-03 | 1.228E-03 | 1.303E-03 | 2.034E-03 | 3.416E-03 | 2.002E-01 | 5.424E-01 |
| Pb-210         | Ra-226        | 1.000E+00 | 1.610E-05          | 1.113E-04 | 1.338E-03 | 4.398E-03 | 4.751E-02 | 8.382E-02 | 1.128E-01 | 1.267E-01 |
| Pb-210         | U-238         | 1.000E+00 | 1.568E-10          | 4.510E-10 | 1.601E-09 | 2.988E-09 | 2.306E-08 | 3.855E-08 | 1.517E-07 | 4.524E-07 |
| Pb-210         | ΣDOSE(j)      |           | 1.610E-05          | 1.113E-04 | 1.338E-03 | 4.398E-03 | 4.751E-02 | 8.382E-02 | 1.128E-01 | 1.267E-01 |
| Sr-90          | Sr-90         | 1.000E+00 | 1.249E-02          | 3.653E-02 | 6.484E-02 | 5.306E-02 | 1.068E-02 | 1.441E-03 | 1.578E-10 | 3.044E-19 |
| U-238          | U-238         | 5.450E-07 | 7.107E-10          | 2.136E-09 | 7.798E-09 | 1.478E-08 | 2.150E-08 | 1.864E-08 | 5.961E-09 | 1.379E-09 |
| U-238          | U-238         | 1.000E+00 | 1.407E-03          | 4.220E-03 | 1.540E-02 | 2.919E-02 | 4.246E-02 | 3.681E-02 | 1.233E-02 | 3.394E-03 |
| U-238          | ΣDOSE(j)      |           | 1.407E-03          | 4.220E-03 | 1.540E-02 | 2.919E-02 | 4.246E-02 | 3.681E-02 | 1.233E-02 | 3.394E-03 |
| U-234          | U-238         | 1.000E+00 | 6.257E-10          | 4.356E-09 | 5.620E-08 | 2.033E-07 | 2.243E-06 | 4.071E-06 | 9.981E-06 | 8.647E-06 |
| Th-230         | U-238         | 1.000E+00 | 2.911E-14          | 8.406E-14 | 3.033E-13 | 5.894E-13 | 5.799E-12 | 1.411E-11 | 1.947E-09 | 1.634E-08 |

THF(i) is the thread fraction of the parent nuclide.

| Nuclide<br>(j) | Parent<br>(i) | THF(i)    | S(j,t), pCi/g |           |           |           |           |           |           |           |
|----------------|---------------|-----------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                |               |           | t= 0.000E+00  | 1.000E+00 | 5.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 |
| Cs-137         | Cs-137        | 1.000E+00 | 5.050E+01     | 4.934E+01 | 4.498E+01 | 4.006E+01 | 1.586E+01 | 4.984E+00 | 4.728E-04 | 4.427E-09 |
| Ra-226         | Ra-226        | 1.000E+00 | 4.960E-01     | 4.957E-01 | 4.947E-01 | 4.934E-01 | 4.829E-01 | 4.702E-01 | 3.797E-01 | 2.907E-01 |
| Ra-226         | U-238         | 1.000E+00 | 0.000E+00     | 8.370E-16 | 1.042E-13 | 8.285E-13 | 9.903E-11 | 7.496E-10 | 6.140E-08 | 3.035E-07 |
| Ra-226         | ΣS(j):        |           | 4.960E-01     | 4.957E-01 | 4.947E-01 | 4.934E-01 | 4.829E-01 | 4.702E-01 | 3.797E-01 | 2.907E-01 |
| Pb-210         | Ra-226        | 1.000E+00 | 0.000E+00     | 1.524E-02 | 7.150E-02 | 1.323E-01 | 3.818E-01 | 4.498E-01 | 3.801E-01 | 2.910E-01 |
| Pb-210         | U-238         | 1.000E+00 | 0.000E+00     | 6.493E-18 | 3.944E-15 | 6.091E-14 | 2.929E-11 | 3.523E-10 | 5.172E-08 | 2.796E-07 |
| Pb-210         | ΣS(j):        |           | 0.000E+00     | 1.524E-02 | 7.150E-02 | 1.323E-01 | 3.818E-01 | 4.498E-01 | 3.801E-01 | 2.910E-01 |
| Sr-90          | Sr-90         | 1.000E+00 | 2.140E-01     | 2.056E-01 | 1.751E-01 | 1.432E-01 | 2.873E-02 | 3.856E-03 | 4.067E-10 | 7.730E-19 |
| U-238          | U-238         | 5.450E-07 | 2.436E-07     | 2.429E-07 | 2.400E-07 | 2.365E-07 | 2.102E-07 | 1.814E-07 | 5.572E-08 | 1.274E-08 |
| U-238          | U-238         | 1.000E+00 | 4.470E-01     | 4.457E-01 | 4.405E-01 | 4.340E-01 | 3.857E-01 | 3.328E-01 | 1.022E-01 | 2.339E-02 |
| U-238          | ΣS(j):        |           | 4.470E-01     | 4.457E-01 | 4.405E-01 | 4.340E-01 | 3.857E-01 | 3.328E-01 | 1.022E-01 | 2.339E-02 |
| U-234          | U-238         | 1.000E+00 | 0.000E+00     | 1.260E-06 | 6.248E-06 | 1.237E-05 | 5.717E-05 | 1.037E-04 | 2.436E-04 | 2.026E-04 |
| Th-230         | U-238         | 1.000E+00 | 0.000E+00     | 5.795E-12 | 1.441E-10 | 5.726E-10 | 1.358E-08 | 5.092E-08 | 7.827E-07 | 1.835E-06 |

THF(i) is the thread fraction of the parent nuclide.



Appendix C  
Building 811 Project ORISE IV Reports



**OAK RIDGE INSTITUTE FOR  
SCIENCE AND EDUCATION**  
Managed by ORAU for DOE

October 20, 2016

Mr. Gerald Granzen  
U.S. Department of Energy  
SC-Brookhaven Site Office  
53 Bell Avenue, Building 464  
Upton, NY 11973-5000

**SUBJECT: CONTRACT NO. DE-SC0014664  
INDEPENDENT REVIEW OF THE BROOKHAVEN NATIONAL  
LABORATORY BUILDING 811 DRAFT CLOSURE REPORT  
UPTON, NEW YORK  
DCN 5098-LT-03-0**

Dear Mr. Granzen:

The Oak Ridge Institute for Science and Education (ORISE), managed by ORAU for the DOE, has reviewed the draft closure report for Building 811 at the Brookhaven National Lab (BNL). ORISE provided comments, via email, to the DOE on September 13, 2016. BNL staff completed a comment-response matrix and provided it to ORISE, through the DOE, on October 4, 2016. The comment response matrix is provided in Attachment 1 to this letter.

After reviewing the comment-response matrix, ORISE finds BNL's responses and revisions to the draft closure report acceptable.

Please feel free to contact me at 865.574.0865, or Tim Vitkus at 865.576.5073 if you have any questions or comments.

Sincerely,

David A. King, CHP, PMP  
Sr. Health Physicist/Project Manager  
ORAU

DAK:lw

Enclosure

electronic distribution: T. Vitkus, ORAU E. Bailey, ORAU  
D. Hagemeyer, ORAU File/5146

| Distribution approval and concurrence: | Initials |
|----------------------------------------|----------|
| Group Manager/Technical Review         | ENB      |

**ATTACHMENT 1**  
**COMMENT RESPONSE MATRIX**

## Reviewer and Organization: ORISE

| Number                   | Reference                           | Comment                                                                                                                                                                                                                                                                                                                                                                                                              | Response                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Disposition                                                          |
|--------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
|                          | General                             | Some of the comments below are related to information that is missing in the text of the report. The reviewer realizes that some of this information may be in the ROD; however, this information is considered important to support the conclusion and should be provided. The final status report should be a standalone document to the degree possible with minimal critical information provided via reference. | Comment Noted. BNL understands the need to have a standalone document to the extent practicable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Resolved                                                             |
| <b>Specific Comments</b> |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                      |
| 1                        | Table 2-1, p. 13                    | Provide clarification to what the cleanup values in Table 2-1 actually correspond. Are all the cleanup values dose-based and if so, are they based on a total effective dose equivalent of 15 mrem/yr? Later, Table 3-7 leads the reviewer to believe the values for Ra-226 and Sr-90 are administrative limits because an area factor of 1 is used in the EMC.                                                      | An additional paragraph was added to Section 2.1 to describe the basis for the cleanup goals, based on Table 4 of the OUI ROD. Cs-137 is dose based, Sr-90 is based on groundwater impacts, and Ra-226 is based on DOE Order 5400.5, "Radiation Protection of the Public and the Environment."                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Added text satisfies this comment.<br>Resolved                       |
| 2                        | Figure 3-1 on p 24 and 3-3 on p. 28 | Based on the narrative, the reviewer believes that Figure 3-1 represents final status survey data as the scans were performed after remediation but prior to FSS. However, there are two locations in Figure 3-1 above 21,500 cpm (marked in red) that are absent from the walkover data in Figure 3-3. Provide an explanation of the difference.                                                                    | Figure 3-1 represents preliminary walkover surveys and soil sampling results completed after building foundations and associated concrete structures and waste transfer lines were removed but before performing the Final Status Survey. The preliminary walkover surveys and sampling represented on the figure occurred over time during site excavation/remediation activities and were used to aid in determining when remediation was complete. The two locations shown on Figure 3-1 were remediated prior to performing the FSS. The text states "...prior to beginning the FSS...". None of the radiological walkover survey data used in generating Figure 3- 1 was used in the Final Status Survey. The description of the figure has been modified to clarify this. | Clarifications added to the text satisfies this comment.<br>Resolved |



## Reviewer and Organization: ORISE

| Number                               | Reference                                                | Comment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Response                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Disposition                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Specific Comments (continued)</b> |                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                               |
| 3                                    | Section 3.2.2, SU-1 and SU-2 Surface Soil Samples, p. 30 | Elevated levels of gamma radiation would have been expected, and thus identified, at surface sample location SU-1-16 given the reported concentration of 30.6 pCi/g. The lack of detection suggests a procedural error, though this may not be the case. ORISE suggests explaining why the location was not identified during the gamma walkover survey and to provide assurance that there are no additional locations of undetected residual contamination. In any case, the scan MDC should be stated in the report text to indicate how effective the equipment should be, theoretically, at locating surface contamination. | Information was added to 3.2.2.1 to explain that the scan MDC calculations (4.4 - 7.5 pCi/g), are shown in the FSS/QAPP Appendix A, and the relationship of 21,500 cpm per 15 pCi/g Cs-137 is developed in the FSS/QAPP Appendix B. These calculations are based on certain assumed areas and depths of contamination, and it is possible for smaller areas of contamination to go undetected. The walkover survey in combination with the soil sampling is sufficient to identify areas of residual contamination large enough to effect the RESRAD dose calculation. BNL does not believe there was a procedural error.                                                                                                                                                                                                                                                                                                                                                      | Response satisfies the comment. Resolved                                                                                                                                                                                                                                                                                      |
| 4                                    | Section 3.2.2, SU-1 and SU-2 Surface Soil Samples, p. 30 | Provide an explanation of how the samples were composited, including how many increments formed each composite and if the analytical results for the composites were compared to a modified investigation level (MIL)—i.e., would it be possible for any single increment to exceed an appropriate MIL? Were the analytical minimum detection concentrations compared with, and determined to be less than, an MIL?                                                                                                                                                                                                              | <p>Composite samples were collected in accordance with the FSP/QAPP, Section 4.4.3 - Composite Samples and Core Samples, and Table C-3 in Appendix C. Each composite consisted of aliquots from 5-6 surface soil samples, as described below:</p> <ol style="list-style-type: none"> <li>1. Composite 1: SU-1-1 through SU-1-5 (5 increments)</li> <li>2. Composite 2: SU-1-6 through SU-1-11 (6 increments)</li> <li>3. Composite 3: SU-1-12 through SU-1-16 (5 increments)</li> <li>4. Composite 4: SU-2-1 through SU-2-5 (5 increments)</li> <li>5. Composite 5: SU-2-6 through SU-2-11 (6 increments)</li> <li>6. Composite 6: SU-2-12 through SU-2-16 (5 increments)</li> </ol> <p>This list was also added to the closeout report in Section 3.2.2. Information on the MIL was added to section 3.2.2, and a new Table 3-7 showing the MIL calculations is provided. The table shows that the MDC was less than the MIL for all analyzed nuclides in the composites.</p> | The MIL calculated by BNL uses $\sqrt{n}$ in the denominator as suggested in the paper by R. Correll (2002). ORISE composite sampling guidance recommends $n$ as opposed to $\sqrt{n}$ , though the point is moot if the method follows an approved FSP/QAPP. This difference only impacts one composite for the analyte H-3. |

## Reviewer and Organization: ORISE

| Number                               | Reference                                               | Comment                                                                                                                                                                                                                                                                                                                                                                       | Response                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Disposition                                        |
|--------------------------------------|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| <b>Specific Comments (continued)</b> |                                                         |                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                    |
| 5                                    | Table 3-4, p. 31                                        | Expand on Table 3-4 to include measurement uncertainty, MDC, and results for the other hard-to- detect radionuclides (in the composite samples). The reviewer understands that all lab data are included in the Appendix; however, it is unreasonable to expect the reader to review 20,495 pages of supplementary documentation to find and independently assess these data. | Two tables (3-5 and 3-6) were added to provide uncertainty and MDC for surface and composite samples.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | The table additions satisfy this comment. Resolved |
| 6                                    | Section 3.2.2, SU-1 and SU-2 Core Sample Results, p. 30 | Provide an explanation of how the core sample locations were selected. Also, explain why a core sample was not collected at location SU-1-16, the only random location above the DCGL.                                                                                                                                                                                        | In general, core sample locations were collected in accordance with the FSP/QAPP, Appendix C, Table C-3. All SU-1 core sample locations were collected as proposed in the FSP/QAPP. Two SU-2 core sample locations were modified, proposed core sample locations SU-2-9 and SU-2-13 were moved to SU-2-8 and SU-2-15, respectively, in order to perform core samples at locations were known/suspected subsurface contamination remained (i.e., Hotspot 3) and where more active remediation took place. Surface soil sampling and subsurface (core) soil sampling occurred concurrently; therefore, the result of the surface soil sample collected from SU-1-16 was not available at the time of the core sampling. | Response satisfies the comment. Resolved           |
| 7                                    | Section 3.2.2, SU-1 and SU-2 Core Sample Results, p. 30 | Provide an explanation as to why Ra-226 was not reported for the core samples.                                                                                                                                                                                                                                                                                                | Due to a miscommunication with the analytical laboratory Ra- 226 results were not available at the time of submission of the original draft. Ra-226 results for the core samples have subsequently been received and have been included in Table 3- 8.                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Response satisfies the comment. Resolved           |

## Reviewer and Organization: ORISE

| Number                               | Reference                          | Comment                                                                                                                                                                                                                                                                             | Response                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Disposition                                                             |
|--------------------------------------|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| <b>Specific Comments (continued)</b> |                                    |                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                         |
| 8                                    | Section 3.2.3, p. 32               | As stated in Section 3.1.3, SU-2 had a location that was above the DCGL, Hotspot #3 that was left after remediation. An elevated measurement comparison should have been performed for this survey unit as well. Alternatively, provide an explanation why an EMC is not necessary. | There was a relatively small quantity of soil that was not remediated fully and remained at depth. EMC was run for SU- 1 because one sample (1-16) exceeded the DCGL for Cs-137. There were no surface samples from the FSS in SU-2 that exceeded the DCGL. The sample at depth that exceeded the DCGL was addressed by performing a RESRAD evaluation. In order to account for the contaminated soil below the surface, the site was split into a surface level and a deep level for purposes of running the Resrad evaluations. This calculation was conservative because the maximum value detected at depth (50.5 pCi/g Cs-137) was considered to be present over the entire area under consideration. The dose results from the surface evaluation and the depth evaluation were added to determine the total dose. | Response satisfies the comment. Resolved                                |
| 9                                    | Section 3.2.3, p. 32               | Decision errors for the hypothesis test should be stated; alpha is 0.05, but what about beta? Furthermore, the number of samples should be justified (i.e., the LBGR, contaminant variation, and resulting relative shift should be stated).                                        | The determination of the number of sample points was described in the FSP/QAPP in Appendix C. For this site, the delta/sigma was 1.9, and alpha and beta were both set to 0.05, and Table 5.5 of MARSSIM listed a number of samples (N) of 16.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | The addition to the text of the report satisfies the comment. Resolved. |
| 10                                   | Table 3-7 and Section 3.2.4, p. 34 | Why is Ra-226 accounted for in the EMC but not in the post remediation dose assessment? Either Ra-226 is an issue and should be accounted for in the receptor dose, or it isn't.                                                                                                    | To be conservative, Ra-226 without background subtracted was included in the EMC. A note was added to the bottom of the sign test and EMC tables to indicate the conservatism of using Ra-226 without background levels subtracted. The 15 mrem/yr cleanup goal in the ROD is with background levels subtracted, and in this case, the average Ra-226 is less than the standard site background of 0.56 pCi/g. All BNL dose assessments previous performed at radiological remediation sites have been calculated with the Ra-226 background subtracted.                                                                                                                                                                                                                                                                 | Added footnote satisfies the comment. Resolved.                         |

## Reviewer and Organization: ORISE

| Number                               | Reference                           | Comment                                                                                                                                                                                                                                                                                  | Response                                                                                                                                                                                                                          | Disposition                                                                                                          |
|--------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>Specific Comments (continued)</b> |                                     |                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                   |                                                                                                                      |
| 11                                   | Section 3.2.4, p. 35, 2nd paragraph | Has Appendix B been provided or is it part of the 20,495-page PDF appendix which was not provided in a searchable format. The author should provide, in the main text, some detail or summary that allows the reader to understand what inputs were used to generate the dose estimates. | Yes Appendix B was provided as part of the larger Appendix.pdf file. Appendix B is provided separately in this submission with the changes made to address these comments. A table of RESRAD inputs has been added to Appendix B. | Response satisfies the comment. Resolved, noting is it odd to include U-238 as a contaminant without U-234 or U-235. |

