

SAFETY EVALUATION BY OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

RELATED TO FINAL STATUS SURVEYS FOR

SIXTY-FOUR SURVEYS OF VARIOUS OPEN LAND AREAS

PACIFIC GAS AND ELECTRIC COMPANY

HUMBOLDT BAY POWER PLANT, UNIT 3

DOCKET NO. 50-133

1.0 INTRODUCTION

The Nuclear Regulatory Commission (NRC) staff reviewed Final Status Survey Reports (FSSRs) for 64 surveys encompassing the remaining open land areas, as submitted in Enclosures 1, 2, and 3 to the letter dated June 8, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21160A224), as submitted by letter dated July 13, 2021 (ADAMS Accession No. ML21194A441), and as submitted by letter dated August 9, 2021 (ADAMS Accession No. ML21221A135). These surveys detailed the results of 63 open land area final status surveys and one concrete pad final status survey. Some of the surveys were overlaps of the same footprint/survey unit but represented conditions both at the completion of excavation of contaminated materials and a subsequent survey performed after backfill of the excavation with reuse soil. Due to the number of surveys involved, the NRC staff chose to evaluate the licensee's reports by way of performing "horizontal" and "vertical" slices of review. This meant reviewing all survey data summaries and review of data as well as verifying licensee calculations and compliance with commitments in the License Termination Plan (LTP) for select survey units. Both the data summaries and the detailed reviews were compared against the approved release criteria and survey methods. The NRC staff considered each survey performed as a stand-alone survey unit even though more than one survey may have been performed to demonstrate a specific area as meeting the unrestricted release criteria (such as may be the case for the Final Site Remediation (FSR) surveys which are typically of the top of backfill used to bring the survey unit up to grade). The NRC staff agree with the licensee that, if multiple surveys in a survey unit all demonstrate meeting the unrestricted release criteria, then a more encompassing dose assessment of all surveys in a survey unit would ultimately result in some average of the hypothetical dose estimated from the individual surveys that also meets the release criteria. The NRC staff's analysis of the surveys performed is provided below.

2.0 EVALUATION

General Review (Horizontal Slice)

The licensee provided data summaries of each survey in each general report submitted. The NRC staff reviewed the data summaries, as well as reviewed the data reported for each survey, and compiled a table of the most relevant information (see Table 1, attached). As may be seen from the table, all surveys were stated as meeting the release criteria (i.e., < 25 mrem/y hypothetical dose) although the NRC staff noted that no elevations (small areas exceeding the Derived Concentration Guideline Levels (DCGLs) were considered in the compliance dose estimates. The highest reported hypothetical dose by the licensee was 2.91 mrem/y.

While this is significantly less than the 25 mrem/y unrestricted release criteria, the NRC staff noted some inconsistencies and non-conservative assumptions were used by the licensee.

### Groundwater

As was noted in previous evaluations of land area surveys submitted by the licensee, the licensee did not include evaluation of existing residual radioactivity in groundwater in its assessments of hypothetical dose. While ingestion of contaminated groundwater was identified as a pathway of concern for the average member of the critical group in the LTP, it is apparent that the licensee only considered ingestion of groundwater as part of the development of the DCGLs. In response to a request for additional information (RAI) 1 (ADAMS Accession No. ML20247J598), the licensee provided groundwater monitoring results from 2015, 2016, and 2017, three years during which the licensee maintains groundwater was most likely to have been impacted due to decommissioning work. Groundwater well monitoring was discontinued in accordance with the LTP during the site decommissioning due to various construction type activities occurring which made maintaining the wells impractical.

Based on the reported groundwater sample results, none of the wells sampled during this period demonstrated detectable contamination for Co-60, Cs-137, or H-3. The licensee also monitored for gross alpha and beta activity during this period and some detectable alpha activity was reported in 2015 while detectable beta activity was sporadic, although mostly not detectable, in wells during the 2015-2017 period. The NRC staff reviewed the reported minimum detectable concentration (MDC) values and noted that the MDCs for Co-60, Cs-137, and H-3 were typically around 5 pCi/L, 5 pCi/L, and 300 pCi/L, respectively. Conservatively assuming these concentrations in groundwater, the staff compared these MDC values to the respective liquid effluent concentration values in Title 10 of the *Code of Federal Regulations* (CFR) Part 20, Appendix B, Table 2 to derive an estimated bounding hypothetical exposure of less than 1 mrem/y from residual radioactivity in groundwater. While the groundwater monitoring results were not encompassing of all radionuclides of concern (ROCs) for the site, the NRC staff consider it adequate to conservatively assume the identified radionuclides are present at the typical MDC value because gross alpha/beta results were not indicative of any significant activity exceeding the MDC values or "missed" ROCs.