## Appendix E

### Backfill Material Analytical Data

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

**Site ID : ISB SP-C1**

| Chemical Name               | Sample Date | Value   | Detlim | Error  | Units | Depth | Qual | Matrix |
|-----------------------------|-------------|---------|--------|--------|-------|-------|------|--------|
| 1,2,4-Trichlorobenzene      | 11/9/2015   | 350     | 350    | 0      | UG/KG | 1.5   | U    | S      |
| 2,4,5-Trichlorophenol       | 11/9/2015   | 350     | 350    | 0      | UG/KG | 1.5   | U    | S      |
| 2,4,6-Trichlorophenol       | 11/9/2015   | 350     | 350    | 0      | UG/KG | 1.5   | U    | S      |
| 2,4-Dichlorophenol          | 11/9/2015   | 350     | 350    | 0      | UG/KG | 1.5   | U    | S      |
| 2,4-Dimethylphenol          | 11/9/2015   | 350     | 350    | 0      | UG/KG | 1.5   | U    | S      |
| 2,4-Dinitrophenol           | 11/9/2015   | 701     | 701    | 0      | UG/KG | 1.5   | U    | S      |
| 2,4-Dinitrotoluene          | 11/9/2015   | 350     | 350    | 0      | UG/KG | 1.5   | U    | S      |
| 2,6-Dinitrotoluene          | 11/9/2015   | 350     | 350    | 0      | UG/KG | 1.5   | U    | S      |
| 2-Chloronaphthalene         | 11/9/2015   | 35      | 35     | 0      | UG/KG | 1.5   | U    | S      |
| 2-Chlorophenol              | 11/9/2015   | 350     | 350    | 0      | UG/KG | 1.5   | U    | S      |
| 2-Methylnaphthalene         | 11/9/2015   | 35      | 35     | 0      | UG/KG | 1.5   | U    | S      |
| 3,3'-Dichlorobenzidine      | 11/9/2015   | 350     | 350    | 0      | UG/KG | 1.5   | U    | S      |
| 4,4''-DDD                   | 11/9/2015   | 1.4     | 1.4    | 0      | UG/KG | 1.5   | U    | S      |
| 4,4''-DDE                   | 11/9/2015   | 0.389   | 1.4    | 0      | UG/KG | 1.5   | J    | S      |
| 4,4''-DDT                   | 11/9/2015   | 0.594   | 1.4    | 0      | UG/KG | 1.5   | JP   | S      |
| 4,6-Dinitro-o-cresol        | 11/9/2015   | 350     | 350    | 0      | UG/KG | 1.5   | U    | S      |
| 4-Bromophenyl phenyl ether  | 11/9/2015   | 350     | 350    | 0      | UG/KG | 1.5   | U    | S      |
| 4-Chlorophenyl phenyl ether | 11/9/2015   | 350     | 350    | 0      | UG/KG | 1.5   | U    | S      |
| Acenaphthene                | 11/9/2015   | 35      | 35     | 0      | UG/KG | 1.5   | U    | S      |
| Acenaphthylene              | 11/9/2015   | 35      | 35     | 0      | UG/KG | 1.5   | U    | S      |
| Aldrin                      | 11/9/2015   | 0.701   | 0.701  | 0      | UG/KG | 1.5   | U    | S      |
| alpha-BHC                   | 11/9/2015   | 0.701   | 0.701  | 0      | UG/KG | 1.5   | U    | S      |
| Aluminum                    | 11/9/2015   | 3770000 | 6930   | 0      | UG/KG | 1.5   |      | S      |
| Americium-241               | 11/9/2015   | 0.0135  | 0.0842 | 0.0637 | PCI/G | 1.5   | U    | S      |
| Anthracene                  | 11/9/2015   | 35      | 35     | 0      | UG/KG | 1.5   | U    | S      |
| Antimony                    | 11/9/2015   | 336     | 336    | 0      | UG/KG | 1.5   | U    | S      |
| Aroclor 1016                | 11/9/2015   | 3.5     | 3.5    | 0      | UG/KG | 1.5   | U    | S      |
| Aroclor 1221                | 11/9/2015   | 3.5     | 3.5    | 0      | UG/KG | 1.5   | U    | S      |
| Aroclor 1232                | 11/9/2015   | 3.5     | 3.5    | 0      | UG/KG | 1.5   | U    | S      |
| Aroclor 1242                | 11/9/2015   | 3.5     | 3.5    | 0      | UG/KG | 1.5   | U    | S      |
| Aroclor 1248                | 11/9/2015   | 7.92    | 3.5    | 0      | UG/KG | 1.5   |      | S      |
| Aroclor 1254                | 11/9/2015   | 9.32    | 3.5    | 0      | UG/KG | 1.5   |      | S      |
| Aroclor 1260                | 11/9/2015   | 8.46    | 3.5    | 0      | UG/KG | 1.5   |      | S      |
| Aroclor-1262                | 11/9/2015   | 3.5     | 3.5    | 0      | UG/KG | 1.5   | U    | S      |
| Arsenic                     | 11/9/2015   | 963     | 206    | 0      | UG/KG | 1.5   | B    | S      |
| Barium                      | 11/9/2015   | 9820    | 102    | 0      | UG/KG | 1.5   |      | S      |
| Benzo(a)anthracene          | 11/9/2015   | 68.7    | 35     | 0      | UG/KG | 1.5   |      | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name              | Sample Date | Value   | Detlim  | Error   | Units | Depth | Qual | Matrix |
|----------------------------|-------------|---------|---------|---------|-------|-------|------|--------|
| Benzo(a)pyrene             | 11/9/2015   | 62      | 35      | 0       | UG/KG | 1.5   |      | S      |
| Benzo(b)fluoranthene       | 11/9/2015   | 89.3    | 35      | 0       | UG/KG | 1.5   |      | S      |
| Benzo(ghi)perylene         | 11/9/2015   | 43.8    | 35      | 0       | UG/KG | 1.5   |      | S      |
| Benzo(k)fluoranthene       | 11/9/2015   | 35.7    | 35      | 0       | UG/KG | 1.5   |      | S      |
| Beryllium                  | 11/9/2015   | 231     | 102     | 0       | UG/KG | 1.5   | B    | S      |
| Beryllium-7                | 11/9/2015   | 0.0568  | 0.113   | 0.0622  | PCI/G | 1.5   | U    | S      |
| beta-BHC                   | 11/9/2015   | 0.701   | 0.701   | 0       | UG/KG | 1.5   | U    | S      |
| Bis(2-chloroethoxy)methane | 11/9/2015   | 350     | 350     | 0       | UG/KG | 1.5   | U    | S      |
| Bis(2-chloroethyl)ether    | 11/9/2015   | 350     | 350     | 0       | UG/KG | 1.5   | U    | S      |
| Bis(2-ethylhexyl)phthalate | 11/9/2015   | 350     | 350     | 0       | UG/KG | 1.5   | U    | S      |
| bis-chloroisopropyl ether  | 11/9/2015   | 350     | 350     | 0       | UG/KG | 1.5   | U    | S      |
| Butyl benzyl phthalate     | 11/9/2015   | 350     | 350     | 0       | UG/KG | 1.5   | U    | S      |
| Cadmium                    | 11/9/2015   | 102     | 102     | 0       | UG/KG | 1.5   | U    | S      |
| Calcium                    | 11/9/2015   | 1230000 | 8150    | 0       | UG/KG | 1.5   |      | S      |
| Carbazole                  | 11/9/2015   | 35      | 35      | 0       | UG/KG | 1.5   | U    | S      |
| Cesium-134                 | 11/9/2015   | 0.0354  | 0.017   | 0.0116  | PCI/G | 1.5   | J-UI | S      |
| Cesium-137                 | 11/9/2015   | 0.0564  | 0.0143  | 0.0142  | PCI/G | 1.5   | J    | S      |
| Chlordane                  | 11/9/2015   | 8.76    | 8.76    | 0       | UG/KG | 1.5   | U    | S      |
| Chromium                   | 11/9/2015   | 6040    | 153     | 0       | UG/KG | 1.5   |      | S      |
| Chromium hexavalent ion    | 11/9/2015   | 0.144   | 0.125   | 0       | MG/KG | 1.5   | J    | S      |
| Chrysene                   | 11/9/2015   | 78.1    | 35      | 0       | UG/KG | 1.5   |      | S      |
| Co-60                      | 11/9/2015   | 0.00201 | 0.0138  | 0.00762 | PCI/G | 1.5   | U    | S      |
| Cobalt                     | 11/9/2015   | 1700    | 153     | 0       | UG/KG | 1.5   |      | S      |
| Cobalt-57                  | 11/9/2015   | -0.0022 | 0.00923 | 0.00519 | PCI/G | 1.5   | U    | S      |
| Copper                     | 11/9/2015   | 4290    | 306     | 0       | UG/KG | 1.5   |      | S      |
| delta-BHC                  | 11/9/2015   | 0.701   | 0.701   | 0       | UG/KG | 1.5   | U    | S      |
| Di-n-butyl phthalate       | 11/9/2015   | 350     | 350     | 0       | UG/KG | 1.5   | U    | S      |
| Di-n-octyl phthalate       | 11/9/2015   | 350     | 350     | 0       | UG/KG | 1.5   | U    | S      |
| Dibenzo(a,h)anthracene     | 11/9/2015   | 11.9    | 35      | 0       | UG/KG | 1.5   | J    | S      |
| Dibenzofuran               | 11/9/2015   | 350     | 350     | 0       | UG/KG | 1.5   | U    | S      |
| Dieldrin                   | 11/9/2015   | 1.4     | 1.4     | 0       | UG/KG | 1.5   | U    | S      |
| Diethyl phthalate          | 11/9/2015   | 350     | 350     | 0       | UG/KG | 1.5   | U    | S      |
| Dimethyl phthalate         | 11/9/2015   | 350     | 350     | 0       | UG/KG | 1.5   | U    | S      |
| Diphenylamine              | 11/9/2015   | 350     | 350     | 0       | UG/KG | 1.5   | U    | S      |
| Endosulfan I               | 11/9/2015   | 0.701   | 0.701   | 0       | UG/KG | 1.5   | U    | S      |
| Endosulfan II              | 11/9/2015   | 1.4     | 1.4     | 0       | UG/KG | 1.5   | U    | S      |
| Endosulfan sulfate         | 11/9/2015   | 1.4     | 1.4     | 0       | UG/KG | 1.5   | U    | S      |
| Endrin                     | 11/9/2015   | 1.4     | 1.4     | 0       | UG/KG | 1.5   | U    | S      |
| Endrin aldehyde            | 11/9/2015   | 1.4     | 1.4     | 0       | UG/KG | 1.5   | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name             | Sample Date | Value    | Detlim | Error   | Units | Depth | Qual | Matrix |
|---------------------------|-------------|----------|--------|---------|-------|-------|------|--------|
| Endrin ketone             | 11/9/2015   | 1.4      | 1.4    | 0       | UG/KG | 1.5   | U    | S      |
| Europium-152              | 11/9/2015   | -0.00568 | 0.0369 | 0.0223  | PCI/G | 1.5   | U    | S      |
| Europium-154              | 11/9/2015   | -0.00025 | 0.0413 | 0.0228  | PCI/G | 1.5   | U    | S      |
| Europium-155              | 11/9/2015   | 0.0567   | 0.0399 | 0.0368  | PCI/G | 1.5   | J-UI | S      |
| Fluoranthene              | 11/9/2015   | 126      | 35     | 0       | UG/KG | 1.5   |      | S      |
| Fluorene                  | 11/9/2015   | 35       | 35     | 0       | UG/KG | 1.5   | U    | S      |
| Heptachlor                | 11/9/2015   | 0.701    | 0.701  | 0       | UG/KG | 1.5   | U    | S      |
| Heptachlor epoxide        | 11/9/2015   | 0.701    | 0.701  | 0       | UG/KG | 1.5   | U    | S      |
| Hexachlorobenzene         | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| Hexachlorobutadiene       | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| Hexachlorocyclopentadiene | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| Hexachloroethane          | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| Indeno(1,2,3-cd)pyrene    | 11/9/2015   | 49       | 35     | 0       | UG/KG | 1.5   |      | S      |
| Iron                      | 11/9/2015   | 5250000  | 8150   | 0       | UG/KG | 1.5   |      | S      |
| Isophorone                | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| Lead                      | 11/9/2015   | 9730     | 103    | 0       | UG/KG | 1.5   |      | S      |
| Lindane                   | 11/9/2015   | 0.701    | 0.701  | 0       | UG/KG | 1.5   | U    | S      |
| m,p-Cresol                | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| m-Dichlorobenzene         | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| m-Nitroaniline            | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| Magnesium                 | 11/9/2015   | 860000   | 8660   | 0       | UG/KG | 1.5   |      | S      |
| Manganese                 | 11/9/2015   | 61300    | 204    | 0       | UG/KG | 1.5   |      | S      |
| Manganese-54              | 11/9/2015   | 0.0151   | 0.0142 | 0.00909 | PCI/G | 1.5   | J-UI | S      |
| Mercury                   | 11/9/2015   | 116      | 4.09   | 0       | UG/KG | 1.5   |      | S      |
| Methoxychlor              | 11/9/2015   | 7.01     | 7.01   | 0       | UG/KG | 1.5   | U    | S      |
| N-Nitrosodipropylamine    | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| Naphthalene               | 11/9/2015   | 35       | 35     | 0       | UG/KG | 1.5   | U    | S      |
| Nickel                    | 11/9/2015   | 3150     | 153    | 0       | UG/KG | 1.5   |      | S      |
| Nitrobenzene              | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| o-Cresol                  | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| o-Dichlorobenzene         | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| o-Nitroaniline            | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| o-Nitrophenol             | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| p-Chloro-m-cresol         | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| p-Chloroaniline           | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| p-Dichlorobenzene         | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| p-Nitroaniline            | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| p-Nitrophenol             | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| PCP                       | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |



Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name | Sample Date | Value    | Detlim | Error   | Units | Depth | Qual | Matrix |
|---------------|-------------|----------|--------|---------|-------|-------|------|--------|
| Phenanthrene  | 11/9/2015   | 63.4     | 35     | 0       | UG/KG | 1.5   |      | S      |
| Phenol        | 11/9/2015   | 350      | 350    | 0       | UG/KG | 1.5   | U    | S      |
| Potassium     | 11/9/2015   | 197000   | 6520   | 0       | UG/KG | 1.5   |      | S      |
| Pyrene        | 11/9/2015   | 127      | 35     | 0       | UG/KG | 1.5   |      | S      |
| Selenium      | 11/9/2015   | 340      | 340    | 0       | UG/KG | 1.5   | U    | S      |
| Silver        | 11/9/2015   | 102      | 102    | 0       | UG/KG | 1.5   | U    | S      |
| Sodium        | 11/9/2015   | 35600    | 7130   | 0       | UG/KG | 1.5   |      | S      |
| Sodium-22     | 11/9/2015   | 1.36E-05 | 0.0145 | 0.00801 | PCI/G | 1.5   | U    | S      |
| Thallium      | 11/9/2015   | 61.8     | 61.8   | 0       | UG/KG | 1.5   | U    | S      |
| Total PCB     | 11/9/2015   | 25.7     | 3.5    | 0       | UG/KG | 1.5   |      | S      |
| Toxaphene     | 11/9/2015   | 17.5     | 17.5   | 0       | UG/KG | 1.5   | U    | S      |
| Vanadium      | 11/9/2015   | 8480     | 102    | 0       | UG/KG | 1.5   |      | S      |
| Zinc          | 11/9/2015   | 13000    | 407    | 0       | UG/KG | 1.5   |      | S      |
| Zinc-65       | 11/9/2015   | -0.00976 | 0.0277 | 0.0191  | PCI/G | 1.5   | U    | S      |

**Site ID : ISB SP-C2**

| Chemical Name               | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-----------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,2,4-Trichlorobenzene      | 11/9/2015   | 349   | 349    | 0     | UG/KG | 1.5   | U    | S      |
| 2,4,5-Trichlorophenol       | 11/9/2015   | 349   | 349    | 0     | UG/KG | 1.5   | U    | S      |
| 2,4,6-Trichlorophenol       | 11/9/2015   | 349   | 349    | 0     | UG/KG | 1.5   | U    | S      |
| 2,4-Dichlorophenol          | 11/9/2015   | 349   | 349    | 0     | UG/KG | 1.5   | U    | S      |
| 2,4-Dimethylphenol          | 11/9/2015   | 349   | 349    | 0     | UG/KG | 1.5   | U    | S      |
| 2,4-Dinitrophenol           | 11/9/2015   | 698   | 698    | 0     | UG/KG | 1.5   | U    | S      |
| 2,4-Dinitrotoluene          | 11/9/2015   | 349   | 349    | 0     | UG/KG | 1.5   | U    | S      |
| 2,6-Dinitrotoluene          | 11/9/2015   | 349   | 349    | 0     | UG/KG | 1.5   | U    | S      |
| 2-Chloronaphthalene         | 11/9/2015   | 34.9  | 34.9   | 0     | UG/KG | 1.5   | U    | S      |
| 2-Chlorophenol              | 11/9/2015   | 349   | 349    | 0     | UG/KG | 1.5   | U    | S      |
| 2-Methylnaphthalene         | 11/9/2015   | 34.9  | 34.9   | 0     | UG/KG | 1.5   | U    | S      |
| 3,3'-Dichlorobenzidine      | 11/9/2015   | 349   | 349    | 0     | UG/KG | 1.5   | U    | S      |
| 4,4''-DDD                   | 11/9/2015   | 1.39  | 1.39   | 0     | UG/KG | 1.5   | U    | S      |
| 4,4''-DDE                   | 11/9/2015   | 0.554 | 1.39   | 0     | UG/KG | 1.5   | J    | S      |
| 4,4''-DDT                   | 11/9/2015   | 0.807 | 1.39   | 0     | UG/KG | 1.5   | JP   | S      |
| 4,6-Dinitro-o-cresol        | 11/9/2015   | 349   | 349    | 0     | UG/KG | 1.5   | U    | S      |
| 4-Bromophenyl phenyl ether  | 11/9/2015   | 349   | 349    | 0     | UG/KG | 1.5   | U    | S      |
| 4-Chlorophenyl phenyl ether | 11/9/2015   | 349   | 349    | 0     | UG/KG | 1.5   | U    | S      |
| Acenaphthene                | 11/9/2015   | 34.9  | 34.9   | 0     | UG/KG | 1.5   | U    | S      |
| Acenaphthylene              | 11/9/2015   | 34.9  | 34.9   | 0     | UG/KG | 1.5   | U    | S      |
| Aldrin                      | 11/9/2015   | 0.697 | 0.697  | 0     | UG/KG | 1.5   | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name              | Sample Date | Value    | Detlim | Error   | Units | Depth | Qual | Matrix |
|----------------------------|-------------|----------|--------|---------|-------|-------|------|--------|
| alpha-BHC                  | 11/9/2015   | 0.697    | 0.697  | 0       | UG/KG | 1.5   | U    | S      |
| Aluminum                   | 11/9/2015   | 3090000  | 6880   | 0       | UG/KG | 1.5   |      | S      |
| Americium-241              | 11/9/2015   | 0.00972  | 0.0652 | 0.0376  | PCI/G | 1.5   | U    | S      |
| Anthracene                 | 11/9/2015   | 34.9     | 34.9   | 0       | UG/KG | 1.5   | U    | S      |
| Antimony                   | 11/9/2015   | 373      | 334    | 0       | UG/KG | 1.5   | B    | S      |
| Aroclor 1016               | 11/9/2015   | 3.49     | 3.49   | 0       | UG/KG | 1.5   | U    | S      |
| Aroclor 1221               | 11/9/2015   | 3.49     | 3.49   | 0       | UG/KG | 1.5   | U    | S      |
| Aroclor 1232               | 11/9/2015   | 3.49     | 3.49   | 0       | UG/KG | 1.5   | U    | S      |
| Aroclor 1242               | 11/9/2015   | 3.49     | 3.49   | 0       | UG/KG | 1.5   | U    | S      |
| Aroclor 1248               | 11/9/2015   | 3.49     | 3.49   | 0       | UG/KG | 1.5   | U    | S      |
| Aroclor 1254               | 11/9/2015   | 4.7      | 3.49   | 0       | UG/KG | 1.5   |      | S      |
| Aroclor 1260               | 11/9/2015   | 4.41     | 3.49   | 0       | UG/KG | 1.5   |      | S      |
| Aroclor-1262               | 11/9/2015   | 3.49     | 3.49   | 0       | UG/KG | 1.5   | U    | S      |
| Arsenic                    | 11/9/2015   | 674      | 204    | 0       | UG/KG | 1.5   | B    | S      |
| Barium                     | 11/9/2015   | 8840     | 101    | 0       | UG/KG | 1.5   |      | S      |
| Benzo(a)anthracene         | 11/9/2015   | 40.2     | 34.9   | 0       | UG/KG | 1.5   |      | S      |
| Benzo(a)pyrene             | 11/9/2015   | 42.6     | 34.9   | 0       | UG/KG | 1.5   |      | S      |
| Benzo(b)fluoranthene       | 11/9/2015   | 60.8     | 34.9   | 0       | UG/KG | 1.5   |      | S      |
| Benzo(ghi)perylene         | 11/9/2015   | 27.9     | 34.9   | 0       | UG/KG | 1.5   | J    | S      |
| Benzo(k)fluoranthene       | 11/9/2015   | 22       | 34.9   | 0       | UG/KG | 1.5   | J    | S      |
| Beryllium                  | 11/9/2015   | 200      | 101    | 0       | UG/KG | 1.5   | B    | S      |
| Beryllium-7                | 11/9/2015   | -0.0158  | 0.0912 | 0.0523  | PCI/G | 1.5   | U    | S      |
| beta-BHC                   | 11/9/2015   | 0.697    | 0.697  | 0       | UG/KG | 1.5   | U    | S      |
| Bis(2-chloroethoxy)methane | 11/9/2015   | 349      | 349    | 0       | UG/KG | 1.5   | U    | S      |
| Bis(2-chloroethyl)ether    | 11/9/2015   | 349      | 349    | 0       | UG/KG | 1.5   | U    | S      |
| Bis(2-ethylhexyl)phthalate | 11/9/2015   | 349      | 349    | 0       | UG/KG | 1.5   | U    | S      |
| bis-chloroisopropyl ether  | 11/9/2015   | 349      | 349    | 0       | UG/KG | 1.5   | U    | S      |
| Butyl benzyl phthalate     | 11/9/2015   | 349      | 349    | 0       | UG/KG | 1.5   | U    | S      |
| Cadmium                    | 11/9/2015   | 101      | 101    | 0       | UG/KG | 1.5   | U    | S      |
| Calcium                    | 11/9/2015   | 1060000  | 8090   | 0       | UG/KG | 1.5   |      | S      |
| Carbazole                  | 11/9/2015   | 34.9     | 34.9   | 0       | UG/KG | 1.5   | U    | S      |
| Cesium-134                 | 11/9/2015   | 0.0242   | 0.0142 | 0.0124  | PCI/G | 1.5   | J-UI | S      |
| Cesium-137                 | 11/9/2015   | 0.0315   | 0.0115 | 0.00993 | PCI/G | 1.5   | J    | S      |
| Chlordane                  | 11/9/2015   | 8.72     | 8.72   | 0       | UG/KG | 1.5   | U    | S      |
| Chromium                   | 11/9/2015   | 4920     | 152    | 0       | UG/KG | 1.5   |      | S      |
| Chromium hexavalent ion    | 11/9/2015   | 0.511    | 0.124  | 0       | MG/KG | 1.5   |      | S      |
| Chrysene                   | 11/9/2015   | 42.2     | 34.9   | 0       | UG/KG | 1.5   |      | S      |
| Co-60                      | 11/9/2015   | 1.05E-05 | 0.0115 | 0.00651 | PCI/G | 1.5   | U    | S      |
| Cobalt                     | 11/9/2015   | 2530     | 152    | 0       | UG/KG | 1.5   |      | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name             | Sample Date | Value    | Detlim  | Error   | Units | Depth | Qual | Matrix |
|---------------------------|-------------|----------|---------|---------|-------|-------|------|--------|
| Cobalt-57                 | 11/9/2015   | 0.00224  | 0.00845 | 0.00468 | PCI/G | 1.5   | U    | S      |
| Copper                    | 11/9/2015   | 3800     | 303     | 0       | UG/KG | 1.5   |      | S      |
| delta-BHC                 | 11/9/2015   | 0.697    | 0.697   | 0       | UG/KG | 1.5   | U    | S      |
| Di-n-butyl phthalate      | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| Di-n-octyl phthalate      | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| Dibenzo(a,h)anthracene    | 11/9/2015   | 34.9     | 34.9    | 0       | UG/KG | 1.5   | U    | S      |
| Dibenzofuran              | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| Dieldrin                  | 11/9/2015   | 1.39     | 1.39    | 0       | UG/KG | 1.5   | U    | S      |
| Diethyl phthalate         | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| Dimethyl phthalate        | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| Diphenylamine             | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| Endosulfan I              | 11/9/2015   | 0.697    | 0.697   | 0       | UG/KG | 1.5   | U    | S      |
| Endosulfan II             | 11/9/2015   | 1.39     | 1.39    | 0       | UG/KG | 1.5   | U    | S      |
| Endosulfan sulfate        | 11/9/2015   | 1.39     | 1.39    | 0       | UG/KG | 1.5   | U    | S      |
| Endrin                    | 11/9/2015   | 1.39     | 1.39    | 0       | UG/KG | 1.5   | U    | S      |
| Endrin aldehyde           | 11/9/2015   | 1.39     | 1.39    | 0       | UG/KG | 1.5   | U    | S      |
| Endrin ketone             | 11/9/2015   | 1.39     | 1.39    | 0       | UG/KG | 1.5   | U    | S      |
| Europium-152              | 11/9/2015   | -0.00513 | 0.0314  | 0.0191  | PCI/G | 1.5   | U    | S      |
| Europium-154              | 11/9/2015   | 0.00094  | 0.0336  | 0.0223  | PCI/G | 1.5   | U    | S      |
| Europium-155              | 11/9/2015   | 0.0318   | 0.0356  | 0.0341  | PCI/G | 1.5   | U    | S      |
| Fluoranthene              | 11/9/2015   | 56.6     | 34.9    | 0       | UG/KG | 1.5   |      | S      |
| Fluorene                  | 11/9/2015   | 34.9     | 34.9    | 0       | UG/KG | 1.5   | U    | S      |
| Heptachlor                | 11/9/2015   | 0.697    | 0.697   | 0       | UG/KG | 1.5   | U    | S      |
| Heptachlor epoxide        | 11/9/2015   | 0.697    | 0.697   | 0       | UG/KG | 1.5   | U    | S      |
| Hexachlorobenzene         | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| Hexachlorobutadiene       | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| Hexachlorocyclopentadiene | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| Hexachloroethane          | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| Indeno(1,2,3-cd)pyrene    | 11/9/2015   | 31.8     | 34.9    | 0       | UG/KG | 1.5   | J    | S      |
| Iron                      | 11/9/2015   | 4580000  | 8090    | 0       | UG/KG | 1.5   |      | S      |
| Isophorone                | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| Lead                      | 11/9/2015   | 6560     | 102     | 0       | UG/KG | 1.5   |      | S      |
| Lindane                   | 11/9/2015   | 0.697    | 0.697   | 0       | UG/KG | 1.5   | U    | S      |
| m,p-Cresol                | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| m-Dichlorobenzene         | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| m-Nitroaniline            | 11/9/2015   | 349      | 349     | 0       | UG/KG | 1.5   | U    | S      |
| Magnesium                 | 11/9/2015   | 617000   | 8590    | 0       | UG/KG | 1.5   |      | S      |
| Manganese                 | 11/9/2015   | 52700    | 202     | 0       | UG/KG | 1.5   |      | S      |
| Manganese-54              | 11/9/2015   | -0.00735 | 0.0114  | 0.00773 | PCI/G | 1.5   | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name          | Sample Date | Value   | Detlim | Error   | Units | Depth | Qual | Matrix |
|------------------------|-------------|---------|--------|---------|-------|-------|------|--------|
| Mercury                | 11/9/2015   | 144     | 4.19   | 0       | UG/KG | 1.5   |      | S      |
| Methoxychlor           | 11/9/2015   | 6.97    | 6.97   | 0       | UG/KG | 1.5   | U    | S      |
| N-Nitrosodipropylamine | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| Naphthalene            | 11/9/2015   | 34.9    | 34.9   | 0       | UG/KG | 1.5   | U    | S      |
| Nickel                 | 11/9/2015   | 2640    | 152    | 0       | UG/KG | 1.5   |      | S      |
| Nitrobenzene           | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| o-Cresol               | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| o-Dichlorobenzene      | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| o-Nitroaniline         | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| o-Nitrophenol          | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| p-Chloro-m-cresol      | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| p-Chloroaniline        | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| p-Dichlorobenzene      | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| p-Nitroaniline         | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| p-Nitrophenol          | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| PCP                    | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| Phenanthrene           | 11/9/2015   | 22.3    | 34.9   | 0       | UG/KG | 1.5   | J    | S      |
| Phenol                 | 11/9/2015   | 349     | 349    | 0       | UG/KG | 1.5   | U    | S      |
| Potassium              | 11/9/2015   | 183000  | 6470   | 0       | UG/KG | 1.5   |      | S      |
| Pyrene                 | 11/9/2015   | 65.6    | 34.9   | 0       | UG/KG | 1.5   |      | S      |
| Selenium               | 11/9/2015   | 336     | 336    | 0       | UG/KG | 1.5   | U    | S      |
| Silver                 | 11/9/2015   | 101     | 101    | 0       | UG/KG | 1.5   | U    | S      |
| Sodium                 | 11/9/2015   | 37800   | 7080   | 0       | UG/KG | 1.5   |      | S      |
| Sodium-22              | 11/9/2015   | 0.00033 | 0.0118 | 0.00785 | PCI/G | 1.5   | U    | S      |
| Thallium               | 11/9/2015   | 61.1    | 61.1   | 0       | UG/KG | 1.5   | U    | S      |
| Total PCB              | 11/9/2015   | 9.11    | 3.49   | 0       | UG/KG | 1.5   |      | S      |
| Toxaphene              | 11/9/2015   | 17.4    | 17.4   | 0       | UG/KG | 1.5   | U    | S      |
| Vanadium               | 11/9/2015   | 8810    | 101    | 0       | UG/KG | 1.5   |      | S      |
| Zinc                   | 11/9/2015   | 10900   | 404    | 0       | UG/KG | 1.5   |      | S      |
| Zinc-65                | 11/9/2015   | 0.0107  | 0.0254 | 0.0167  | PCI/G | 1.5   | U    | S      |

**Site ID : ISB SP-G1**

| Chemical Name             | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|---------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1,1-Trichloroethane     | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane     | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane        | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene      | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,2-Dichloroethane            | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene            | 11/9/2015   | 4.08  | 4.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane           | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether     | 11/9/2015   | 10.2  | 10.2   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                    | 11/9/2015   | 10.2  | 10.2   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                     | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                       | 11/9/2015   | 10.2  | 10.2   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                       | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane          | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                     | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide              | 11/9/2015   | 10.2  | 10.2   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride          | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene                 | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane                  | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                    | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene       | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane          | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene                  | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene             | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide                | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 10.2  | 10.2   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 10.2  | 10.2   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.1   | 5.1    | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                       | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene           | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                       | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene     | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene             | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane        | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate                 | 11/9/2015   | 5.1   | 5.1    | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride                | 11/9/2015   | 2.04  | 2.04   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)                | 11/9/2015   | 6.12  | 6.12   | 0     | UG/KG | 0.63  | U    | S      |

**Site ID : ISB SP-G2**

|  |        |  |  |  |  |  |  |  |
|--|--------|--|--|--|--|--|--|--|
|  | Sample |  |  |  |  |  |  |  |
|--|--------|--|--|--|--|--|--|--|

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| Chemical Name                 | Date        | Value | Detlim | Error | Units | Depth | Qual | Matrix |
| 1,1,1-Trichloroethane         | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane     | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane         | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane            | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene          | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane            | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene            | 11/9/2015   | 4.62  | 4.62   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane           | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether     | 11/9/2015   | 11.6  | 11.6   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                    | 11/9/2015   | 11.6  | 11.6   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                     | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                       | 11/9/2015   | 11.6  | 11.6   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                       | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane          | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                     | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide              | 11/9/2015   | 11.6  | 11.6   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride          | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene                 | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane                  | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                    | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene       | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane          | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene                  | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene             | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide                | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 11.6  | 11.6   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 11.6  | 11.6   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.78  | 5.78   | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                       | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene           | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                       | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene     | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene             | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane        | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name  | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|----------------|-------------|-------|--------|-------|-------|-------|------|--------|
| Vinyl acetate  | 11/9/2015   | 5.78  | 5.78   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride | 11/9/2015   | 2.31  | 2.31   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total) | 11/9/2015   | 6.94  | 6.94   | 0     | UG/KG | 0.63  | U    | S      |

**Site ID : ISB SP-G3**

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1,1-Trichloroethane         | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane     | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane         | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane            | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene          | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane            | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene            | 11/9/2015   | 4.19  | 4.19   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane           | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether     | 11/9/2015   | 10.5  | 10.5   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                    | 11/9/2015   | 10.5  | 10.5   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                     | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                       | 11/9/2015   | 10.5  | 10.5   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                       | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane          | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                     | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide              | 11/9/2015   | 10.5  | 10.5   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride          | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene                 | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane                  | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                    | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene       | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane          | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene                  | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene             | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide                | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 10.5  | 10.5   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 10.5  | 10.5   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.23  | 5.23   | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name             | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|---------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| Styrene                   | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene       | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                   | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene         | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane    | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate             | 11/9/2015   | 5.23  | 5.23   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride            | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)            | 11/9/2015   | 6.28  | 6.28   | 0     | UG/KG | 0.63  | U    | S      |

**Site ID : ISB SP-G4**

| Chemical Name             | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|---------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1,1-Trichloroethane     | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane     | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane        | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene      | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane        | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene        | 11/9/2015   | 4.49  | 4.49   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane       | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether | 11/9/2015   | 11.2  | 11.2   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                | 11/9/2015   | 11.2  | 11.2   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                 | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                   | 11/9/2015   | 11.2  | 11.2   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                   | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane      | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                 | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide          | 11/9/2015   | 11.2  | 11.2   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride      | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene             | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane              | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene   | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane      | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene              | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene         | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide            | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride           | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |



Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| Methyl ethyl ketone           | 11/9/2015   | 11.2  | 11.2   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 11.2  | 11.2   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.61  | 5.61   | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                       | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene           | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                       | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene     | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene             | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane        | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate                 | 11/9/2015   | 5.61  | 5.61   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride                | 11/9/2015   | 2.25  | 2.25   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)                | 11/9/2015   | 6.74  | 6.74   | 0     | UG/KG | 0.63  | U    | S      |

**Site ID : ISB SP-G5**

| Chemical Name             | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|---------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1,1-Trichloroethane     | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane     | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane        | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene      | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane        | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene        | 11/9/2015   | 4.16  | 4.16   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                 | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                   | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                   | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane      | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                 | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide          | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride      | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane              | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| cis-1,3-Dichloropropene       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane          | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene                  | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide                | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.2   | 5.2    | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene           | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene     | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane        | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate                 | 11/9/2015   | 5.2   | 5.2    | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride                | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)                | 11/9/2015   | 6.24  | 6.24   | 0     | UG/KG | 0.63  | U    | S      |

**Site ID : ISB SP-G6**

| Chemical Name             | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|---------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1,1-Trichloroethane     | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane     | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane        | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene      | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane        | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene        | 11/9/2015   | 4.11  | 4.11   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane       | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether | 11/9/2015   | 10.3  | 10.3   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                | 11/9/2015   | 10.3  | 10.3   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                 | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                   | 11/9/2015   | 10.3  | 10.3   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                   | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane      | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| Bromoform                     | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide              | 11/9/2015   | 10.3  | 10.3   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride          | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene                 | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane                  | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                    | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene       | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane          | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene                  | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene             | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide                | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 10.3  | 10.3   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 10.3  | 10.3   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.13  | 5.13   | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                       | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene           | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                       | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene     | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene             | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane        | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate                 | 11/9/2015   | 5.13  | 5.13   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride                | 11/9/2015   | 2.05  | 2.05   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)                | 11/9/2015   | 6.16  | 6.16   | 0     | UG/KG | 0.63  | U    | S      |

**Site ID : ISB SP-G7**

| Chemical Name             | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|---------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1,1-Trichloroethane     | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane     | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane        | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene      | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane        | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene        | 11/9/2015   | 4.43  | 4.43   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane       | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 2-Chloroethyl vinyl ether     | 11/9/2015   | 11.1  | 11.1   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                    | 11/9/2015   | 11.1  | 11.1   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                     | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                       | 11/9/2015   | 11.1  | 11.1   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                       | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane          | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                     | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide              | 11/9/2015   | 11.1  | 11.1   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride          | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene                 | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane                  | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                    | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene       | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane          | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene                  | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene             | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide                | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 11.1  | 11.1   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 11.1  | 11.1   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.53  | 5.53   | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                       | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene           | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                       | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene     | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene             | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane        | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate                 | 11/9/2015   | 5.53  | 5.53   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride                | 11/9/2015   | 2.21  | 2.21   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)                | 11/9/2015   | 6.64  | 6.64   | 0     | UG/KG | 0.63  | U    | S      |