Also, while the NRC staff agree with the licensee that it is unlikely ingestion of contaminated groundwater at the site would occur due to tidal basin flow affecting groundwater potability and limited impact of past plant operations to the available drinking water aquifers, staff consider it is reasonably conservative to assume some contaminated groundwater could be present and ingested by future site occupants because the licensee did not justify disregarding this potential pathway in its LTP. As such, the NRC staff find it reasonable to conservatively bound a hypothetical dose contribution through ingestion of existing residual radioactivity in groundwater equivalent to the typical MDC values and corresponding to 1 mrem/y even though this was not addressed by the licensee in its FSSRs.

### Unaddressed Radionuclides of Concern

Like past submittals by the licensee, the NRC staff noted that the licensee sometimes does not report on, nor address the contribution of, some of the easy-to-detect (ETD) ROCs for which criteria were established in the LTP. The licensee maintains that this is appropriate as some ROCs were not found to be present in the data collected so it made sense to not incorporate them into the report (i.e., ETD ROCs that never exceeded the respective MDC during sample analysis for a survey unit, see ADAMS Accession No. ML21301A143). While the NRC staff

understand the reasoning presented by the licensee, the LTP requires that insignificant ROCs be addressed and their contribution to the hypothetical dose considered when demonstrating compliance with the release criteria (see Section 6.2.5 of the LTP which is consistent with Section 3.3 of NUREG-1757, Vol 2).

In previous evaluations of this situation, the NRC staff elected to conservatively bound the hypothetical dose contribution from unaddressed and unreported ETD ROCs at 1 mrem/y. The NRC staff believe that this is still appropriate for these surveys as exemplified by the survey for OOL11-01 in which the ETD ROCs were reported but only Cs-137 was used to assess the potential hypothetical dose. The licensee believes it was reasonable to exclude Am-241, Co-60, Eu-152, Eu-154, Nb-94, and Np-237 from consideration as these ROCs only contribute an "insignificant hypothetical dose of 0.11 mrem/y." The NRC staff find this reasoning somewhat confusing as the hypothetical dose contribution from Cs-137 alone was reported as 0.874 mrem/y and dose from assessed hard-to-detect (HTD) ROCs was 0.568 mrem/y, which the NRC staff consider to not be significantly different from the 0.11 mrem/y contribution from the unaddressed ROCs. The NRC staff also noted that several other surveys reported having a dose contribution from the unaddressed ROCs of 0 mrem/y as the sum of fractions (SOF) for these ROCs was negative, on average. Regardless, relative to the release criteria of 25 mrem/y, the NRC staff agree that the contribution of unaddressed and unreported ROCs is of relatively minor consequence and the NRC staff's position of bounding the hypothetical contribution from these ROCs at 1 mrem/y appears reasonably conservative.

#### Assessment of Hard-to-Detect Radionuclides of Concern

The licensee performed a site-wide assessment of HTD ROCs as described in Attachment 1 to a response to RAIs (see ADAMS Accession No. ML21063A474). In Tables 2, 3, and 4 of the referenced Attachment, the licensee estimates the average hypothetical dose contribution from HTD ROCs for each Classification of survey units as less than 1 mrem/y, on average, across the site. These values are what the licensee used to consider the dose contribution from the HTD ROCs in each survey submitted. The NRC staff note that the licensee states that C-14 is not a radionuclide expected to be present in any of the evaluated survey units because it is produced from neutron activation of concrete and, as such, is only considered to be potentially present in the Caisson FSS (Final Status Survey) Unit NOL01-09. Also, in Table 8 of the same Attachment, the licensee bounds the hypothetical dose from all HTD ROCs in any survey unit as being less than 2.9 mrem/y. The NRC staff believe it more appropriate to conservatively bound the impact of the HTD ROCs at 2.9 mrem/y for all survey units. The NRC staff believe this is exemplified in the survey data for survey unit OOL01-02 in which the licensee assigned an additional 1.7 mrem/y dose due to detection of Tc-99 (a HTD ROC) in the quality control sample analyses performed for that survey unit. This appears to be an anomalous detection as no other surveys detected Tc-99 in their analyses and NRC staff believe it reasonably conservative for the licensee to incorporate this into its hypothetical dose in addition to the generic dose contribution for HTD ROCs across the site. Preferably, the NRC staff would expect the licensee to reanalyze all systematic samples collected in this survey unit for Tc-99 and report it in the FSSR; however, the licensee verbally communicated that it did not stockpile its samples, therefore reanalysis was not a practical consideration. Because the licensee cannot properly assess the impact of select HTD ROCs in such situations, the NRC staff continue to consider it reasonably conservative to bound the hypothetical dose contribution from HTD ROCs as being 2.9 mrem/y for all survey units.