**Site ID : NSLSII WestSP-C1**

| Chemical Name          | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,2,4-Trichlorobenzene | 11/9/2015   | 357   | 357    | 0     | UG/KG | 4     | U    | S      |
| 2,4,5-Trichlorophenol  | 11/9/2015   | 357   | 357    | 0     | UG/KG | 4     | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name               | Sample Date | Value   | Detlim | Error  | Units | Depth | Qual | Matrix |
|-----------------------------|-------------|---------|--------|--------|-------|-------|------|--------|
| 2,4,6-Trichlorophenol       | 11/9/2015   | 357     | 357    | 0      | UG/KG | 4     | U    | S      |
| 2,4-Dichlorophenol          | 11/9/2015   | 357     | 357    | 0      | UG/KG | 4     | U    | S      |
| 2,4-Dimethylphenol          | 11/9/2015   | 357     | 357    | 0      | UG/KG | 4     | U    | S      |
| 2,4-Dinitrophenol           | 11/9/2015   | 714     | 714    | 0      | UG/KG | 4     | U    | S      |
| 2,4-Dinitrotoluene          | 11/9/2015   | 357     | 357    | 0      | UG/KG | 4     | U    | S      |
| 2,6-Dinitrotoluene          | 11/9/2015   | 357     | 357    | 0      | UG/KG | 4     | U    | S      |
| 2-Chloronaphthalene         | 11/9/2015   | 35.7    | 35.7   | 0      | UG/KG | 4     | U    | S      |
| 2-Chlorophenol              | 11/9/2015   | 357     | 357    | 0      | UG/KG | 4     | U    | S      |
| 2-Methylnaphthalene         | 11/9/2015   | 24.3    | 35.7   | 0      | UG/KG | 4     | J    | S      |
| 3,3'-Dichlorobenzidine      | 11/9/2015   | 357     | 357    | 0      | UG/KG | 4     | U    | S      |
| 4,4''-DDD                   | 11/9/2015   | 1.43    | 1.43   | 0      | UG/KG | 4     | U    | S      |
| 4,4''-DDE                   | 11/9/2015   | 0.794   | 1.43   | 0      | UG/KG | 4     | JP   | S      |
| 4,4''-DDT                   | 11/9/2015   | 2.23    | 1.43   | 0      | UG/KG | 4     | JP   | S      |
| 4,6-Dinitro-o-cresol        | 11/9/2015   | 357     | 357    | 0      | UG/KG | 4     | U    | S      |
| 4-Bromophenyl phenyl ether  | 11/9/2015   | 357     | 357    | 0      | UG/KG | 4     | U    | S      |
| 4-Chlorophenyl phenyl ether | 11/9/2015   | 357     | 357    | 0      | UG/KG | 4     | U    | S      |
| Acenaphthene                | 11/9/2015   | 57.9    | 35.7   | 0      | UG/KG | 4     |      | S      |
| Acenaphthylene              | 11/9/2015   | 23.2    | 35.7   | 0      | UG/KG | 4     | J    | S      |
| Aldrin                      | 11/9/2015   | 0.713   | 0.713  | 0      | UG/KG | 4     | U    | S      |
| alpha-BHC                   | 11/9/2015   | 0.713   | 0.713  | 0      | UG/KG | 4     | U    | S      |
| Aluminum                    | 11/9/2015   | 4380000 | 7150   | 0      | UG/KG | 4     |      | S      |
| Americium-241               | 11/9/2015   | 0.0514  | 0.0609 | 0.0355 | PCI/G | 4     | U    | S      |
| Anthracene                  | 11/9/2015   | 163     | 35.7   | 0      | UG/KG | 4     |      | S      |
| Antimony                    | 11/9/2015   | 347     | 347    | 0      | UG/KG | 4     | U    | S      |
| Aroclor 1016                | 11/9/2015   | 35.7    | 35.7   | 0      | UG/KG | 4     | U    | S      |
| Aroclor 1221                | 11/9/2015   | 35.7    | 35.7   | 0      | UG/KG | 4     | U    | S      |
| Aroclor 1232                | 11/9/2015   | 35.7    | 35.7   | 0      | UG/KG | 4     | U    | S      |
| Aroclor 1242                | 11/9/2015   | 35.7    | 35.7   | 0      | UG/KG | 4     | U    | S      |
| Aroclor 1248                | 11/9/2015   | 35.7    | 35.7   | 0      | UG/KG | 4     | U    | S      |
| Aroclor 1254                | 11/9/2015   | 35.7    | 35.7   | 0      | UG/KG | 4     | U    | S      |
| Aroclor 1260                | 11/9/2015   | 35.7    | 35.7   | 0      | UG/KG | 4     | U    | S      |
| Aroclor-1262                | 11/9/2015   | 35.7    | 35.7   | 0      | UG/KG | 4     | U    | S      |
| Arsenic                     | 11/9/2015   | 1220    | 211    | 0      | UG/KG | 4     |      | S      |
| Barium                      | 11/9/2015   | 14400   | 105    | 0      | UG/KG | 4     | *    | S      |
| Benzo(a)anthracene          | 11/9/2015   | 658     | 35.7   | 0      | UG/KG | 4     |      | S      |
| Benzo(a)pyrene              | 11/9/2015   | 676     | 35.7   | 0      | UG/KG | 4     |      | S      |
| Benzo(b)fluoranthene        | 11/9/2015   | 909     | 35.7   | 0      | UG/KG | 4     |      | S      |
| Benzo(ghi)perylene          | 11/9/2015   | 349     | 35.7   | 0      | UG/KG | 4     |      | S      |
| Benzo(k)fluoranthene        | 11/9/2015   | 344     | 35.7   | 0      | UG/KG | 4     |      | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name              | Sample Date | Value    | Detlim  | Error   | Units | Depth | Qual | Matrix |
|----------------------------|-------------|----------|---------|---------|-------|-------|------|--------|
| Beryllium                  | 11/9/2015   | 277      | 105     | 0       | UG/KG | 4     | B    | S      |
| Beryllium-7                | 11/9/2015   | 0.067    | 0.101   | 0.0558  | PCI/G | 4     | U    | S      |
| beta-BHC                   | 11/9/2015   | 0.713    | 0.713   | 0       | UG/KG | 4     | U    | S      |
| Bis(2-chloroethoxy)methane | 11/9/2015   | 357      | 357     | 0       | UG/KG | 4     | U    | S      |
| Bis(2-chloroethyl)ether    | 11/9/2015   | 357      | 357     | 0       | UG/KG | 4     | U    | S      |
| Bis(2-ethylhexyl)phthalate | 11/9/2015   | 357      | 357     | 0       | UG/KG | 4     | U    | S      |
| bis-chloroisopropyl ether  | 11/9/2015   | 357      | 357     | 0       | UG/KG | 4     | U    | S      |
| Butyl benzyl phthalate     | 11/9/2015   | 357      | 357     | 0       | UG/KG | 4     | U    | S      |
| Cadmium                    | 11/9/2015   | 105      | 105     | 0       | UG/KG | 4     | U    | S      |
| Calcium                    | 11/9/2015   | 3290000  | 8410    | 0       | UG/KG | 4     |      | S      |
| Carbazole                  | 11/9/2015   | 40.4     | 35.7    | 0       | UG/KG | 4     |      | S      |
| Cesium-134                 | 11/9/2015   | 0.0442   | 0.0152  | 0.0124  | PCI/G | 4     | UI   | S      |
| Cesium-137                 | 11/9/2015   | 0.0277   | 0.0121  | 0.0141  | PCI/G | 4     | J    | S      |
| Chlordane                  | 11/9/2015   | 5.46     | 8.92    | 0       | UG/KG | 4     | J    | S      |
| Chromium                   | 11/9/2015   | 5930     | 158     | 0       | UG/KG | 4     |      | S      |
| Chromium hexavalent ion    | 11/9/2015   | 0.31     | 0.128   | 0       | MG/KG | 4     | J    | S      |
| Chrysene                   | 11/9/2015   | 620      | 35.7    | 0       | UG/KG | 4     |      | S      |
| Co-60                      | 11/9/2015   | -0.00012 | 0.0121  | 0.00807 | PCI/G | 4     | U    | S      |
| Cobalt                     | 11/9/2015   | 1800     | 158     | 0       | UG/KG | 4     |      | S      |
| Cobalt-57                  | 11/9/2015   | 0.00043  | 0.00914 | 0.00509 | PCI/G | 4     | U    | S      |
| Copper                     | 11/9/2015   | 4960     | 315     | 0       | UG/KG | 4     |      | S      |
| delta-BHC                  | 11/9/2015   | 0.713    | 0.713   | 0       | UG/KG | 4     | U    | S      |
| Di-n-butyl phthalate       | 11/9/2015   | 357      | 357     | 0       | UG/KG | 4     | U    | S      |
| Di-n-octyl phthalate       | 11/9/2015   | 357      | 357     | 0       | UG/KG | 4     | U    | S      |
| Dibenzo(a,h)anthracene     | 11/9/2015   | 92.5     | 35.7    | 0       | UG/KG | 4     |      | S      |
| Dibenzofuran               | 11/9/2015   | 357      | 357     | 0       | UG/KG | 4     | U    | S      |
| Dieldrin                   | 11/9/2015   | 1.43     | 1.43    | 0       | UG/KG | 4     | U    | S      |
| Diethyl phthalate          | 11/9/2015   | 357      | 357     | 0       | UG/KG | 4     | U    | S      |
| Dimethyl phthalate         | 11/9/2015   | 357      | 357     | 0       | UG/KG | 4     | U    | S      |
| Diphenylamine              | 11/9/2015   | 357      | 357     | 0       | UG/KG | 4     | U    | S      |
| Endosulfan I               | 11/9/2015   | 0.713    | 0.713   | 0       | UG/KG | 4     | U    | S      |
| Endosulfan II              | 11/9/2015   | 1.43     | 1.43    | 0       | UG/KG | 4     | U    | S      |
| Endosulfan sulfate         | 11/9/2015   | 1.43     | 1.43    | 0       | UG/KG | 4     | U    | S      |
| Endrin                     | 11/9/2015   | 1.43     | 1.43    | 0       | UG/KG | 4     | U    | S      |
| Endrin aldehyde            | 11/9/2015   | 1.43     | 1.43    | 0       | UG/KG | 4     | U    | S      |
| Endrin ketone              | 11/9/2015   | 1.43     | 1.43    | 0       | UG/KG | 4     | U    | S      |
| Europium-152               | 11/9/2015   | -0.0109  | 0.033   | 0.0288  | PCI/G | 4     | U    | S      |
| Europium-154               | 11/9/2015   | 0.00474  | 0.0387  | 0.0223  | PCI/G | 4     | U    | S      |
| Europium-155               | 11/9/2015   | 0.0418   | 0.0368  | 0.0313  | PCI/G | 4     | J-UI | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name             | Sample Date | Value   | Detlim | Error   | Units | Depth | Qual | Matrix |
|---------------------------|-------------|---------|--------|---------|-------|-------|------|--------|
| Fluoranthene              | 11/9/2015   | 943     | 35.7   | 0       | UG/KG | 4     |      | S      |
| Fluorene                  | 11/9/2015   | 69.6    | 35.7   | 0       | UG/KG | 4     |      | S      |
| Heptachlor                | 11/9/2015   | 0.713   | 0.713  | 0       | UG/KG | 4     | U    | S      |
| Heptachlor epoxide        | 11/9/2015   | 0.713   | 0.713  | 0       | UG/KG | 4     | U    | S      |
| Hexachlorobenzene         | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| Hexachlorobutadiene       | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| Hexachlorocyclopentadiene | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| Hexachloroethane          | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| Indeno(1,2,3-cd)pyrene    | 11/9/2015   | 375     | 35.7   | 0       | UG/KG | 4     |      | S      |
| Iron                      | 11/9/2015   | 5420000 | 8410   | 0       | UG/KG | 4     |      | S      |
| Isophorone                | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| Lead                      | 11/9/2015   | 8120    | 106    | 0       | UG/KG | 4     |      | S      |
| Lindane                   | 11/9/2015   | 0.713   | 0.713  | 0       | UG/KG | 4     | U    | S      |
| m,p-Cresol                | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| m-Dichlorobenzene         | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| m-Nitroaniline            | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| Magnesium                 | 11/9/2015   | 1240000 | 8940   | 0       | UG/KG | 4     | N    | S      |
| Manganese                 | 11/9/2015   | 67200   | 210    | 0       | UG/KG | 4     | *    | S      |
| Manganese-54              | 11/9/2015   | 0.00387 | 0.0126 | 0.00717 | PCI/G | 4     | U    | S      |
| Mercury                   | 11/9/2015   | 58.5    | 3.93   | 0       | UG/KG | 4     |      | S      |
| Methoxychlor              | 11/9/2015   | 7.13    | 7.13   | 0       | UG/KG | 4     | U    | S      |
| N-Nitrosodipropylamine    | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| Naphthalene               | 11/9/2015   | 27.5    | 35.7   | 0       | UG/KG | 4     | J    | S      |
| Nickel                    | 11/9/2015   | 3610    | 158    | 0       | UG/KG | 4     |      | S      |
| Nitrobenzene              | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| o-Cresol                  | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| o-Dichlorobenzene         | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| o-Nitroaniline            | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| o-Nitrophenol             | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| p-Chloro-m-cresol         | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| p-Chloroaniline           | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| p-Dichlorobenzene         | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| p-Nitroaniline            | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| p-Nitrophenol             | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| PCP                       | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| Phenanthrene              | 11/9/2015   | 588     | 35.7   | 0       | UG/KG | 4     |      | S      |
| Phenol                    | 11/9/2015   | 357     | 357    | 0       | UG/KG | 4     | U    | S      |
| Potassium                 | 11/9/2015   | 266000  | 6730   | 0       | UG/KG | 4     |      | S      |
| Pyrene                    | 11/9/2015   | 1120    | 35.7   | 0       | UG/KG | 4     |      | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name | Sample Date | Value   | Detlim | Error   | Units | Depth | Qual | Matrix |
|---------------|-------------|---------|--------|---------|-------|-------|------|--------|
| Selenium      | 11/9/2015   | 380     | 348    | 0       | UG/KG | 4     | B    | S      |
| Silver        | 11/9/2015   | 105     | 105    | 0       | UG/KG | 4     | U    | S      |
| Sodium        | 11/9/2015   | 52500   | 7360   | 0       | UG/KG | 4     |      | S      |
| Sodium-22     | 11/9/2015   | 0.00152 | 0.0136 | 0.00783 | PCI/G | 4     | U    | S      |
| Thallium      | 11/9/2015   | 68.8    | 63.3   | 0       | UG/KG | 4     | B    | S      |
| Total PCB     | 11/9/2015   | 35.7    | 35.7   | 0       | UG/KG | 4     | U    | S      |
| Toxaphene     | 11/9/2015   | 17.8    | 17.8   | 0       | UG/KG | 4     | U    | S      |
| Vanadium      | 11/9/2015   | 9760    | 105    | 0       | UG/KG | 4     |      | S      |
| Zinc          | 11/9/2015   | 13800   | 421    | 0       | UG/KG | 4     |      | S      |
| Zinc-65       | 11/9/2015   | 0.0528  | 0.0314 | 0.019   | PCI/G | 4     | J-UI | S      |

**Site ID : NSLSII WestSP-C2**

| Chemical Name               | Sample Date | Value   | Detlim | Error | Units | Depth | Qual | Matrix |
|-----------------------------|-------------|---------|--------|-------|-------|-------|------|--------|
| 1,2,4-Trichlorobenzene      | 11/9/2015   | 358     | 358    | 0     | UG/KG | 4     | U    | S      |
| 2,4,5-Trichlorophenol       | 11/9/2015   | 358     | 358    | 0     | UG/KG | 4     | U    | S      |
| 2,4,6-Trichlorophenol       | 11/9/2015   | 358     | 358    | 0     | UG/KG | 4     | U    | S      |
| 2,4-Dichlorophenol          | 11/9/2015   | 358     | 358    | 0     | UG/KG | 4     | U    | S      |
| 2,4-Dimethylphenol          | 11/9/2015   | 358     | 358    | 0     | UG/KG | 4     | U    | S      |
| 2,4-Dinitrophenol           | 11/9/2015   | 715     | 715    | 0     | UG/KG | 4     | U    | S      |
| 2,4-Dinitrotoluene          | 11/9/2015   | 358     | 358    | 0     | UG/KG | 4     | U    | S      |
| 2,6-Dinitrotoluene          | 11/9/2015   | 358     | 358    | 0     | UG/KG | 4     | U    | S      |
| 2-Chloronaphthalene         | 11/9/2015   | 35.8    | 35.8   | 0     | UG/KG | 4     | U    | S      |
| 2-Chlorophenol              | 11/9/2015   | 358     | 358    | 0     | UG/KG | 4     | U    | S      |
| 2-Methylnaphthalene         | 11/9/2015   | 17.2    | 35.8   | 0     | UG/KG | 4     | J    | S      |
| 3,3'-Dichlorobenzidine      | 11/9/2015   | 358     | 358    | 0     | UG/KG | 4     | U    | S      |
| 4,4''-DDD                   | 11/9/2015   | 1.15    | 1.43   | 0     | UG/KG | 4     | J    | S      |
| 4,4''-DDE                   | 11/9/2015   | 1.1     | 1.43   | 0     | UG/KG | 4     | J    | S      |
| 4,4''-DDT                   | 11/9/2015   | 1.89    | 1.43   | 0     | UG/KG | 4     | J    | S      |
| 4,6-Dinitro-o-cresol        | 11/9/2015   | 358     | 358    | 0     | UG/KG | 4     | U    | S      |
| 4-Bromophenyl phenyl ether  | 11/9/2015   | 358     | 358    | 0     | UG/KG | 4     | U    | S      |
| 4-Chlorophenyl phenyl ether | 11/9/2015   | 358     | 358    | 0     | UG/KG | 4     | U    | S      |
| Acenaphthene                | 11/9/2015   | 33.3    | 35.8   | 0     | UG/KG | 4     | J    | S      |
| Acenaphthylene              | 11/9/2015   | 27.2    | 35.8   | 0     | UG/KG | 4     | J    | S      |
| Aldrin                      | 11/9/2015   | 0.715   | 0.715  | 0     | UG/KG | 4     | U    | S      |
| alpha-BHC                   | 11/9/2015   | 0.715   | 0.715  | 0     | UG/KG | 4     | U    | S      |
| Aluminum                    | 11/9/2015   | 4130000 | 7110   | 0     | UG/KG | 4     |      | S      |
| Americium-241               | 11/9/2015   | 0.00546 | 0.073  | 0.045 | PCI/G | 4     | U    | S      |
| Anthracene                  | 11/9/2015   | 146     | 35.8   | 0     | UG/KG | 4     |      | S      |



Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name              | Sample Date | Value    | Detlim  | Error   | Units | Depth | Qual | Matrix |
|----------------------------|-------------|----------|---------|---------|-------|-------|------|--------|
| Antimony                   | 11/9/2015   | 524      | 345     | 0       | UG/KG | 4     | B    | S      |
| Aroclor 1016               | 11/9/2015   | 35.8     | 35.8    | 0       | UG/KG | 4     | U    | S      |
| Aroclor 1221               | 11/9/2015   | 35.8     | 35.8    | 0       | UG/KG | 4     | U    | S      |
| Aroclor 1232               | 11/9/2015   | 35.8     | 35.8    | 0       | UG/KG | 4     | U    | S      |
| Aroclor 1242               | 11/9/2015   | 35.8     | 35.8    | 0       | UG/KG | 4     | U    | S      |
| Aroclor 1248               | 11/9/2015   | 35.8     | 35.8    | 0       | UG/KG | 4     | U    | S      |
| Aroclor 1254               | 11/9/2015   | 35.8     | 35.8    | 0       | UG/KG | 4     | U    | S      |
| Aroclor 1260               | 11/9/2015   | 35.8     | 35.8    | 0       | UG/KG | 4     | U    | S      |
| Aroclor-1262               | 11/9/2015   | 35.8     | 35.8    | 0       | UG/KG | 4     | U    | S      |
| Arsenic                    | 11/9/2015   | 1160     | 209     | 0       | UG/KG | 4     |      | S      |
| Barium                     | 11/9/2015   | 13400    | 105     | 0       | UG/KG | 4     | *    | S      |
| Benzo(a)anthracene         | 11/9/2015   | 708      | 35.8    | 0       | UG/KG | 4     |      | S      |
| Benzo(a)pyrene             | 11/9/2015   | 720      | 35.8    | 0       | UG/KG | 4     |      | S      |
| Benzo(b)fluoranthene       | 11/9/2015   | 949      | 35.8    | 0       | UG/KG | 4     |      | S      |
| Benzo(ghi)perylene         | 11/9/2015   | 384      | 35.8    | 0       | UG/KG | 4     |      | S      |
| Benzo(k)fluoranthene       | 11/9/2015   | 327      | 35.8    | 0       | UG/KG | 4     |      | S      |
| Beryllium                  | 11/9/2015   | 260      | 105     | 0       | UG/KG | 4     | B    | S      |
| Beryllium-7                | 11/9/2015   | 0.00389  | 0.122   | 0.0697  | PCI/G | 4     | U    | S      |
| beta-BHC                   | 11/9/2015   | 0.715    | 0.715   | 0       | UG/KG | 4     | U    | S      |
| Bis(2-chloroethoxy)methane | 11/9/2015   | 358      | 358     | 0       | UG/KG | 4     | U    | S      |
| Bis(2-chloroethyl)ether    | 11/9/2015   | 358      | 358     | 0       | UG/KG | 4     | U    | S      |
| Bis(2-ethylhexyl)phthalate | 11/9/2015   | 358      | 358     | 0       | UG/KG | 4     | U    | S      |
| bis-chloroisopropyl ether  | 11/9/2015   | 358      | 358     | 0       | UG/KG | 4     | U    | S      |
| Butyl benzyl phthalate     | 11/9/2015   | 358      | 358     | 0       | UG/KG | 4     | U    | S      |
| Cadmium                    | 11/9/2015   | 105      | 105     | 0       | UG/KG | 4     | U    | S      |
| Calcium                    | 11/9/2015   | 4020000  | 8370    | 0       | UG/KG | 4     |      | S      |
| Carbazole                  | 11/9/2015   | 24       | 35.8    | 0       | UG/KG | 4     | J    | S      |
| Cesium-134                 | 11/9/2015   | 0.0235   | 0.0198  | 0.0118  | PCI/G | 4     | J-UI | S      |
| Cesium-137                 | 11/9/2015   | 0.0124   | 0.0163  | 0.0192  | PCI/G | 4     | U    | S      |
| Chlordane                  | 11/9/2015   | 11.7     | 8.94    | 0       | UG/KG | 4     |      | S      |
| Chromium                   | 11/9/2015   | 6390     | 157     | 0       | UG/KG | 4     |      | S      |
| Chromium hexavalent ion    | 11/9/2015   | 0.127    | 0.127   | 0       | MG/KG | 4     | U    | S      |
| Chrysene                   | 11/9/2015   | 648      | 35.8    | 0       | UG/KG | 4     |      | S      |
| Co-60                      | 11/9/2015   | -0.0063  | 0.0156  | 0.00927 | PCI/G | 4     | U    | S      |
| Cobalt                     | 11/9/2015   | 1710     | 157     | 0       | UG/KG | 4     |      | S      |
| Cobalt-57                  | 11/9/2015   | -0.00135 | 0.00937 | 0.00512 | PCI/G | 4     | U    | S      |
| Copper                     | 11/9/2015   | 9890     | 314     | 0       | UG/KG | 4     |      | S      |
| delta-BHC                  | 11/9/2015   | 0.715    | 0.715   | 0       | UG/KG | 4     | U    | S      |
| Di-n-butyl phthalate       | 11/9/2015   | 358      | 358     | 0       | UG/KG | 4     | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name             | Sample Date | Value   | Detlim | Error  | Units | Depth | Qual | Matrix |
|---------------------------|-------------|---------|--------|--------|-------|-------|------|--------|
| Di-n-octyl phthalate      | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| Dibenzo(a,h)anthracene    | 11/9/2015   | 96.2    | 35.8   | 0      | UG/KG | 4     |      | S      |
| Dibenzofuran              | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| Dieldrin                  | 11/9/2015   | 1.43    | 1.43   | 0      | UG/KG | 4     | U    | S      |
| Diethyl phthalate         | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| Dimethyl phthalate        | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| Diphenylamine             | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| Endosulfan I              | 11/9/2015   | 0.715   | 0.715  | 0      | UG/KG | 4     | U    | S      |
| Endosulfan II             | 11/9/2015   | 1.43    | 1.43   | 0      | UG/KG | 4     | U    | S      |
| Endosulfan sulfate        | 11/9/2015   | 1.43    | 1.43   | 0      | UG/KG | 4     | U    | S      |
| Endrin                    | 11/9/2015   | 1.43    | 1.43   | 0      | UG/KG | 4     | U    | S      |
| Endrin aldehyde           | 11/9/2015   | 1.43    | 1.43   | 0      | UG/KG | 4     | U    | S      |
| Endrin ketone             | 11/9/2015   | 1.43    | 1.43   | 0      | UG/KG | 4     | U    | S      |
| Europium-152              | 11/9/2015   | -0.0293 | 0.0396 | 0.0339 | PCI/G | 4     | U    | S      |
| Europium-154              | 11/9/2015   | -0.0326 | 0.0446 | 0.0273 | PCI/G | 4     | U    | S      |
| Europium-155              | 11/9/2015   | 0.0552  | 0.0396 | 0.0391 | PCI/G | 4     | J-UI | S      |
| Fluoranthene              | 11/9/2015   | 1150    | 35.8   | 0      | UG/KG | 4     |      | S      |
| Fluorene                  | 11/9/2015   | 39.7    | 35.8   | 0      | UG/KG | 4     |      | S      |
| Heptachlor                | 11/9/2015   | 0.715   | 0.715  | 0      | UG/KG | 4     | U    | S      |
| Heptachlor epoxide        | 11/9/2015   | 0.715   | 0.715  | 0      | UG/KG | 4     | U    | S      |
| Hexachlorobenzene         | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| Hexachlorobutadiene       | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| Hexachlorocyclopentadiene | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| Hexachloroethane          | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| Indeno(1,2,3-cd)pyrene    | 11/9/2015   | 411     | 35.8   | 0      | UG/KG | 4     |      | S      |
| Iron                      | 11/9/2015   | 5870000 | 8370   | 0      | UG/KG | 4     |      | S      |
| Isophorone                | 11/9/2015   | 133     | 358    | 0      | UG/KG | 4     | J    | S      |
| Lead                      | 11/9/2015   | 8030    | 104    | 0      | UG/KG | 4     |      | S      |
| Lindane                   | 11/9/2015   | 0.715   | 0.715  | 0      | UG/KG | 4     | U    | S      |
| m,p-Cresol                | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| m-Dichlorobenzene         | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| m-Nitroaniline            | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| Magnesium                 | 11/9/2015   | 1360000 | 8890   | 0      | UG/KG | 4     | N    | S      |
| Manganese                 | 11/9/2015   | 62900   | 209    | 0      | UG/KG | 4     | *    | S      |
| Manganese-54              | 11/9/2015   | 0.0105  | 0.0153 | 0.0111 | PCI/G | 4     | U    | S      |
| Mercury                   | 11/9/2015   | 52.4    | 3.93   | 0      | UG/KG | 4     |      | S      |
| Methoxychlor              | 11/9/2015   | 7.15    | 7.15   | 0      | UG/KG | 4     | U    | S      |
| N-Nitrosodipropylamine    | 11/9/2015   | 358     | 358    | 0      | UG/KG | 4     | U    | S      |
| Naphthalene               | 11/9/2015   | 22.2    | 35.8   | 0      | UG/KG | 4     | J    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name     | Sample Date | Value   | Detlim | Error   | Units | Depth | Qual | Matrix |
|-------------------|-------------|---------|--------|---------|-------|-------|------|--------|
| Nickel            | 11/9/2015   | 3410    | 157    | 0       | UG/KG | 4     |      | S      |
| Nitrobenzene      | 11/9/2015   | 358     | 358    | 0       | UG/KG | 4     | U    | S      |
| o-Cresol          | 11/9/2015   | 358     | 358    | 0       | UG/KG | 4     | U    | S      |
| o-Dichlorobenzene | 11/9/2015   | 358     | 358    | 0       | UG/KG | 4     | U    | S      |
| o-Nitroaniline    | 11/9/2015   | 358     | 358    | 0       | UG/KG | 4     | U    | S      |
| o-Nitrophenol     | 11/9/2015   | 358     | 358    | 0       | UG/KG | 4     | U    | S      |
| p-Chloro-m-cresol | 11/9/2015   | 358     | 358    | 0       | UG/KG | 4     | U    | S      |
| p-Chloroaniline   | 11/9/2015   | 358     | 358    | 0       | UG/KG | 4     | U    | S      |
| p-Dichlorobenzene | 11/9/2015   | 358     | 358    | 0       | UG/KG | 4     | U    | S      |
| p-Nitroaniline    | 11/9/2015   | 358     | 358    | 0       | UG/KG | 4     | U    | S      |
| p-Nitrophenol     | 11/9/2015   | 358     | 358    | 0       | UG/KG | 4     | U    | S      |
| PCP               | 11/9/2015   | 358     | 358    | 0       | UG/KG | 4     | U    | S      |
| Phenanthrene      | 11/9/2015   | 478     | 35.8   | 0       | UG/KG | 4     |      | S      |
| Phenol            | 11/9/2015   | 358     | 358    | 0       | UG/KG | 4     | U    | S      |
| Potassium         | 11/9/2015   | 248000  | 6700   | 0       | UG/KG | 4     |      | S      |
| Pyrene            | 11/9/2015   | 1220    | 35.8   | 0       | UG/KG | 4     |      | S      |
| Selenium          | 11/9/2015   | 345     | 345    | 0       | UG/KG | 4     | U    | S      |
| Silver            | 11/9/2015   | 105     | 105    | 0       | UG/KG | 4     | U    | S      |
| Sodium            | 11/9/2015   | 51700   | 7320   | 0       | UG/KG | 4     |      | S      |
| Sodium-22         | 11/9/2015   | -0.0115 | 0.0157 | 0.00958 | PCI/G | 4     | U    | S      |
| Thallium          | 11/9/2015   | 62.7    | 62.7   | 0       | UG/KG | 4     | U    | S      |
| Total PCB         | 11/9/2015   | 35.8    | 35.8   | 0       | UG/KG | 4     | U    | S      |
| Toxaphene         | 11/9/2015   | 17.9    | 17.9   | 0       | UG/KG | 4     | U    | S      |
| Vanadium          | 11/9/2015   | 10400   | 105    | 0       | UG/KG | 4     |      | S      |
| Zinc              | 11/9/2015   | 15200   | 418    | 0       | UG/KG | 4     |      | S      |
| Zinc-65           | 11/9/2015   | -0.0182 | 0.0343 | 0.0237  | PCI/G | 4     | U    | S      |

**Site ID : NSLSII WestSP-G1**

| Chemical Name             | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|---------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1,1-Trichloroethane     | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane     | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane        | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene      | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane        | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene        | 11/9/2015   | 4.15  | 4.15   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 2-Hexanone                    | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                     | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                       | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane          | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                     | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide              | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride          | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene                 | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane                  | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                    | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane          | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene                  | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide                | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.19  | 5.19   | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene           | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene     | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane        | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate                 | 11/9/2015   | 5.19  | 5.19   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride                | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)                | 11/9/2015   | 6.23  | 6.23   | 0     | UG/KG | 0.63  | U    | S      |

**Site ID : NSLSII WestSP-G2**

| Chemical Name             | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|---------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1,1-Trichloroethane     | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane     | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1-Dichloroethane            | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene          | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane            | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene            | 11/9/2015   | 4.71  | 4.71   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane           | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether     | 11/9/2015   | 11.8  | 11.8   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                    | 11/9/2015   | 11.8  | 11.8   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                     | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                       | 11/9/2015   | 11.8  | 11.8   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                       | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane          | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                     | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide              | 11/9/2015   | 11.8  | 11.8   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride          | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene                 | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane                  | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                    | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene       | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane          | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene                  | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene             | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide                | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 11.8  | 11.8   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 11.8  | 11.8   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.89  | 5.89   | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                       | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene           | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                       | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene     | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene             | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane        | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate                 | 11/9/2015   | 5.89  | 5.89   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride                | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)                | 11/9/2015   | 7.07  | 7.07   | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| Site ID : NSLSII WestSP-G3    |             |       |        |       |       |       |      |        |
| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
| 1,1,1-Trichloroethane         | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane     | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane         | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane            | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene          | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane            | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene            | 11/9/2015   | 4.72  | 4.72   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane           | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether     | 11/9/2015   | 11.8  | 11.8   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                    | 11/9/2015   | 11.8  | 11.8   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                     | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                       | 11/9/2015   | 11.8  | 11.8   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                       | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane          | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                     | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide              | 11/9/2015   | 11.8  | 11.8   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride          | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene                 | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane                  | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                    | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene       | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane          | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene                  | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene             | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide                | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 11.8  | 11.8   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 11.8  | 11.8   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.9   | 5.9    | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                       | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene           | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                       | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene     | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name          | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| Trichloroethylene      | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate          | 11/9/2015   | 5.9   | 5.9    | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride         | 11/9/2015   | 2.36  | 2.36   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)         | 11/9/2015   | 7.07  | 7.07   | 0     | UG/KG | 0.63  | U    | S      |

**Site ID : NSLSII WestSP-G4**

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1,1-Trichloroethane         | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane     | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane         | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane            | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene          | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane            | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene            | 11/9/2015   | 4.46  | 4.46   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane           | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether     | 11/9/2015   | 11.1  | 11.1   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                    | 11/9/2015   | 11.1  | 11.1   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                     | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                       | 11/9/2015   | 11.1  | 11.1   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                       | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane          | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                     | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide              | 11/9/2015   | 11.1  | 11.1   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride          | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene                 | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane                  | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                    | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene       | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane          | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene                  | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene             | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide                | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 11.1  | 11.1   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 11.1  | 11.1   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.57  | 5.57   | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name             | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|---------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| o-Dichlorobenzene         | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene         | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                   | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene       | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                   | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene         | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane    | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate             | 11/9/2015   | 5.57  | 5.57   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride            | 11/9/2015   | 2.23  | 2.23   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)            | 11/9/2015   | 6.69  | 6.69   | 0     | UG/KG | 0.63  | U    | S      |

**Site ID : NSLSII WestSP-G5**

| Chemical Name             | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|---------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1,1-Trichloroethane     | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane     | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane        | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene      | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane        | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene        | 11/9/2015   | 4.19  | 4.19   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane       | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether | 11/9/2015   | 10.5  | 10.5   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                | 11/9/2015   | 10.5  | 10.5   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                 | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                   | 11/9/2015   | 10.5  | 10.5   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                   | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane      | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                 | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide          | 11/9/2015   | 10.5  | 10.5   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride      | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene             | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane              | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene   | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane      | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene              | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene         | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |



Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| Methyl bromide                | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 10.5  | 10.5   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 10.5  | 10.5   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.23  | 5.23   | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                       | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene           | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                       | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene     | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene             | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane        | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate                 | 11/9/2015   | 5.23  | 5.23   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride                | 11/9/2015   | 2.09  | 2.09   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)                | 11/9/2015   | 6.28  | 6.28   | 0     | UG/KG | 0.63  | U    | S      |

**Site ID : NSLSII WestSP-G6**

| Chemical Name             | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|---------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1,1-Trichloroethane     | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane     | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane        | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene      | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane        | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene        | 11/9/2015   | 4.59  | 4.59   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane       | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether | 11/9/2015   | 11.5  | 11.5   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                | 11/9/2015   | 11.5  | 11.5   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                 | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                   | 11/9/2015   | 11.5  | 11.5   | 0     | UG/KG | 0.63  | U    | S      |
| Benzene                   | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane      | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                 | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide          | 11/9/2015   | 11.5  | 11.5   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride      | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene             | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| Chloroethane                  | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                    | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene       | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane          | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene                  | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene             | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide                | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 11.5  | 11.5   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 11.5  | 11.5   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.74  | 5.74   | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                       | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene           | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                       | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene     | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene             | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane        | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate                 | 11/9/2015   | 5.74  | 5.74   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride                | 11/9/2015   | 2.3   | 2.3    | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)                | 11/9/2015   | 6.89  | 6.89   | 0     | UG/KG | 0.63  | U    | S      |

**Site ID : NSLSII WestSP-G7**

| Chemical Name             | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|---------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| 1,1,1-Trichloroethane     | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2,2-Tetrachloroethane | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1,2-Trichloroethane     | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethane        | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,1-Dichloroethylene      | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethane        | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloroethene        | 11/9/2015   | 4.16  | 4.16   | 0     | UG/KG | 0.63  | U    | S      |
| 1,2-Dichloropropane       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Chloroethyl vinyl ether | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| 2-Hexanone                | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| 8260 TVOC                 | 11/9/2015   | 0     | 0      | 0     | UG/KG | 0.63  |      | S      |
| Acetone                   | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |

Table 1  
Analytical Data from NSLS II and ISB Soil Piles Along Princeton Avenue  
November 2015

| Chemical Name                 | Sample Date | Value | Detlim | Error | Units | Depth | Qual | Matrix |
|-------------------------------|-------------|-------|--------|-------|-------|-------|------|--------|
| Benzene                       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Bromodichloromethane          | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Bromoform                     | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon disulfide              | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| Carbon tetrachloride          | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Chlorobenzene                 | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroethane                  | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Chloroform                    | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| cis-1,3-Dichloropropene       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Dibromochloromethane          | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Ethylbenzene                  | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| m-Dichlorobenzene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl bromide                | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl chloride               | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl ethyl ketone           | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl isobutyl ketone (MIBK) | 11/9/2015   | 10.4  | 10.4   | 0     | UG/KG | 0.63  | U    | S      |
| Methyl tert-butyl ether       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Methylene chloride            | 11/9/2015   | 5.2   | 5.2    | 0     | UG/KG | 0.63  | U    | S      |
| o-Dichlorobenzene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| p-Dichlorobenzene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Styrene                       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Tetrachloroethylene           | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Toluene                       | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| trans-1,3-Dichloropropene     | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Trichloroethylene             | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Trichlorofluoromethane        | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl acetate                 | 11/9/2015   | 5.2   | 5.2    | 0     | UG/KG | 0.63  | U    | S      |
| Vinyl chloride                | 11/9/2015   | 2.08  | 2.08   | 0     | UG/KG | 0.63  | U    | S      |
| Xylene (total)                | 11/9/2015   | 6.24  | 6.24   | 0     | UG/KG | 0.63  | U    | S      |

U = Not detected

J = The associated numerical value is an estimated quantity.

B = Indicates that the reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL).

\* = Indicates that the duplicate analysis is not within control limits.

UI = (Uncertain identification for gamma spectroscopy) - Radionuclide peaks that are detected but fail to meet the positive identification criteria.

P =

N = Indicates that the spiked sample recovery is not within control limits.

NYS Part 375 Table 6.8(b) Restricted Use Soil Cleanup Objectives  
for Protection of Public Health (Residential Use)

| <b>Metals</b>                     | <b>Residential Use</b> |
|-----------------------------------|------------------------|
| Arsenic                           | 16 <sub>f</sub>        |
| Barium                            | 350 <sub>f</sub>       |
| Beryllium                         | 14                     |
| Cadmium                           | 2.5 <sub>f</sub>       |
| Chromium, hexavalent <sub>h</sub> | 22                     |
| Chromium, trivalent <sub>h</sub>  | 36                     |
| Copper                            | 270                    |
| Total Cyanide <sub>h</sub>        | 27                     |
| Lead                              | 400                    |
| Manganese                         | 2,000 <sub>f</sub>     |
| Total Mercury                     | 0.81 <sub>j</sub>      |
| Nickel                            | 140                    |
| Selenium                          | 36                     |
| Silver                            | 36                     |
| Zinc                              | 2200                   |

**PCBs/Pesticides**

|                           |                  |
|---------------------------|------------------|
| 2,4,5-TP Acid (Silvex)    | 58               |
| 4,4' -DDE                 | 1.8              |
| 4,4' -DDT                 | 1.7              |
| 4,4' - DDD                | 2.6              |
| Aldrin                    | 0.019            |
| alpha-BHC                 | 0.097            |
| beta-BHC                  | 0.072            |
| Chlordane (alpha)         | 0.91             |
| delta-BHC                 | 100 <sub>a</sub> |
| Dibenzofuran              | 14               |
| Dieldrin                  | 0.039            |
| Endosulfan I              | 4.8 <sub>i</sub> |
| Endosulfan II             | 4.8 <sub>i</sub> |
| Endosulfan sulfate        | 4.8 <sub>i</sub> |
| Endrin                    | 2.2              |
| Heptachlor                | 0.42             |
| Lindane                   | 0.28             |
| Polychlorinated biphenyls | 1                |

**Semivolatiles**

|                      |                  |
|----------------------|------------------|
| Acenaphthene         | 100 <sub>a</sub> |
| Acenaphthylene       | 100 <sub>a</sub> |
| Anthracene           | 100 <sub>a</sub> |
| Benz(a)anthracene    | 1 <sub>f</sub>   |
| Benzo(a)pyrene       | 1 <sub>f</sub>   |
| Benzo(b)fluoranthene | 1 <sub>f</sub>   |
| Benzo(g,h,i)perylene | 100 <sub>a</sub> |

NYS Part 375 Table 6.8(b) Restricted Use Soil Cleanup Objectives  
for Protection of Public Health (Residential Use)

|                        |                   |
|------------------------|-------------------|
| Benzo(k)fluoranthene   | 1                 |
| Chrysene               | 1 <sub>f</sub>    |
| Dibenz(a,h)anthracene  | 0.33 <sub>e</sub> |
| Fluoranthene           | 100 <sub>a</sub>  |
| Fluorene               | 100 <sub>a</sub>  |
| Indeno(1,2,3-cd)pyrene | 0.5 <sub>f</sub>  |
| m-Cresol               | 100 <sub>a</sub>  |
| Naphthalene            | 100 <sub>a</sub>  |
| o-Cresol               | 100 <sub>a</sub>  |
| p-Cresol               | 34                |
| Pentachlorophenol      | 2.4               |
| Phenanthrene           | 100 <sub>a</sub>  |
| Phenol                 | 100 <sub>a</sub>  |
| Pyrene                 | 100 <sub>a</sub>  |

**Volatiles**

|                          |                   |
|--------------------------|-------------------|
| 1,1,1-Trichloroethane    | 100 <sub>a</sub>  |
| 1,1-Dichloroethane       | 19                |
| 1,1-Dichloroethene       | 100 <sub>a</sub>  |
| 1,2-Dichlorobenzene      | 100 <sub>a</sub>  |
| 1,2-Dichloroethane       | 2.3               |
| cis-1,2-Dichloroethene   | 59                |
| trans-1,2-Dichloroethene | 100 <sub>a</sub>  |
| 1,3-Dichlorobenzene      | 17                |
| 1,4-Dichlorobenzene      | 9.8               |
| 1,4-Dioxane              | 9.8               |
| Acetone                  | 100 <sub>a</sub>  |
| Benzene                  | 2.9               |
| Butylbenzene             | 100 <sub>a</sub>  |
| Carbon tetrachloride     | 1.4               |
| Chlorobenzene            | 100 <sub>a</sub>  |
| Chloroform               | 10                |
| Ethylbenzene             | 30                |
| Hexachlorobenzene        | 0.33 <sub>e</sub> |
| Methyl ethyl ketone      | 100 <sub>a</sub>  |
| Methyl tert-butyl ether  | 62                |
| Methylene chloride       | 51                |
| n-Propylbenzene          | 100 <sub>a</sub>  |
| sec-Butylbenzene         | 100 <sub>a</sub>  |
| tert-Butylbenzene        | 100 <sub>a</sub>  |
| Tetrachloroethene        | 5.5               |
| Toluene                  | 100 <sub>a</sub>  |
| Trichloroethene          | 10                |
| 1,2,4-Trimethylbenzene   | 47                |
| 1,3,5- Trimethylbenzene  | 47                |
| Vinyl chloride           | 0.21              |
| Xylene (mixed)           | 100 <sub>a</sub>  |

All soil cleanup objectives (SCOs) are in parts per million (ppm).