## Scanning Assessment

In each survey performed, the licensee reported meeting the required scanning coverage consistent with the LTP and the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Table 5.9, with three exceptions. These exceptions were for survey units OOL02-01, OOL06-01, and OOL11-01, in which the licensee reported no scanning was performed although this was somewhat contradicted in the FSSR text that stated that survey units OOL02-01 and OOL06-01 were partially scanned. Upon review, these survey units consist of the intake canal, which is a surface water body, and, as such, scanning is not a practical activity. The licensee obtained additional samples in lieu of scanning. The NRC staff reviewed the sample results and noted that residual radioactivity appeared to be significantly less than the release criteria in these survey units and find the approach taken reasonable under the circumstances.

The NRC staff also noted that several survey units included In Situ Object Counting System (ISOCS) measurements as part of the survey. Upon review of the write up for scanning surveys in these survey units, the NRC staff found that the licensee states that ISOCS scanning measurements were taken to perform scanning in areas in which the project safety group deemed it to be unsafe for personnel to perform traditional walkover scanning. This, in some surveys, could constitute a significant portion of the scanning performed. For example, survey unit OOL03-02 had 97 reported ISOCS measurements. The licensee, in its scanning assessment for this survey unit, states that approximately 77 percent of the survey unit was scanned using traditional methods while 23 percent of the survey unit was assessed by taking ISOCS scanning measurements. ISOCS measurements were supposedly taken in deep excavation areas which were deemed unsafe to enter by the project safety group. The NRC staff will not dispute the project safety group with respect to ensuring personnel safety during this review; however, the NRC staff consider ISOCS measurements to be a poor substitute for traditional scanning as it can easily lead to "misses" of discrete elevated residual radioactivity, such as may be the case for hot particles, due to its wide field of view. Regardless, this practice has been approved for this site as stated in Section 5.2.1.3 of the LTP and the NRC staff find alternative scanning methods appropriate when traditional scanning methods would pose a real safety risk to personnel.

## At Depth Backfill Material

The licensee has conducted several FSR surveys after an excavation has been backfilled. The NRC staff have previously noted that the FSR surveys are only of the top layer (~15 cm) of the backfill even though the backfill may be of considerable depth. The materials used for the backfill are typically reuse materials from Class 1 survey units that have been screened using the Gamma Radiation Detection and In-Container Analysis (GARDIAN) system, a bulk material gamma detection system, and then stored elsewhere on-site before being reused as backfill. The top of the backfilled areas is then surveyed as shown in the various FSR designated survey units.

The licensee maintains that, while the entirety of the backfill at depth is not characterized, the materials are generally well mixed due to placement and moving operations in both the stockpiling area and then in the excavations. Also, multiple surveys of the reuse material (in multiple survey units) all demonstrate meeting the release criteria. As such, the licensee thinks that the preponderance of evidence indicates that the material is relatively homogenous in that it all meets the release criteria. The NRC staff acknowledge this reasoning and accept that, in

this case, the preponderance of evidence demonstrates the reuse material will meet the release criteria even though the at depth material is not well characterized.

### Elevated Areas

The NRC staff noted in three survey units (OOL01-03, NOL01-02, and NOL01-04) that the licensee reported investigative sampling results that exceeded the DCGLw (the "w" indicates survey wide limit). The NRC staff further noted that there was no contribution from elevated measurements in the compliance dose stated in the summaries. These particular survey units were selected for additional review as a vertical slice review and the NRC staff noted that the licensee erroneously considered negative average values in its assessments of these areas as well as not understanding that the compliance dose estimate considers contributions from elevated areas. While these errors did not result in non-compliance (see write ups in the vertical slice review), the NRC staff simply note that these assessments were not accurately performed nor were the survey units appropriately assessed for elevated areas.

### Survey Unit OOL10-24-FSR

Survey unit OOL10-24-FSR was noted by NRC staff during review because the measurements taken in this survey unit were primarily surface area measurements, such as is normally performed for structures, as opposed to volumetric soil sampling. In this case, it is appropriate because the survey unit was an engineered material pad located outside and around the Waste Management Facility. However, the NRC staff noted that the surface area (2,286 m<sup>2</sup>) was consistent with that of a Class 2 open land area survey unit as opposed to a Class 2 structural survey unit which should be limited in size to less than 1,000 m<sup>2</sup>. The NRC staff considered this situation to be akin to surveys of a large parking lot which has in the past been allowed to be treated as an open land area. The licensee in this case performed a 100 percent scan of the accessible areas as well as systematic measurements consistent with a single survey unit, the number of which would likely increase three-fold if the area was subdivided to meet structural survey unit size limits. Investigative sampling done in an area identified during scanning surveys did not find any significant plant related contaminants (elevated Be-7 was noted in the sample but its presence is believed to be due to natural deposition as the sample was generated by surface scabbling near a drainage point, Be-7 has a 53 day half-life so would be unlikely to originate from plant operations which ended many years ago, also Be-7 is generated by cosmic radiation interactions in the atmosphere). Because scanning did not identify any exceedances of the release criteria nor was any single systematic measurement in excess of 10 percent of the release criteria, the NRC staff find this survey adequate although the discrepancy between open land areas versus structures was confusing.