NYS Part 375 Table 6.8(b) Restricted Use Soil Cleanup Objectives  
for Protection of Public Health (Residential Use)

**Footnotes**

<sup>a</sup> The SCOs for residential, restricted-residential and ecological resources use were capped at a maximum value of 100 ppm. See TSD section 9.3.

---

<sup>b</sup> The SCOs for commercial use were capped at a maximum value of 500 ppm. See TSD section 9.3.

---

<sup>c</sup> The SCOs for industrial use and the protection of groundwater were capped at a maximum value of 1000 ppm. See TSD section 9.3.

---

<sup>d</sup> The SCOs for metals were capped at a maximum value of 10,000 ppm. See TSD section 9.3.

---

<sup>e</sup> For constituents where the calculated SCO was lower than the contract required quantitation limit (CRQL), the CRQL is used as the SCO value.

---

<sup>f</sup> For constituents where the calculated SCO was lower than the rural soil background concentration as determined by the Department and Department of Health rural soil survey, the rural soil background concentration is used as the Track 2 SCO value for this use of the site.

---

<sup>g</sup> This SCO is derived from data on mixed isomers of BHC.

---

<sup>h</sup> The SCO for this specific compound (or family of compounds) is considered to be met if the analysis for the total species of this contaminant is below the specific SCO.

---

<sup>i</sup> This SCO is for the sum of endosulfan I, endosulfan II, and endosulfan sulfate.

---

<sup>j</sup> This SCO is the lower of the values for mercury (elemental) or mercury (inorganic salts). See TSD Table 5.6-1.

## Appendix F

### Data Verification and Validation Checklists

**Attachment 1**  
**Brookhaven National Laboratory**  
**Analytical Data Package Verification Checklist**

|                         |                                        |                |    |         |
|-------------------------|----------------------------------------|----------------|----|---------|
| Project                 | Bldg 811 Excavation                    |                |    |         |
| Sampling Contractor     | PWC Grosser                            |                |    |         |
| Analytical Laboratory   | General Engineering Labs               |                |    |         |
| Analytical Method       | DOE HASL 300 / EPA 905/906             |                |    |         |
| Sample Delivery Group   | 37801                                  |                |    |         |
| COC No./Sample IDs      | 37801 / 001-040                        |                |    |         |
| Date Sampled            | 5/11/16                                |                |    |         |
| Parameter(s)            | Gamma Scan, Sr-90, Alpha Spec, Tritium |                |    |         |
|                         | Satisfactory                           | Unsatisfactory | NA | Comment |
| Sample IDs              | X                                      |                |    |         |
| Detection Limits (CRDL) | X                                      |                |    |         |
| Duplicates              | X                                      |                |    |         |
| Matrix Spike (MS/MSD)   | X                                      |                |    |         |
| MS/MSD Recoveries       | X                                      |                |    |         |
| Field Blanks            |                                        |                | X  |         |
| Equipment Blanks        |                                        |                | X  |         |
| Method Blanks           | X                                      |                |    |         |
| Chain-of-Custody Forms  | X                                      |                |    |         |
| Field Sampling Logs     | X                                      |                |    |         |
| Holding Times           | X                                      |                |    |         |
| Nonconformance          |                                        |                | X  |         |
| Other                   |                                        |                |    |         |

Reviewed by *C. Schaefer, CHP* Date 7/20/16  
Project Manager



## Attachment 1

### BNL RADIOCHEMICAL VALIDATION REPORT

Project No. N/A Program Waste Management  
Site Brookhaven National Laboratory Project Name 811 Excavation  
Contract Laboratory General Engineering Labs Project Manager A. Lockwood  
Sample Delivery Group (SDG) 37801 Sampling Date (Month/Year) 5/16

#### Type of Analyses/Special Request:

| BNL Sample ID | Lab ID |  | BNL Sample ID | Lab ID |
|---------------|--------|--|---------------|--------|
| 37801         | 398677 |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |

#### Laboratory QC Samples:

Number of Samples Analyzed 26 Total Number of Analyses 124

MS = Matrix Spike

MSD = Matrix Spike Duplicate

Dup = Matrix Duplicate (replicate)

RE = Reanalysis

Data Reviewer C. Acher, CHP Date 8/24/16  
QA Review by C. Acher, CHP Date 8/24/16  
Data Validation Management (if applicable) N/A Date \_\_\_\_\_  
EM Manager Approval N/A Date \_\_\_\_\_

Contractual violations found? Yes \_\_\_\_\_ No X Not Applicable \_\_\_\_\_

Attach, as necessary, the following Sample Delivery Group (SDF) information:

- I. Data Qualifier and Sub Qualifier Definitions
- II. Laboratory Case Narratives, Telephone Logs and Correspondence
- III. Qualified Sample Results (Form 1's)
- IV. Laboratory Matrix QC Summary Forms (Forms 5A and 6)
- V. Standardized Data Validation Comments

**Deliverable:**

**Analyte:**

Case Narrative  
 Chain-of-Custody Records/Traffic Reports/Tracking Records  
 BNL Sample Identifiers and Unique Laboratory ID  
 Initial Calibration / Efficiency Determination  
 Daily Efficiency Check /Continuing Calibration Verification Results  
 Minimum Detectable Concentration Results and a Hand Calculation  
 Daily Background Results  
 Method Blank Results  
 Matrix Spike/Matrix Spike Duplicates Results  
 Gravimetric Standard / Chemical Tracer Results  
 Duplicate/Replicate Results  
 Laboratory Control Sample (LCS) Results  
 LCS Control Charts  
 EMSL and EML QAP Sample Results  
 Self Absorption Factors (Sr 90, alpha spec., gross alpha and gross beta)  
 Percent Completeness Report  
 Turn Around Time Documents (COC and Case Narrative)  
 Run Log  
 Sample Raw Data  
 Preparation Log Benchsheets  
 Percent Solids Calculations / Benchsheets  
 Legible Pages  
 Pages in Package Numbered and in Sequence

| GS  | Sr-90 | Pu/a | H3  |
|-----|-------|------|-----|
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| N/A | N/A   | N/A  | N/A |
| X   | X     | X    | X   |
| 0   | 0     | 0    | 0   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |
| X   | X     | X    | X   |

a/b = gross alpha/gross beta

GS = gamma scan

H3 = Tritium

Np-237 = neptunium-237

NR = Not Required

0 = Not included and/or Not Complete

Pu-240 = plutonium-240, Pu-242 = plutonium-242

Ra-228 = radium-228

RS = Provided as a Resubmission

Th-230 = thorium-230

U-233 = uranium-233, U-234 = uranium-234, U-235 = uranium-235, U-236 = uranium-236, U-238 = uranium-238

Tc-99 = technetium-99

Sr-89 = Strontium-89, Sr-89/90 = Strontium-89/90, Sr-90 = Strontium-90

X = Included in original data package

**Questions:**

1. Deliverables

All data deliverables, as expected, were found in the package and sent through resubmissions.

Yes ☒ No ☐ Comments:

- a. The following are expected deliverables that were not found in the data package:
- b. The following deliverables were found to have problems or contain errors, as provided in the data package:
- c. The following are expected deliverables that were initially not in the data package, but were provided as a resubmission:
- d. The following deliverables were initially found to have problems or contain errors; corrected information was provided in the laboratory resubmission:

2. Holding Times/Preservations

- a. Samples were prepared and analyzed within holding times specified by the project guidelines. The holding time is based on the date of sample collection to the date of analysis, with modifications for preservatives as necessary.

Yes ☒ No ☐ Comments:

3. Tentatively Identified Radionuclides

- a. All tentatively identified radionuclides have been identified and assigned a data qualifier.

Yes ☒ No ☐ Comments:

- b. Sample identification met all spectral line energy and percent of major peaks accounted for requirements.

Yes ☒ No ☐ Comments:

4. Contract Required Detection Limits

- a. The MDCs for all results that are at or near background levels were less than or equal to the contract required detection limits (CRDL).

Yes ☒ No ☐ Comments:

5. Background and Laboratory Quality Control Samples

- a. The required summary forms/information were provided and information was present to **determine** that initial calibration and geometry met guidelines (correlation, number of calibration standards, distribution range of standards, peak shape, spectral lines for gamma, etc.) or method criteria.

Yes X No \_\_\_\_\_ Comments:

- b. The continuing calibration standard (CCV) efficiency analyses were reported as required and had recoveries reported to be within the specified control limits.

Yes X No \_\_\_\_\_ Comments:

6. Contamination and Background Stability Quality Control

- a. Preparation/method blank was prepared and analyzed at the specified frequency. Background determinations were performed.

Yes X No \_\_\_\_\_ Comments:

- b. All analytes in the blank and background were below the minimum detectable concentration (i.e., detection limit).

Yes X No \_\_\_\_\_ Comments:

- c. The package contained other types of blanks submitted to the laboratory with the field samples.

Yes \_\_\_\_\_ No X Comments: *No Field Blanks submitted.*

7. Gravimetric Standard / Chemical Tracer

- a. Gravimetric standards / chemical tracers were analyzed at the specified frequency and had **measured** recoveries within the required control limits.

Yes X No \_\_\_\_\_ Comments:

8. Accuracy Statements

- a. Spike/laboratory control samples (LCS) analyses were performed with each sample batch and for each matrix in the data package.

Yes X No \_\_\_\_\_ Comments:

b. Laboratory control charts were provided in the package.

Yes ☒

No ☐

Comments:

c. Spike/laboratory control sample (LCS) analyses were reported to be within control limits (75-125%).

Yes ☒

No ☐

Comments:

d. EMSL and EML QAP sample analyses were present in the data package.

Yes ☐

No ☒

Comments:

*Not Required*

e. EMSL and EML QAP sample analyses were reported to be within specified control limits.

Yes ☐

No ☒

Comments:

*Not Required*

f. The matrix (pre-digest) spike frequency requirement was met.

Yes ☒

No ☐

Comments:

g. Matrix spike recoveries were within the specified control limits (75 - 125%).

Yes ☒

No ☐

Comments:

9. Precision Statement

a. The matrix (pre-digest) duplicate frequency was met.

Yes ☒

No ☐

Comments:

b. Matrix (pre-digest) duplicate differences were within specified control limits (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes ☒

No ☐

Comments:

c. This package contained a field duplicate.

Yes ☐

No ☒

Comments:

- d. All field duplicate results met criteria (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes X No \_\_\_\_\_ Comments:

10. Self-Absorption Factors

- a. Self-absorption factors were generated for alpha and beta determinations. Solids content in samples did not exceed 100 mg total.

Yes X No \_\_\_\_\_ Comments:

11. Analytical Methods

- a. The analytical methods used were as specified on the chain-of-custody, the BNL QAPP.

Yes X No \_\_\_\_\_ Comments:

12. Turnaround Time

- a. The turnaround time specified on the chain-of-custody record of 30 days was met.

Yes X No \_\_\_\_\_ Comments:

13. Completeness

- a. The percent of data completeness for all radionuclides and methods were greater than 90%.

Yes X No \_\_\_\_\_ Comments:

14. Calculations and Transcription

- a. Correct contract/method calculations (i.e. curve generation, sample quantitation, etc.) were performed.

Yes X No \_\_\_\_\_ Comments:

Verified <sup>137</sup>Cs result for  
Sample 37801-018. OKAY

- b. Raw data was transcribed accurately to sample and QC summary sheets.

Yes X No \_\_\_\_\_ Comments:

15. System Performance

- a. The instrumental and analytical systems used in the analysis of these samples maintained an acceptable level of performance throughout this case.

Yes X No \_\_\_\_\_ Comments:

16. Contract Requirements

- a. All contract requirements were met by the laboratory in the preparation and analysis of the samples in the package.

Yes X No \_\_\_\_\_ Comments:

17. Additional Comments

Gamma Spec Queue sheet (pg 632 of 1166) incorrectly identifies Sample 37801-016 as Sample 37801-014, but the Certificate of Analysis for Sample 37801-016 is correct.

All supporting QC data is satisfactory.

*C. Harper, CHP*  
8/24/16



**Attachment 1**  
**Brookhaven National Laboratory**  
**Analytical Data Package Verification Checklist**

|                         |                          |                |    |         |
|-------------------------|--------------------------|----------------|----|---------|
| Project                 | Bldg 811 Excavation      |                |    |         |
| Sampling Contractor     | PWS Grosser              |                |    |         |
| Analytical Laboratory   | General Engineering Labs |                |    |         |
| Analytical Method       | DOE HASL 300 / EPA 905   |                |    |         |
| Sample Delivery Group   | 37802                    |                |    |         |
| COC No./Sample IDs      | 37802 / 001-003          |                |    |         |
| Date Sampled            | 5/20/16                  |                |    |         |
| Parameter(s)            | Gamma Scans, Sr-90       |                |    |         |
|                         | Satisfactory             | Unsatisfactory | NA | Comment |
| Sample IDs              | X                        |                |    |         |
| Detection Limits (CRDL) | X                        |                |    |         |
| Duplicates              | X                        |                |    |         |
| Matrix Spike (MS/MSD)   | X                        |                |    |         |
| MS/MSD Recoveries       | X                        |                |    |         |
| Field Blanks            |                          |                | X  |         |
| Equipment Blanks        |                          |                | X  |         |
| Method Blanks           | X                        |                |    |         |
| Chain-of-Custody Forms  | X                        |                |    |         |
| Field Sampling Logs     | X                        |                |    |         |
| Holding Times           | X                        |                |    |         |
| Nonconformance          |                          |                | X  |         |
| Other                   |                          |                |    |         |

Reviewed by C. Schaefer, OHP Date 7/21/16  
Project Manager



# Attachment 1

## BNL RADIOCHEMICAL VALIDATION REPORT

Project No. N/A Program Waste Management  
 Site Brookhaven National Lab Project Name 811 Excavation  
 Contract Laboratory General Engineering Labs Project Manager A. Lockwood  
 Sample Delivery Group (SDG) 37802 Sampling Date (Month/Year) 5/16

### Type of Analyses/Special Request:

| BNL Sample ID | Lab ID |  | BNL Sample ID | Lab ID |
|---------------|--------|--|---------------|--------|
| 37802         | 398732 |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |

### Laboratory QC Samples:

Number of Samples Analyzed 3 Total Number of Analyses 14

MS = Matrix Spike

MSD = Matrix Spike Duplicate

Dup = Matrix Duplicate (replicate)

RE = Reanalysis

Data Reviewer C. Achefer, CHP Date 7/21/16  
 QA Review by C. Achefer, CHP Date 7/21/16  
 Data Validation Management (if applicable) N/A Date \_\_\_\_\_  
 EM Manager Approval N/A Date \_\_\_\_\_

Contractual violations found? Yes \_\_\_\_\_ No X Not Applicable \_\_\_\_\_

Attach, as necessary, the following Sample Delivery Group (SDF) information:

- I. Data Qualifier and Sub Qualifier Definitions
- II. Laboratory Case Narratives, Telephone Logs and Correspondence
- III. Qualified Sample Results (Form 1's)
- IV. Laboratory Matrix QC Summary Forms (Forms 5A and 6)
- V. Standardized Data Validation Comments

**Deliverable:****Analyte:**

|                                                                          | GS  | Sr-90 |  |  |
|--------------------------------------------------------------------------|-----|-------|--|--|
| Case Narrative                                                           | X   | X     |  |  |
| Chain-of-Custody Records/Traffic Reports/Tracking Records                | X   | X     |  |  |
| BNL Sample Identifiers and Unique Laboratory ID                          | X   | X     |  |  |
| Initial Calibration / Efficiency Determination                           | X   | X     |  |  |
| Daily Efficiency Check /Continuing Calibration Verification Results      | X   | X     |  |  |
| Minimum Detectable Concentration Results and a Hand Calculation          | X   | X     |  |  |
| Daily Background Results                                                 | X   | X     |  |  |
| Method Blank Results                                                     | X   | X     |  |  |
| Matrix Spike/Matrix Spike Duplicates Results                             | X   | X     |  |  |
| Gravimetric Standard / Chemical Tracer Results                           | X   | X     |  |  |
| Duplicate/Replicate Results                                              | X   | X     |  |  |
| Laboratory Control Sample (LCS) Results                                  | X   | X     |  |  |
| LCS Control Charts                                                       | X   | X     |  |  |
| EMSL and EML QAP Sample Results                                          | N/A | N/A   |  |  |
| Self Absorption Factors (Sr 90, alpha spec., gross alpha and gross beta) | X   | X     |  |  |
| Percent Completeness Report                                              | 0   | 0     |  |  |
| Turn Around Time Documents (COC and Case Narrative)                      | X   | X     |  |  |
| Run Log                                                                  | X   | X     |  |  |
| Sample Raw Data                                                          | X   | X     |  |  |
| Preparation Log Benchsheets                                              | X   | X     |  |  |
| Percent Solids Calculations / Benchsheets                                | X   | X     |  |  |
| Legible Pages                                                            | X   | X     |  |  |
| Pages in Package Numbered and in Sequence                                | X   | X     |  |  |

a/b = gross alpha/gross beta

GS = gamma scan

H3 = Tritium

Np-237 = neptunium-237

NR = Not Required

0 = Not included and/or Not Complete

Pu-240 = plutonium-240, Pu-242 = plutonium-242

Ra-228 = radium-228

RS = Provided as a Resubmission

Th-230 = thorium-230

U-233 = uranium-233, U-234 = uranium-234, U-235 = uranium-235, U-236 = uranium-236, U-238 = uranium-238

Tc-99 = technetium-99

Sr-89 = Strontium-89, Sr-89/90 = Strontium-89/90, Sr-90 = Strontium-90

X = Included in original data package

### Questions:

#### 1. Deliverables

All data deliverables, as expected, were found in the package and sent through resubmissions.

Yes X No \_\_\_\_\_ Comments:

- a. The following are expected deliverables that were not found in the data package:
- b. The following deliverables were found to have problems or contain errors, as provided in the data package:
- c. The following are expected deliverables that were initially not in the data package, but were provided as a resubmission:
- d. The following deliverables were initially found to have problems or contain errors; corrected information was provided in the laboratory resubmission:

#### 2. Holding Times/Preservations

- a. Samples were prepared and analyzed within holding times specified by the project guidelines. The holding time is based on the date of sample collection to the date of analysis, with modifications for preservatives as necessary.

Yes X No \_\_\_\_\_ Comments:

#### 3. Tentatively Identified Radionuclides

- a. All tentatively identified radionuclides have been identified and assigned a data qualifier.

Yes X No \_\_\_\_\_ Comments:

- b. Sample identification met all spectral line energy and percent of major peaks accounted for requirements.

Yes X No \_\_\_\_\_ Comments:

#### 4. Contract Required Detection Limits

- a. The MDCs for all results that are at or near background levels were less than or equal to the contract required detection limits (CRDL).

Yes X No \_\_\_\_\_ Comments:

5. Background and Laboratory Quality Control Samples

- a. The required summary forms/information were provided and information was present to determine that initial calibration and geometry met guidelines (correlation, number of calibration standards, distribution range of standards, peak shape, spectral lines for gamma, etc.) or method criteria.

Yes X No \_\_\_\_\_ Comments:

- b. The continuing calibration standard (CCV) efficiency analyses were reported as required and had recoveries reported to be within the specified control limits.

Yes X No \_\_\_\_\_ Comments:

6. Contamination and Background Stability Quality Control

- a. Preparation/method blank was prepared and analyzed at the specified frequency. Background determinations were performed.

Yes X No \_\_\_\_\_ Comments:

- b. All analytes in the blank and background were below the minimum detectable concentration (i.e., detection limit).

Yes X No \_\_\_\_\_ Comments:

- c. The package contained other types of blanks submitted to the laboratory with the field samples.

Yes \_\_\_\_\_ No X Comments:

7. Gravimetric Standard / Chemical Tracer

- a. Gravimetric standards / chemical tracers were analyzed at the specified frequency and had measured recoveries within the required control limits.

Yes X No \_\_\_\_\_ Comments:

8. Accuracy Statements

- a. Spike/laboratory control samples (LCS) analyses were performed with each sample batch and for each matrix in the data package.

Yes X No \_\_\_\_\_ Comments:

b. Laboratory control charts were provided in the package.

Yes ☒ No ☐ Comments:

c. Spike/laboratory control sample (LCS) analyses were reported to be within control limits (75-125%).

Yes ☒ No ☐ Comments:

d. EMSL and EML QAP sample analyses were present in the data package.

Yes ☐ No ☒ Comments: *Not Applicable*

e. EMSL and EML QAP sample analyses were reported to be within specified control limits.

Yes ☐ No ☒ Comments: *Not Required*

f. The matrix (pre-digest) spike frequency requirement was met.

Yes ☒ No ☐ Comments:

g. Matrix spike recoveries were within the specified control limits (75 - 125%).

Yes ☒ No ☐ Comments:

9. Precision Statement

a. The matrix (pre-digest) duplicate frequency was met.

Yes ☒ No ☐ Comments:

b. Matrix (pre-digest) duplicate differences were within specified control limits (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes ☒ No ☐ Comments:

c. This package contained a field duplicate.

Yes ☐ No ☒ Comments:

- d. All field duplicate results met criteria (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes X No \_\_\_\_\_ Comments:

10. Self-Absorption Factors

- a. Self-absorption factors were generated for alpha and beta determinations. Solids content in samples did not exceed 100 mg total.

Yes X No \_\_\_\_\_ Comments:

11. Analytical Methods

- a. The analytical methods used were as specified on the chain-of-custody, the BNL QAPP.

Yes X No \_\_\_\_\_ Comments:

12. Turnaround Time

- a. The turnaround time specified on the chain-of-custody record of 30 days was met.

Yes X No \_\_\_\_\_ Comments:

13. Completeness

- a. The percent of data completeness for all radionuclides and methods were greater than 90%.

Yes X No \_\_\_\_\_ Comments:

14. Calculations and Transcription

- a. Correct contract/method calculations (i.e. curve generation, sample quantitation, etc.) were performed.

Yes X No \_\_\_\_\_ Comments:

- b. Raw data was transcribed accurately to sample and QC summary sheets.

Yes X No \_\_\_\_\_ Comments:

15. System Performance

- a. The instrumental and analytical systems used in the analysis of these samples maintained an acceptable level of performance throughout this case.

Yes X

No \_\_\_\_\_

Comments:

Minor instrument Control  
Chart issues noted.

16. Contract Requirements

- a. All contract requirements were met by the laboratory in the preparation and analysis of the samples in the package.

Yes X

No \_\_\_\_\_

Comments:

17. Additional Comments

None.

Chase, CHP  
7/21/16

**Attachment 1**  
**Brookhaven National Laboratory**  
**Analytical Data Package Verification Checklist**

|                         |                                  |                |    |         |
|-------------------------|----------------------------------|----------------|----|---------|
| Project                 | Bldg 811 Excavation              |                |    |         |
| Sampling Contractor     | PWO Grosser                      |                |    |         |
| Analytical Laboratory   | General Engineering Laboratories |                |    |         |
| Analytical Method       | DOE HASL 300                     |                |    |         |
| Sample Delivery Group   | 398656                           |                |    |         |
| COC No./Sample IDs      | 37695 - 001/026                  |                |    |         |
| Date Sampled            | 5/17/16                          |                |    |         |
| Parameter(s)            | Gamma Spectroscopy, Sr-90        |                |    |         |
|                         | Satisfactory                     | Unsatisfactory | NA | Comment |
| Sample IDs              | X                                |                |    |         |
| Detection Limits (CRDL) | X                                |                |    |         |
| Duplicates              | X                                |                |    |         |
| Matrix Spike (MS/MSD)   | X                                |                |    |         |
| MS/MSD Recoveries       | X                                |                |    |         |
| Field Blanks            | X                                |                |    |         |
| Equipment Blanks        |                                  |                | X  |         |
| Method Blanks           | X                                |                |    |         |
| Chain-of-Custody Forms  | X                                |                |    |         |
| Field Sampling Logs     | X                                |                |    |         |
| Holding Times           | X                                |                |    |         |
| Nonconformance          | X                                |                |    |         |
| Other                   |                                  |                |    |         |

Reviewed by CAhugh, CHP  
Project Manager

Date 7/19/16



## Attachment 1

### BNL RADIOCHEMICAL VALIDATION REPORT

Project No. N/A Program Waste Management  
 Site Brookhaven National Lab Project Name 811 Excavation  
 Contract Laboratory General Engineering Labs Project Manager A. Lockwood  
 Sample Delivery Group (SDG) 398656 Sampling Date (Month/Year) 5/16  
 Type of Analyses/Special Request: GS, Sr-90

| BNL Sample ID | Lab ID |  | BNL Sample ID | Lab ID |
|---------------|--------|--|---------------|--------|
| 37695         | 398656 |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |
|               |        |  |               |        |

#### Laboratory QC Samples:

Number of Samples Analyzed 26 Total Number of Analyses 50

MS = Matrix Spike  
 MSD = Matrix Spike Duplicate  
 Dup = Matrix Duplicate (replicate)  
 RE = Reanalysis

Data Reviewer C. A. Haefer, CHP Date 7/19/16  
 QA Review by C. A. Haefer, CHP Date 7/19/16  
 Data Validation Management (if applicable) N/A Date \_\_\_\_\_  
 EM Manager Approval N/A Date \_\_\_\_\_

Contractual violations found? Yes \_\_\_\_\_ No \_\_\_\_\_ Not Applicable \_\_\_\_\_

Attach, as necessary, the following Sample Delivery Group (SDF) information:

- I. Data Qualifier and Sub Qualifier Definitions
- II. Laboratory Case Narratives, Telephone Logs and Correspondence
- III. Qualified Sample Results (Form 1's)
- IV. Laboratory Matrix QC Summary Forms (Forms 5A and 6)
- V. Standardized Data Validation Comments

**Deliverable:****Analyte:**

| GS  | Sr-90 |  |  |
|-----|-------|--|--|
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| N/A | N/A   |  |  |
| X   | X     |  |  |
| 0   | 0     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |
| X   | X     |  |  |

a/b = gross alpha/gross beta

GS = gamma scan

H3 = Tritium

Np-237 = neptunium-237

NR = Not Required

0 = Not included and/or Not Complete

Pu-240 = plutonium-240, Pu-242 = plutonium-242

Ra-228 = radium-228

RS = Provided as a Resubmission

Th-230 = thorium-230

U-233 = uranium-233, U-234 = uranium-234, U-235 = uranium-235, U-236 = uranium-236, U-238 = uranium-238

Tc-99 = technetium-99

Sr-89 = Strontium-89, Sr-89/90 = Strontium-89/90, Sr-90 = Strontium-90

X = Included in original data package

**Questions:**

1. Deliverables

All data deliverables, as expected, were found in the package and sent through resubmissions.

Yes ☒ No ☐ Comments:

- a. The following are expected deliverables that were not found in the data package:
- b. The following deliverables were found to have problems or contain errors, as provided in the data package:
- c. The following are expected deliverables that were initially not in the data package, but were provided as a resubmission:
- d. The following deliverables were initially found to have problems or contain errors; corrected information was provided in the laboratory resubmission:

2. Holding Times/Preservations

- a. Samples were prepared and analyzed within holding times specified by the project guidelines. The holding time is based on the date of sample collection to the date of analysis, with modifications for preservatives as necessary.

Yes ☒ No ☐ Comments:

3. Tentatively Identified Radionuclides

- a. All tentatively identified radionuclides have been identified and assigned a data qualifier.

Yes ☒ No ☐ Comments:

- b. Sample identification met all spectral line energy and percent of major peaks accounted for requirements.

Yes ☒ No ☐ Comments:

4. Contract Required Detection Limits

- a. The MDCs for all results that are at or near background levels were less than or equal to the contract required detection limits (CRDL).

Yes ☒ No ☐ Comments:

5. Background and Laboratory Quality Control Samples

- a. The required summary forms/information were provided and information was present to determine that initial calibration and geometry met guidelines (correlation, number of calibration standards, distribution range of standards, peak shape, spectral lines for gamma, etc.) or method criteria.

Yes X No \_\_\_\_\_ Comments:

- b. The continuing calibration standard (CCV) efficiency analyses were reported as required and had recoveries reported to be within the specified control limits.

Yes X No \_\_\_\_\_ Comments:

6. Contamination and Background Stability Quality Control

- a. Preparation/method blank was prepared and analyzed at the specified frequency. Background determinations were performed.

Yes X No \_\_\_\_\_ Comments:

- b. All analytes in the blank and background were below the minimum detectable concentration (i.e., detection limit).

Yes X No \_\_\_\_\_ Comments:

- c. The package contained other types of blanks submitted to the laboratory with the field samples.

Yes X No \_\_\_\_\_ Comments:

7. Gravimetric Standard / Chemical Tracer

- a. Gravimetric standards / chemical tracers were analyzed at the specified frequency and had measured recoveries within the required control limits.

Yes X No \_\_\_\_\_ Comments:

8. Accuracy Statements

- a. Spike/laboratory control samples (LCS) analyses were performed with each sample batch and for each matrix in the data package.

Yes X No \_\_\_\_\_ Comments:

- b. Laboratory control charts were provided in the package.

Yes ☒ No ☐ Comments:

- c. Spike/laboratory control sample (LCS) analyses were reported to be within control limits (75-125%).

Yes ☒ No ☐ Comments:

- d. EMSL and EML QAP sample analyses were present in the data package.

Yes ☐ No ☒ Comments: *Not Applicable*

- e. EMSL and EML QAP sample analyses were reported to be within specified control limits.

Yes ☐ No ☒ Comments: *Not Required*

- f. The matrix (pre-digest) spike frequency requirement was met.

Yes ☒ No ☐ Comments:

- g. Matrix spike recoveries were within the specified control limits (75 - 125%).

Yes ☒ No ☐ Comments:

9. Precision Statement

- a. The matrix (pre-digest) duplicate frequency was met.

Yes ☒ No ☐ Comments:

- b. Matrix (pre-digest) duplicate differences were within specified control limits (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes ☒ No ☐ Comments:

- c. This package contained a field duplicate.

Yes ☒ No ☐ Comments:

- d. All field duplicate results met criteria (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes X No \_\_\_\_\_ Comments:

10. Self-Absorption Factors

- a. Self-absorption factors were generated for alpha and beta determinations. Solids content in samples did not exceed 100 mg total.

Yes X No \_\_\_\_\_ Comments:

11. Analytical Methods

- a. The analytical methods used were as specified on the chain-of-custody, the BNL QAPP.

Yes X No \_\_\_\_\_ Comments:

12. Turnaround Time

- a. The turnaround time specified on the chain-of-custody record of 30 days was met.

Yes X No \_\_\_\_\_ Comments:

13. Completeness

- a. The percent of data completeness for all radionuclides and methods were greater than 90%.

Yes X No \_\_\_\_\_ Comments:

14. Calculations and Transcription

- a. Correct contract/method calculations (i.e. curve generation, sample quantitation, etc.) were performed.

Yes X No \_\_\_\_\_ Comments:

- b. Raw data was transcribed accurately to sample and QC summary sheets.

Yes X No \_\_\_\_\_ Comments:

15. System Performance

- a. The instrumental and analytical systems used in the analysis of these samples maintained an acceptable level of performance throughout this case.

Yes X

No \_\_\_\_\_

Comments:

Gamma Detector #20 was beyond its annual calibration by a few weeks but QC data was in specification.

16. Contract Requirements

- a. All contract requirements were met by the laboratory in the preparation and analysis of the samples in the package.

Yes X

No \_\_\_\_\_

Comments:

17. Additional Comments

The <sup>241</sup>Am LCS QC Plot shows a positive bias of ~10%, but the <sup>137</sup>Cs LCS QC Plot shows no bias.

Four samples were re-counted for Sr-90 (not re-prepared) due to results more negative than 3σ or suspected false positives. The re-counts were reported.

<sup>137</sup>Cs was rejected due to high peak width in Sample #16. If not rejected, the activity would be typical of soil background concentrations.

C. Schaefer, CHP  
7/19/16



**Attachment 1**  
**Brookhaven National Laboratory**  
**Analytical Data Package Verification Checklist**

|                         |                                  |                |    |         |
|-------------------------|----------------------------------|----------------|----|---------|
| Project                 | Bldg 811 Excavation              |                |    |         |
| Sampling Contractor     | PW Grasser                       |                |    |         |
| Analytical Laboratory   | General Engineering Laboratories |                |    |         |
| Analytical Method       | DOE HASL 300                     |                |    |         |
| Sample Delivery Group   | 387060                           |                |    |         |
| COC No./Sample IDs      | 37205 / 001-007                  |                |    |         |
| Date Sampled            | 12/1/15                          |                |    |         |
| Parameter(s)            | Gamma Spectroscopy, Sr-90        |                |    |         |
|                         | Satisfactory                     | Unsatisfactory | NA | Comment |
| Sample IDs              | X                                |                |    |         |
| Detection Limits (CRDL) | X                                |                |    |         |
| Duplicates              | X                                |                |    |         |
| Matrix Spike (MS/MSD)   | X                                |                |    |         |
| MS/MSD Recoveries       | X                                |                |    |         |
| Field Blanks            |                                  |                | X  |         |
| Equipment Blanks        |                                  |                | X  |         |
| Method Blanks           | X                                |                |    |         |
| Chain-of-Custody Forms  | X                                |                |    |         |
| Field Sampling Logs     | X                                |                |    |         |
| Holding Times           | X                                |                |    |         |
| Nonconformance          |                                  |                | X  |         |
| Other                   |                                  |                |    |         |

Reviewed by C. Schaefer, CHP Date 7/15/16  
Project Manager



## Attachment 1

### BNL RADIOCHEMICAL VALIDATION REPORT

Project No. N/A Program Waste Management  
 Site Brookhaven National Lab Project Name 811 Excavation  
 Contract Laboratory General Engineering Labs Project Manager A. Lockwood  
 Sample Delivery Group (SDG) 387060 Sampling Date (Month/Year) 12/15

**Type of Analyses/Special Request:**

| BNL Sample ID | Lab ID    |  | BNL Sample ID | Lab ID |
|---------------|-----------|--|---------------|--------|
| 37205-01      | 387060-01 |  |               |        |
| -02           | -02       |  |               |        |
| -03           | -03       |  |               |        |
| -04           | -04       |  |               |        |
| -05           | -05       |  |               |        |
| -06           | -06       |  |               |        |
| -07           | -07       |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |

**Laboratory QC Samples:**

Number of Samples Analyzed 8 Total Number of Analyses 8

MS = Matrix Spike

MSD = Matrix Spike Duplicate

Dup = Matrix Duplicate (replicate)

RE = Reanalysis

Data Reviewer C. Achefer, CHP Date 7/15/16  
 QA Review by C. Achefer, CHP Date 7/15/16  
 Data Validation Management (if applicable) N/A Date \_\_\_\_\_  
 EM Manager Approval N/A Date \_\_\_\_\_

Contractual violations found? Yes \_\_\_\_\_ No X Not Applicable \_\_\_\_\_

Attach, as necessary, the following Sample Delivery Group (SDF) information:

- I. Data Qualifier and Sub Qualifier Definitions
- II. Laboratory Case Narratives, Telephone Logs and Correspondence
- III. Qualified Sample Results (Form 1's)
- IV. Laboratory Matrix QC Summary Forms (Forms 5A and 6)
- V. Standardized Data Validation Comments

**Deliverable:****Analyte:**

|                                                                          | X-Spec | Sr-90 |  |  |
|--------------------------------------------------------------------------|--------|-------|--|--|
| Case Narrative                                                           | X      | X     |  |  |
| Chain-of-Custody Records/Traffic Reports/Tracking Records                | X      | X     |  |  |
| BNL Sample Identifiers and Unique Laboratory ID                          | X      | X     |  |  |
| Initial Calibration / Efficiency Determination                           | X      | X     |  |  |
| Daily Efficiency Check /Continuing Calibration Verification Results      | X      | X     |  |  |
| Minimum Detectable Concentration Results and a Hand Calculation          | X      | X     |  |  |
| Daily Background Results                                                 | X      | X     |  |  |
| Method Blank Results                                                     | X      | X     |  |  |
| Matrix Spike/Matrix Spike Duplicates Results                             | X      | X     |  |  |
| Gravimetric Standard / Chemical Tracer Results                           | X      | X     |  |  |
| Duplicate/Replicate Results                                              | X      | X     |  |  |
| Laboratory Control Sample (LCS) Results                                  | X      | X     |  |  |
| LCS Control Charts                                                       | X      | X     |  |  |
| EMSL and EML QAP Sample Results                                          | N/A    | N/A   |  |  |
| Self Absorption Factors (Sr 90, alpha spec., gross alpha and gross beta) | X      | X     |  |  |
| Percent Completeness Report                                              | 0      | 0     |  |  |
| Turn Around Time Documents (COC and Case Narrative)                      | X      | X     |  |  |
| Run Log                                                                  | X      | X     |  |  |
| Sample Raw Data                                                          | X      | X     |  |  |
| Preparation Log Benchsheets                                              | X      | X     |  |  |
| Percent Solids Calculations / Benchsheets                                | X      | X     |  |  |
| Legible Pages                                                            | X      | X     |  |  |
| Pages in Package Numbered and in Sequence                                | X      | X     |  |  |

a/b = gross alpha/gross beta

GS = gamma scan

H3 = Tritium

Np-237 = neptunium-237

NR = Not Required

0 = Not included and/or Not Complete

Pu-240 = plutonium-240, Pu-242 = plutonium-242

Ra-228 = radium-228

RS = Provided as a Resubmission

Th-230 = thorium-230

U-233 = uranium-233, U-234 = uranium-234, U-235 = uranium-235, U-236 = uranium-236, U-238 = uranium-238

Tc-99 = technetium-99

Sr-89 = Strontium-89, Sr-89/90 = Strontium-89/90, Sr-90 = Strontium-90

X = Included in original data package

**Questions:**

1. Deliverables

All data deliverables, as expected, were found in the package and sent through resubmissions.