### *In-Depth Review of Select Survey Units (Vertical Slices)*

As was previously noted, the licensee submitted 64 FSSRs related to the remaining open land areas on the site (all other survey units have been previously surveyed, reported, and evaluated). The NRC staff selected nine survey units, approximately 14 percent of the surveys, on which to perform an in-depth review to verify the appropriate implementation of the FSS commitments in the LTP and demonstration of meeting the release criteria. The following sections discuss each survey selected.

### OOL03-01 (Land Around Unit 1)

The survey unit designated as OOL03-01 was classified by the licensee as a MARSSIM Class 1 unit and is described as an approximately 1,977 m<sup>2</sup> area, which is consistent with MARSSIM, Section 4.6, limitations on survey unit areas. The licensee describes the survey unit as being bounded by OOL08-03 on the north, OOL03-02 on the east, NOL01-06 on the south, and OOL08-01, OOL08-02, and OOL08-03 on the west. Survey unit OOL03-01 consists of the open land area north of Units 1 and 2 footprint and encompasses the north yard and embankment. The licensee further described this area as an excavation to remove the remaining Unit 1 and Unit 2 underground commodities along with the hydrogen storage building, north yard loop drainage system, and other miscellaneous decommissioning commodities. After the licensee removed the waste materials, the FSS of the excavation was conducted and the area was backfilled by the licensee with reclaimed soil from various locations on-site that had passed through the GARDIAN system. After backfilling of the area was completed, a second survey of the surface of this area was performed with the survey unit redesignated as OOL03-01-FSR. As such, the FSS of this survey unit can be best described as being two FSSs, one of the excavation footprint, and another of the remediated area after backfilling. So long as both surveys demonstrate compliance with the unrestricted release criteria, a weighted average of the two would similarly be expected to meet the criteria.

The licensee's survey design was based on a SOF determination and a value less than unity would result in meeting the unrestricted dose criteria of 25 mrem/y. The licensee "deselected" the HTD ROCs listed in Table 6-4 of the LTP with the exception of Sr-90 and H-3 and leaving only seven ETD ROCs plus Sr-90 and H-3 to be quantified through sampling/analysis. The licensee's plans for the survey emphasized Cs-137, Co-60, and Sr-90 for the survey. The licensee determined the required number of soil samples using a Type 1 and Type 2 error rate of 0.05 and a relative shift of 1. The licensee determined that the required number of samples was 29 which the NRC staff determined is consistent with Table 5.5 of MARSSIM.

The hypothetical dose estimated from the 14 deselected ROCs (inclusive of Sr-90 and H-3) was 0.187 mrem/y in the submittal consistent with Table 2 of Attachment 1 in a recent white paper submitted in response to a RAI (see ADAMS Accession No. ML21063A474, Attachment 1). Table 8 of the same Attachment bounds the hypothetical dose from all HTD ROCs in any survey unit as being 2.9 mrem/y. As previously discussed, the NRC staff believe it more appropriate to conservatively bound the impact of the HTD ROCs at 2.9 mrem/y, in this case.

Of the systematic samples collected in this survey, the licensee reported that the maximum SOF from the analytical results, based solely on Co-60, Cs-137, and Sr-90 data, is 0.27 and the average is 0.0182, equating to 0.463 mrem/y hypothetical dose. Only two samples had Cs-137 greater than the MDC with neither of the other reported ROCs exceeding the relative MDC. The NRC staff checked the licensee's calculations and found them correct. Because none of the data exceeded a SOF of unity, the licensee describes the survey unit as passing based on inspection. The NRC staff concurs that, based solely on the analytical results presented, the data indicate meeting the release criteria by inspection.

Of the ROCs neither deselected nor reported (H-3, Nb-94, Eu-152, Eu-154, Np-237, and Am-241), the licensee verbally stated that these ROCs were not detected above their respective MDCs and had negligible dose impact so were not reported. As previously discussed, the NRC staff assessed the unreported and unaddressed ROCs as generally being conservatively bounded by contributing 1 mrem/y hypothetical dose.

The licensee stated that approximately 100 percent of the survey unit was scanned. This is consistent with MARSSIM guidance for Class 1 survey units when accounting for human error in scanning coverage. The licensee noted in its description of the scanning survey that ~94 percent of the area was scanned by walking transects across the area while moving the detector in a serpentine fashion (i.e., traditional scanning). The remainder of the survey unit was addressed by taking ISOCS measurements as the project safety team decided those portions of the area were unsafe to traverse while scanning. As previously mentioned, while not ideal for scanning, the NRC staff find use of ISOCS measurements for this purpose to be acceptable, given the circumstances. The licensee collected one biased and four investigative samples in the survey unit in areas identified by scanning that were subsequently analyzed for ETD ROCs. Only one of these samples had Cs-137 detected at greater than the MDC and it had a SOF of 0.09 (based solely on Cs-137 and Co-60 results). As such, the licensee concluded, and the NRC staff concur, that no elevated areas of residual radioactivity (i.e., exceeding the release criteria) were identified in the survey unit.

Based on the initially reported data, the licensee stated the hypothetical dose in the survey unit was 0.65 mrem/y (0.463 mrem/y based upon the Co-60, Cs-137, and Sr-90 analytical results in the systematic collected samples, plus 0.187 mrem/y from the deselected HTD ROCs). The NRC staff's determination of a bounding hypothetical dose is 5.4 mrem/y (0.463 from the Co-60, Cs-137, and Sr-90 analytical results in the systematic collected samples, plus 2.9 mrem/y bounding dose from HTD ROCs, plus 1 mrem/y bounding dose from the unaddressed and unreported ROCs, and plus 1 mrem/y from a bounding consideration of residual radioactivity in groundwater). Regardless, in both cases the hypothetical dose in the survey unit from residual radioactivity in soil/groundwater is far below the 25 mrem/y unrestricted release criteria.

For Survey Unit OOL03-01-FSR, the licensee follows a similar logic as for Survey Unit OOL03-01 and estimates a slightly lower dose based on those survey results of 0.33 mrem/y. As such, the licensee estimates both surveys as contributing less than 1 mrem/y hypothetical dose while the NRC staff would bound the hypothetical dose at less than 6 mrem/y. Both the survey for OOL03-01 and the survey for OOL03-01-FSR indicate that the survey unit meets the unrestricted release criteria by being less than 25 mrem/y.

#### OOL04-01 (Land Containing Unit 3 Commodities)

The survey unit designated as OOL04-01 was classified by the licensee as a MARSSIM Class 1 unit and is described as an approximately 1,978 m<sup>2</sup> area, which is consistent with MARSSIM, Section 4.6, limitations on survey unit areas. The licensee describes the survey unit as being bounded by OOL10-20 and OOL07-02 on the north, OOL07-01, OOL07-02, OOL09-01, and NFGA-East on the east, NFGA-West on the south, and NOL01-03, NOL01-06, NOL01-08, and NFGA-West on the west. The licensee describes this area as an excavation to remove the Unit 3 sump and drainage line, contaminated electrical raceway, an associated drain line that was contaminated, as well as other miscellaneous commodities. After the waste materials were removed, the FSS of the excavation was conducted, and the area was backfilled with reclaimed soil from various locations on-site that had passed through the GARDIAN system. After backfilling of the area was completed, a second survey of the surface of this area was performed with the survey unit redesignated as OOL04-01-FSR. As such, the FSS of this survey unit can be best described as being two FSSs, one of the areas containing the excavation footprint, and another of the remediated area after backfilling. So long as both surveys demonstrate compliance with the unrestricted release criteria, a weighted average of the two would similarly be expected to meet the criteria.

The licensee's survey design was based on a SOF determination and a value less than unity would result in meeting the unrestricted dose criteria of 25 mrem/y. The licensee "deselected" the HTD ROCs listed in Table 6-4 of the LTP with the exception of Sr-90 and leaving only seven ETD ROCs and Sr-90 to be quantified through sampling/analysis. The licensee's plans for the survey emphasized Cs-137, Co-60, Sr-90, Eu-152, and Eu-154. The licensee determined the required number of soil samples using a Type 1 and Type 2 error rate of 0.05 and a relative shift of 2. The licensee determined that the required number of samples was 20 which the NRC staff determined is conservative compared to Table 5.5 of MARSSIM, which would require 15.

The hypothetical dose estimated from the 14 deselected ROCs (inclusive of Sr-90) was 0.187 mrem/y in the submittal consistent with Table 2 of Attachment 1 in a recent white paper submitted in response to a Request for Information (see ADAMS Accession No. ML21063A474, Attachment 1). Table 8 of the same Attachment bounds the hypothetical dose from all HTD ROCs in any survey unit as being 2.9 mrem/y. As previously described, the NRC staff believe it more appropriate to conservatively bound the impact of the HTD ROCs at 2.9 mrem/y, in this case.