Yes X No \_\_\_\_\_ Comments:

- a. The following are expected deliverables that were not found in the data package:
- b. The following deliverables were found to have problems or contain errors, as provided in the data package:
- c. The following are expected deliverables that were initially not in the data package, but were provided as a resubmission:
- d. The following deliverables were initially found to have problems or contain errors; corrected information was provided in the laboratory resubmission:

2. Holding Times/Preservations

- a. Samples were prepared and analyzed within holding times specified by the project guidelines. The holding time is based on the date of sample collection to the date of analysis, with modifications for preservatives as necessary.

Yes X No \_\_\_\_\_ Comments:

3. Tentatively Identified Radionuclides

- a. All tentatively identified radionuclides have been identified and assigned a data qualifier.

Yes X No \_\_\_\_\_ Comments:

- b. Sample identification met all spectral line energy and percent of major peaks accounted for requirements.

Yes X No \_\_\_\_\_ Comments:

4. Contract Required Detection Limits

- a. The MDCs for all results that are at or near background levels were less than or equal to the contract required detection limits (CRDL).

Yes X No \_\_\_\_\_ Comments:

5. Background and Laboratory Quality Control Samples

- a. The required summary forms/information were provided and information was present to determine that initial calibration and geometry met guidelines (correlation, number of calibration standards, distribution range of standards, peak shape, spectral lines for gamma, etc.) or method criteria.

Yes X No \_\_\_\_\_ Comments:

- b. The continuing calibration standard (CCV) efficiency analyses were reported as required and had recoveries reported to be within the specified control limits.

Yes X No \_\_\_\_\_ Comments:

6. Contamination and Background Stability Quality Control

- a. Preparation/method blank was prepared and analyzed at the specified frequency. Background determinations were performed.

Yes X No \_\_\_\_\_ Comments:

- b. All analytes in the blank and background were below the minimum detectable concentration (i.e., detection limit).

Yes X No \_\_\_\_\_ Comments:

- c. The package contained other types of blanks submitted to the laboratory with the field samples.

Yes \_\_\_\_\_ No X Comments: *No Field Blanks Submitted*

7. Gravimetric Standard / Chemical Tracer

- a. Gravimetric standards / chemical tracers were analyzed at the specified frequency and had measured recoveries within the required control limits.

Yes X No \_\_\_\_\_ Comments:

8. Accuracy Statements

- a. Spike/laboratory control samples (LCS) analyses were performed with each sample batch and for each matrix in the data package.

Yes X No \_\_\_\_\_ Comments:

b. Laboratory control charts were provided in the package.

Yes ☒ No ☐ Comments:

c. Spike/laboratory control sample (LCS) analyses were reported to be within control limits (75-125%).

Yes ☒ No ☐ Comments:

d. EMSL and EML QAP sample analyses were present in the data package.

Yes ☐ No ☒ Comments:

e. EMSL and EML QAP sample analyses were reported to be within specified control limits.

Yes ☐ No ☒ Comments: *Not Required*

f. The matrix (pre-digest) spike frequency requirement was met.

Yes ☐ No ☐ Comments:

g. Matrix spike recoveries were within the specified control limits (75 - 125%).

Yes ☒ No ☐ Comments:

*90  
Only for Sr. ms/msd  
not used for gamma  
spectroscopy and not required.*

9. Precision Statement

a. The matrix (pre-digest) duplicate frequency was met.

Yes ☒ No ☐ Comments:

b. Matrix (pre-digest) duplicate differences were within specified control limits (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes ☒ No ☐ Comments:

c. This package contained a field duplicate.

Yes ☐ No ☒ Comments:

- d. All field duplicate results met criteria (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes X No \_\_\_\_\_ Comments:

10. Self-Absorption Factors

- a. Self-absorption factors were generated for alpha and beta determinations. Solids content in samples did not exceed 100 mg total.

Yes X No \_\_\_\_\_ Comments:

11. Analytical Methods

- a. The analytical methods used were as specified on the chain-of-custody, the BNL QAPP.

Yes X No \_\_\_\_\_ Comments:

12. Turnaround Time

- a. The turnaround time specified on the chain-of-custody record of 7 days was met.

Yes X No \_\_\_\_\_ Comments:

13. Completeness

- a. The percent of data completeness for all radionuclides and methods were greater than 90%.

Yes X No \_\_\_\_\_ Comments:

14. Calculations and Transcription

- a. Correct contract/method calculations (i.e. curve generation, sample quantitation, etc.) were performed.

Yes X No \_\_\_\_\_ Comments:

- b. Raw data was transcribed accurately to sample and QC summary sheets.

Yes X No \_\_\_\_\_ Comments:

15. System Performance

- a. The instrumental and analytical systems used in the analysis of these samples maintained an acceptable level of performance throughout this case.

Yes X No \_\_\_\_\_ Comments:

16. Contract Requirements

- a. All contract requirements were met by the laboratory in the preparation and analysis of the samples in the package.

Yes X No \_\_\_\_\_ Comments:

17. Additional Comments

The Investigate ( $\pm 2\sigma$ ) and Action ( $\pm 3\sigma$ ) limits for a couple of the detectors used to count samples appear to require updating. There were many more data points on the high side ( $> +2\sigma$ ) than the low side ( $< -2\sigma$ ) indicating that they need to be re-determined. Overall, the QC charts are acceptable.

*C. Schofer, CHP*  
7/15/16

**Attachment 1**  
**Brookhaven National Laboratory**  
**Analytical Data Package Verification Checklist**

|                         |                                  |                |    |         |
|-------------------------|----------------------------------|----------------|----|---------|
| Project                 | Bldg 811 Excavation              |                |    |         |
| Sampling Contractor     | PW Grosser                       |                |    |         |
| Analytical Laboratory   | General Engineering Laboratories |                |    |         |
| Analytical Method       | DOE HASL 300                     |                |    |         |
| Sample Delivery Group   | 387177                           |                |    |         |
| COC No./Sample IDs      | 37206 - 001/002                  |                |    |         |
| Date Sampled            | 12/4/15                          |                |    |         |
| Parameter(s)            | Gamma Spectroscopy, Sr-90        |                |    |         |
|                         | Satisfactory                     | Unsatisfactory | NA | Comment |
| Sample IDs              | X                                |                |    |         |
| Detection Limits (CRDL) | X                                |                |    |         |
| Duplicates              | X                                |                |    |         |
| Matrix Spike (MS/MSD)   | X                                |                |    |         |
| MS/MSD Recoveries       | X                                |                |    |         |
| Field Blanks            |                                  |                | X  |         |
| Equipment Blanks        |                                  |                | X  |         |
| Method Blanks           | X                                |                |    |         |
| Chain-of-Custody Forms  | X                                |                |    |         |
| Field Sampling Logs     | X                                |                |    |         |
| Holding Times           | X                                |                |    |         |
| Nonconformance          |                                  |                |    |         |
| Other                   |                                  |                |    |         |

Reviewed by Achefer, CHP Date 7/18/16  
Project Manager



## Attachment 1

### BNL RADIOCHEMICAL VALIDATION REPORT

Project No. N/A Program Waste Management  
 Site Brookhaven National Lab Project Name 811 Excavation  
 Contract Laboratory General Engineering Labs Project Manager A. Lockwood  
 Sample Delivery Group (SDG) 387177 Sampling Date (Month/Year) 12/15

**Type of Analyses/Special Request:**

| BNL Sample ID | Lab ID    |  | BNL Sample ID | Lab ID |
|---------------|-----------|--|---------------|--------|
| 37206-01      | 387177-01 |  |               |        |
| -02           | -02       |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |
|               |           |  |               |        |

**Laboratory QC Samples:**

Number of Samples Analyzed 8 Total Number of Analyses 8

MS = Matrix Spike  
 MSD = Matrix Spike Duplicate  
 Dup = Matrix Duplicate (replicate)  
 RE = Reanalysis

Data Reviewer C. Achter, CHP Date 7/18/16  
 QA Review by C. Achter, CHP Date 7/18/16  
 Data Validation Management (if applicable) N/A Date \_\_\_\_\_  
 EM Manager Approval N/A Date \_\_\_\_\_

Contractual violations found? Yes \_\_\_\_\_ No X Not Applicable \_\_\_\_\_

Attach, as necessary, the following Sample Delivery Group (SDF) information:

- I. Data Qualifier and Sub Qualifier Definitions
- II. Laboratory Case Narratives, Telephone Logs and Correspondence
- III. Qualified Sample Results (Form 1's)
- IV. Laboratory Matrix QC Summary Forms (Forms 5A and 6)
- V. Standardized Data Validation Comments

**Deliverable:****Analyte:**

| Y-Spec | Sr-90 |  |  |
|--------|-------|--|--|
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| N/A    | N/A   |  |  |
| X      | X     |  |  |
| 0      | 0     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |
| X      | X     |  |  |

a/b = gross alpha/gross beta

GS = gamma scan

H3 = Tritium

Np-237 = neptunium-237

NR = Not Required

0 = Not included and/or Not Complete

Pu-240 = plutonium-240, Pu-242 = plutonium-242

Ra-228 = radium-228

RS = Provided as a Resubmission

Th-230 = thorium-230

U-233 = uranium-233, U-234 = uranium-234, U-235 = uranium-235, U-236 = uranium-236, U-238 = uranium-238

Tc-99 = technetium-99

Sr-89 = Strontium-89, Sr-89/90 = Strontium-89/90, Sr-90 = Strontium-90

X = Included in original data package

**Questions:**

1. Deliverables

All data deliverables, as expected, were found in the package and sent through resubmissions.

Yes ☒ No ☐ Comments:

- a. The following are expected deliverables that were not found in the data package:
- b. The following deliverables were found to have problems or contain errors, as provided in the data package:
- c. The following are expected deliverables that were initially not in the data package, but were provided as a resubmission:
- d. The following deliverables were initially found to have problems or contain errors; corrected information was provided in the laboratory resubmission:

2. Holding Times/Preservations

- a. Samples were prepared and analyzed within holding times specified by the project guidelines. The holding time is based on the date of sample collection to the date of analysis, with modifications for preservatives as necessary.

Yes ☒ No ☐ Comments:

3. Tentatively Identified Radionuclides

- a. All tentatively identified radionuclides have been identified and assigned a data qualifier.

Yes ☒ No ☐ Comments:

- b. Sample identification met all spectral line energy and percent of major peaks accounted for requirements.

Yes ☒ No ☐ Comments:

4. Contract Required Detection Limits

- a. The MDCs for all results that are at or near background levels were less than or equal to the contract required detection limits (CRDL).

Yes ☒ No ☐ Comments:

5. Background and Laboratory Quality Control Samples

- a. The required summary forms/information were provided and information was present to determine that initial calibration and geometry met guidelines (correlation, number of calibration standards, distribution range of standards, peak shape, spectral lines for gamma, etc.) or method criteria.

Yes X No \_\_\_\_\_ Comments:

- b. The continuing calibration standard (CCV) efficiency analyses were reported as required and had recoveries reported to be within the specified control limits.

Yes X No \_\_\_\_\_ Comments:

6. Contamination and Background Stability Quality Control

- a. Preparation/method blank was prepared and analyzed at the specified frequency. Background determinations were performed.

Yes X No \_\_\_\_\_ Comments:

- b. All analytes in the blank and background were below the minimum detectable concentration (i.e., detection limit).

Yes X No \_\_\_\_\_ Comments:

- c. The package contained other types of blanks submitted to the laboratory with the field samples.

Yes \_\_\_\_\_ No X Comments: No Field Blanks submitted

7. Gravimetric Standard / Chemical Tracer

- a. Gravimetric standards / chemical tracers were analyzed at the specified frequency and had measured recoveries within the required control limits.

Yes X No \_\_\_\_\_ Comments:

8. Accuracy Statements

- a. Spike/laboratory control samples (LCS) analyses were performed with each sample batch and for each matrix in the data package.

Yes X No \_\_\_\_\_ Comments:

b. Laboratory control charts were provided in the package.

Yes ☒ No ☐ Comments:

c. Spike/laboratory control sample (LCS) analyses were reported to be within control limits (75-125%).

Yes ☒ No ☐ Comments:

d. EMSL and EML QAP sample analyses were present in the data package.

Yes ☐ No ☒ Comments:

e. EMSL and EML QAP sample analyses were reported to be within specified control limits.

Yes ☐ No ☒ Comments: Not Required

f. The matrix (pre-digest) spike frequency requirement was met.

Yes ☒ No ☐ Comments:

g. Matrix spike recoveries were within the specified control limits (75 - 125%).

Yes ☒ No ☐ Comments: 90  
Only for Sr. MS/MSD  
not required and not  
used for Gamma scans.

9. Precision Statement

a. The matrix (pre-digest) duplicate frequency was met.

Yes ☒ No ☐ Comments:

b. Matrix (pre-digest) duplicate differences were within specified control limits (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes ☒ No ☐ Comments:

c. This package contained a field duplicate.

Yes ☐ No ☒ Comments:

- d. All field duplicate results met criteria (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes X

No \_\_\_\_\_

Comments:

10. Self-Absorption Factors

- a. Self-absorption factors were generated for alpha and beta determinations. Solids content in samples did not exceed 100 mg total.

Yes X

No \_\_\_\_\_

Comments:

11. Analytical Methods

- a. The analytical methods used were as specified on the chain-of-custody, the BNL QAPP.

Yes X

No \_\_\_\_\_

Comments:

12. Turnaround Time

- a. The turnaround time specified on the chain-of-custody record of 7 days was met.

Yes X

No \_\_\_\_\_

Comments:

13. Completeness

- a. The percent of data completeness for all radionuclides and methods were greater than 90%.

Yes X

No \_\_\_\_\_

Comments:

14. Calculations and Transcription

- a. Correct contract/method calculations (i.e. curve generation, sample quantitation, etc.) were performed.

Yes X

No \_\_\_\_\_

Comments:

- b. Raw data was transcribed accurately to sample and QC summary sheets.

Yes X

No \_\_\_\_\_

Comments:

15. System Performance

- a. The instrumental and analytical systems used in the analysis of these samples maintained an acceptable level of performance throughout this case.

Yes X No \_\_\_\_\_ Comments:

16. Contract Requirements

- a. All contract requirements were met by the laboratory in the preparation and analysis of the samples in the package.

Yes X No \_\_\_\_\_ Comments:

17. Additional Comments

An incorrect sample mass appears to have been used for the Gamma Scan Method Blank. This does not negatively impact this or the sample results. No QC data for detector GAM 5 is available from 11/15/15 - 12/15/15. The  $^{241}\text{Am}$  LCS QC plot shows a positive bias of ~10%, but the  $^{137}\text{Cs}$  LCS QC plot shows no bias.

For the  $^{90}\text{Sr}$  analyses, the QC plots for Beta efficiency for detectors PIC 7C and PIC 8A are consistently below the mean indicating that the mean and control levels need to be reset.

C. Schaefer, CHP  
7/18/16

## Attachment 1

### BROOKHAVEN NATIONAL LABORATORY

#### Data Usability Summary Report

|                        |                          |
|------------------------|--------------------------|
| Project:               | Bldg 811 Excavation      |
| Sampling Contractor:   | PW Grassier              |
| Analytical Laboratory: | General Engineering Labs |
| Analytical Method:     | DOE HASL 300 / EPA 905   |
| Sample Delivery Group: | 37802                    |
| COC No. / Sample IDs:  | 37802 / 001-003          |
| Date Sampled:          | 5/20/16                  |
| Parameter(s):          | Gamma Scans, Sr-90       |

| SAMPLE ID         | DATA<br>USABILITY<br>QUALIFIERS | EXPLANATION FOR QUALIFIERS |
|-------------------|---------------------------------|----------------------------|
| 37802-<br>001-003 | No<br>Qualifiers                | N/A                        |

**Summary:**

Data useable as reported by GEL.

Reviewed by:

C. A. Lockwood  
Project Manager  
A. Lockwood

Date:

8/25/16



## Attachment 1

### BROOKHAVEN NATIONAL LABORATORY

#### Data Usability Summary Report

|                        |                                        |
|------------------------|----------------------------------------|
| Project:               | Bldg 811 Excavation                    |
| Sampling Contractor:   | PWN Grosser                            |
| Analytical Laboratory: | General Engineering Labs               |
| Analytical Method:     | DOE HASE 300 / EPA 905/906             |
| Sample Delivery Group: | 37801                                  |
| COC No. / Sample IDs:  | 37801 / 001-040                        |
| Date Sampled:          | 5/11/16                                |
| Parameter(s):          | Gamma Scan, Sr-90, Alpha Spec, Tritium |

| SAMPLE ID         | DATA<br>USABILITY<br>QUALIFIERS | EXPLANATION FOR QUALIFIERS |
|-------------------|---------------------------------|----------------------------|
| 37801-<br>001-040 | No<br>Qualifiers                | N/A                        |

**Summary:**

Data useable as reported by GEL.

Reviewed by:

*C. A. Schaefer*  
Project Manager  
*A. Lockwood*

Date:

*8/25/16*

## Attachment 1

### BROOKHAVEN NATIONAL LABORATORY

#### Data Usability Summary Report

|                        |                          |
|------------------------|--------------------------|
| Project:               | Bldg 811 Excavation      |
| Sampling Contractor:   | PLW Grasser              |
| Analytical Laboratory: | General Engineering Labs |
| Analytical Method:     | DOE HASL 300 / EPA 905   |
| Sample Delivery Group: | 37695 (398656)           |
| COC No. / Sample IDs:  | 37695 / 001-026          |
| Date Sampled:          | 5/17/16                  |
| Parameter(s):          | Gamma Scans, Sr-90       |

| SAMPLE ID         | DATA<br>USABILITY<br>QUALIFIERS | EXPLANATION FOR QUALIFIERS |
|-------------------|---------------------------------|----------------------------|
| 37695-<br>001-026 | No<br>Qualifiers                | N/A                        |

**Summary:**

Data useable as reported by GEL.

Reviewed by:

A. Lockwood  
Project Manager  
A. Lockwood

Date:

8/25/16

## Attachment 1

### BROOKHAVEN NATIONAL LABORATORY

#### Data Usability Summary Report

|                        |                          |
|------------------------|--------------------------|
| Project:               | Bldg 811 Excavation      |
| Sampling Contractor:   | PW Grosser               |
| Analytical Laboratory: | General Engineering Labs |
| Analytical Method:     | DOE HASL 300 / EPA 905   |
| Sample Delivery Group: | 37206 (387177)           |
| COC No. / Sample IDs:  | 37206 / 001-002          |
| Date Sampled:          | 12/4/15                  |
| Parameter(s):          | Gamma Scans, Sr-90       |

| SAMPLE ID         | DATA<br>USABILITY<br>QUALIFIERS | EXPLANATION FOR QUALIFIERS |
|-------------------|---------------------------------|----------------------------|
| 37206-<br>001-002 | No<br>Qualifiers                | N/A                        |

**Summary:**

Data useable as reported by GEL.

Reviewed by:

C. A. L. For  
Project Manager  
A. Lockwood

Date:

8/25/16

## Attachment 1

### BROOKHAVEN NATIONAL LABORATORY

#### Data Usability Summary Report

|                        |                          |
|------------------------|--------------------------|
| Project:               | Bldg 811 Excavation      |
| Sampling Contractor:   | PW Grosser               |
| Analytical Laboratory: | General Engineering Labs |
| Analytical Method:     | DOE HASL 300 / EPA 905   |
| Sample Delivery Group: | 37205 (387066)           |
| COC No. / Sample IDs:  | 37205 / 001-007          |
| Date Sampled:          | 12/1/15                  |
| Parameter(s):          | Gamma Scans, Sr-90       |

| SAMPLE ID         | DATA<br>USABILITY<br>QUALIFIERS | EXPLANATION FOR QUALIFIERS |
|-------------------|---------------------------------|----------------------------|
| 37205-<br>001-007 | No<br>Qualifiers                | N/A                        |

Summary: Data useable as reported by GEL.

Reviewed by: C. L. Lockwood for  
Project Manager  
A. Lockwood

Date: 8/25/16