Of the systematic samples collected in this survey, the licensee reported that the maximum SOF from the analytical results, based solely on Co-60, Cs-137, Sr-90, Eu-152, and Eu-154 data, is 0.36 and the average is 0.102, equating to 2.55 mrem/y hypothetical dose. Only one sample had any of these ROCs greater than the MDC, that being the sample with the maximum SOF which had detectable Sr-90 at less than 1 pCi/g. None of the other reported ROCs exceeding their MDC in any systematic sample. The NRC staff checked the licensee's calculations and found them correct. Because none of the data exceeded a SOF of unity, the licensee describes the survey unit as passing based on inspection. The NRC staff concurs that, based solely on the analytical results presented, the data indicate meeting the release criteria by inspection.

Of the ROCs neither deselected nor reported (Nb-94, Np-237, and Am-241), the license verbally stated that these ROCs were not detected above their respective MDCs and had negligible dose impact, so they were not reported. As previously discussed, the NRC staff assessed the unreported and unaddressed ROCs as generally being conservatively bounded by contributing 1 mrem/y hypothetical dose.

The licensee stated that approximately 100 percent of the survey unit was scanned. This is consistent with MARSSIM guidance for Class 1 survey units when accounting for human error in scanning coverage. The licensee noted in its description of the scanning survey that ~97 percent of the area was scanned by walking transects across the area while moving the detector in a serpentine fashion (i.e., traditional scanning). The remainder of the survey unit was addressed by taking ISOCS measurements as the project safety team decided those portions of the area were unsafe to traverse while scanning. As previously mentioned, while not ideal for scanning, the NRC staff find use of ISOCS measurements for this purpose to be acceptable, given the circumstances. The licensee collected 11 biased samples, three were composite samples, in the survey unit which were subsequently analyzed for the ROCs designated by the licensee for the survey unit. None these samples had Co-60, Sr-90, Cs-137, Eu-152, or Eu-154 detected at greater than the MDC leading the licensee to conclude that no plant derived ROCs were present in those samples. As such, the licensee concluded, and the NRC staff concur, that no elevated areas of residual radioactivity (i.e., exceeding the release criteria) were identified in the survey unit.

Based on the initially reported data, the licensee stated the hypothetical dose in the survey unit was 2.74 mrem/y (2.55 mrem/y based upon the Co-60, Sr-90, Cs-137, Eu-152, and Eu-154



analytical results in the systematic collected samples, plus 0.187 mrem/y from the deselected HTD ROCs). The NRC staff's determination of a bounding hypothetical dose is 7.5 mrem/y (2.55 from the Co-60, Sr-90, Cs-137, Eu-152, and Eu-154 analytical results in the systematic collected samples, plus 2.9 mrem/y bounding dose from HTD ROCs, plus 1 mrem/y bounding dose from the unaddressed and unreported ROCs, and plus 1 mrem/y from a bounding consideration of residual radioactivity in groundwater). Regardless, in both cases the hypothetical dose in the survey unit from residual radioactivity in soil/groundwater is far below the 25 mrem/y unrestricted release criteria.

Following similar logic for the survey of OOL04-01-FSR as for OOL04-01, the licensee estimates a lower dose based on those survey results of 0.27 mrem/y. As such, the licensee estimates both surveys as contributing less than 3 mrem/y hypothetical dose while the NRC staff would bound the hypothetical dose at less than 8 mrem/y. Both the survey for OOL04-01-FSR and the survey for OOL04-01 indicate that the survey unit meets the unrestricted release criteria by being less than 25 mrem/y.

#### OOL01-02 (Middle of Discharge Canal)

The survey unit designated as OOL01-02 was classified by the licensee as a MARSSIM Class 1 unit and is described as an approximately 1,018 m<sup>2</sup> area, which is consistent with MARSSIM, Section 4.6, limitations on survey unit areas. The licensee describes the survey unit as abutting OOL01-01 to the north, OOL09-07 to the east, OOL01-03 to the south, and OOL07-01 to the west. Survey unit OOL01-02 consists of the middle portion of the discharge canal and is primarily made up of soil and silt. The licensee further described this area as an excavation to remove the remaining contaminated soil and silt gathered during the release periods of plant operation and discharges to the bay and to remove any remaining decommissioning commodities. After the waste materials were removed, the FSS of the excavation was conducted and, after the FSS activities for the excavation were completed, the area was backfilled with reclaimed soil from various locations on-site that had passed through the GARDIAN system. After backfilling of the area was completed, a second survey of the surface of this area was performed with the survey unit redesignated as OOL01-02-FSR. As such, the FSS of this survey unit can be best described as being two FSSs, one of the excavation footprint, and another of the remediated area after backfilling. So long as both surveys demonstrate compliance with the unrestricted release criteria, a weighted average of the two would similarly be expected to meet the criteria.

The licensee's survey design was based on a SOF determination and a value less than unity would result in meeting the unrestricted dose criteria of 25 mrem/y. The licensee "deselected" the HTD ROCs listed in Table 6-4 of the LTP leaving only seven ETD ROCs to be quantified through sampling/analysis. The licensee's plans for the survey emphasized Cs-137 and Co-60 for the survey. The licensee determined the required number of soil samples using a Type 1 and Type 2 error rate of 0.05 and 0.1, respectively, and a relative shift of 1.18. The licensee determined that the required number of systematic samples was 18, which the NRC staff determined is consistent with Table 5.5 of MARSSIM. The NRC staff also note that the licensee collected 21 samples which is consistent with Table 5.5 of MARSSIM assuming a relative shift of 1.1.

The hypothetical dose estimated from the 14 deselected ROCs was 0.187 mrem/y in the submittal, consistent with Table 2 of Attachment 1 in a recent white paper submitted in response to a RAI (see ADAMS Accession No. ML21063A474, Attachment 1). Table 8 of the same Attachment bounds the hypothetical dose from all HTD ROCs in any survey unit as being 2.9

mrem/y. As previously discussed, the NRC staff believe it more appropriate to conservatively bound the impact of the HTD ROCs at 2.9 mrem/y, in this case.

Of the systematic samples collected in this survey, the licensee reported that the maximum SOF from the analytical results, based solely on Co-60 and Cs-137 data, is 0.35 and the average is 0.0405, equating to 1.02 mrem/y hypothetical dose. Only five samples had Cs-137 greater than the MDC with the highest result being 2.74 pCi/g. The NRC staff checked the licensee's calculations and found them correct. Because none of the data exceeded a SOF of unity, the licensee describes the survey unit as passing based on inspection. The NRC staff concurs that, based solely on the analytical results presented, the data indicate meeting the release criteria by inspection.

Of the ROCs neither deselected nor reported (Nb-94, Eu-152, Eu-154, Np-237, and Am-241), the licensee verbally stated that these ROCs were not detected above their respective MDCs and had negligible dose impact so were not reported. As previously discussed, the NRC staff assessed the unreported and unaddressed ROCs as generally being conservatively bounded by contributing 1 mrem/y hypothetical dose.

The licensee stated that approximately 100 percent of the survey unit was scanned. This is consistent with MARSSIM guidance for Class 1 survey units when accounting for human error in scanning coverage. The licensee noted in its description of the scanning survey that ~100 percent of the area was scanned by walking transects across the area while moving the detector in a serpentine fashion (i.e., traditional scanning). The licensee collected five biased samples and one investigative sample in the survey unit in areas identified by scanning and were subsequently analyzed for ETD ROCs. Two of these samples had Cs-137 detected at greater than the MDC although both were significantly less than 1 pCi/g. As such, the licensee concluded, and the NRC staff concur, that no elevated areas of residual radioactivity (i.e., exceeding the release criteria) were identified in the survey unit.

Based on the initially reported data, the licensee stated the hypothetical dose in the survey unit was 2.91 mrem/y (1.02 mrem/y based upon the Co-60 and Cs-137 analytical results in the systematic collected samples, plus 0.187 mrem/y from the deselected HTD ROCs plus 1.71 mrem/y dose from Tc-99 as detected in Quality Assurance (QA) samples). The NRC staff's determination of a bounding hypothetical dose is 5.9 mrem/y (1.02 mrem/y from the Co-60 and Cs-137 analytical results in the systematic collected samples, plus 2.9 mrem/y bounding dose from HTD ROCs, plus 1 mrem/y bounding dose from the unaddressed and unreported ROCs, and plus 1 mrem/y from a bounding consideration of residual radioactivity in groundwater). Regardless, in both cases the hypothetical dose in the survey unit from residual radioactivity in soil/groundwater is far below the 25 mrem/y unrestricted release criteria.

It is worth noting in this case that the licensee accounts for Tc-99 twice in its dose estimate, once as an average across the site and once as a survey unit specific contributor because it was detected in a QA sample collected in the survey unit and analyzed for all HTD ROCs. It is for this reason that the NRC staff feel it reasonable to conservatively bound the dose from HTD ROCs at 2.9 mrem/y because the licensee cannot reanalyze all of its systematically collected samples for Tc-99.

The survey of OOL01-02-FSR followed similar logic as was used for the survey of OOL01-02 and the licensee estimated a slightly lower dose based on those survey results of 0.34 mrem/y. As such, the licensee estimates both surveys as contributing less than 3 mrem/y hypothetical dose while the NRC staff would bound the hypothetical dose at less than 6 mrem/y. Both the

survey of OOL01-02-FSR and the survey for OOL01-01 indicate that the survey unit meets the unrestricted release criteria by being less than 25 mrem/y.

#### OOL01-03 (Southern End of Discharge Canal)

The survey unit designated as OOL01-03 was classified by the licensee as a MARSSIM Class 1 unit and is described as an approximately 1,319 m<sup>2</sup> area, which is consistent with MARSSIM, Section 4.6, limitations on survey unit areas. The licensee describes the survey unit as being made up of soil and silt abutted by survey units OOL01-02 on the north, OOL09-01 and OOL09-07 to the east, OOL09-01 to the south, and OOL07-01 and OOL07-02 on the west. The licensee further described this area as an excavation to remove the remaining soil and silt gathered during the release periods of the plant operation and discharges to the bay and to remove any remaining miscellaneous decommissioning commodities. After the waste materials were removed, the FSS of the excavation was conducted and the area was backfilled with reclaimed soil from various locations on-site that had passed through the GARDIAN system. After backfilling of the area was completed, a second survey of the surface of this area was performed with the survey unit redesignated as OOL01-03-FSR. As such, the FSS of this survey unit can be best described as being two FSSs, one of the excavation footprint, and another of the remediated area after backfilling. So long as both surveys demonstrate compliance with the unrestricted release criteria, a weighted average of the two would similarly be expected to meet the criteria.

The licensee's survey design was based on a SOF determination and a value less than unity would result in meeting the unrestricted dose criteria of 25 mrem/y. The licensee "deselected" the HTD ROCs listed in Table 6-4 of the LTP (assigning a hypothetical dose of 0.187 mrem/y from the HTD ROCs) and leaving only seven ETD ROCs to be quantified through sampling/analysis. The licensee's plans for the survey emphasized Co-60 and Cs-137 for the survey. The licensee determined the required number of soil samples using a Type 1 and Type 2 error rate of 0.05 and a relative shift of 1.41. The licensee determined that the required number of systematic samples was 20 (the licensee collected 21 samples), which the NRC staff determined is consistent with Table 5.5 of MARSSIM.

The hypothetical dose estimated from the 14 deselected ROCs was 0.187 mrem/y in the submittal consistent with Table 2 of Attachment 1 in a recent white paper submitted in response to a Request for Information (see ADAMS Accession No. ML21063A474, Attachment 1). Table 8 of the same Attachment bounds the hypothetical dose from all HTD ROCs in any survey unit as being 2.9 mrem/y. As previously described, the NRC staff believe it more appropriate to conservatively bound the impact of the HTD ROCs at 2.9 mrem/y, in this case.

Of the systematic samples collected in this survey, the licensee reported that the maximum SOFs from the analytical results, based solely on Co-60 and Cs-137, is 0.26 and the average is 0.0367, equating to 0.923 mrem/y hypothetical dose. Four samples had Cs-137 greater than the MDC (the highest was 2.08 pCi/g) with no Co-60 exceeding its relative MDC. The NRC staff verified the licensee's calculations. Because none of the data exceeded a SOF of unity, the licensee describes the survey unit as passing based on inspection. The NRC staff concurs that, based solely on the analytical results presented, the data indicate meeting the release criteria by inspection.

In addition, the licensee collected five biased and one investigative sample at a location flagged because of elevated measurements during scanning. Most of the data continued to demonstrate compliance with the release criteria; however, the investigative sample exceeded

the release criteria (26.8 pCi/g Cs-137). The licensee stated during a clarification call (see ADAMS Accession No ML21301A143) that this was a discrete area of elevated residual radioactivity that was effectively remediated by collection of the sample. The licensee evaluated the location pre and post sample collection, as well as subsequently taking a collimated ISOCS measurement over this location after sample collection, and noted that the measurement indicated 0.49 pCi/g Cs-137, which was not inconsistent with other biased samples collected in the survey unit and which meets the release criteria. Because only one data point indicated exceedance of the release criteria and that location was effectively remediated to less than the release criteria, the licensee concluded, and the NRC staff agree, that there were no elevations (i.e., exceedances of the release criteria) left in the survey unit and the elevated measurement was not assessed further. The NRC staff note that should an elevated area assessment have been conservatively performed based on the elevated measurement, it likely would not have resulted in exceeding the release criteria because other survey units with comparable elevations have been assessed (see assessments of NOL01-02 and NOL01-04) with a compliance dose determination of less than 10 mrem/y.

Of the ROCs neither deselected nor reported (Nb-94, Eu-152, Eu-154, Np-237, and Am-241), the licensee verbally stated that these ROCs were not detected above their respective MDCs and had negligible dose impact so were not reported. As previously discussed, the NRC staff assessed the unreported and unaddressed ROCs as generally being conservatively bounded by contributing 1 mrem/y hypothetical dose.

The licensee stated that approximately 100 percent of the survey unit was scanned. This is consistent with MARSSIM guidance for Class 1 survey units when accounting for human error in scanning coverage. The licensee noted in its description of the scanning survey that ~88 percent of the area was scanned by walking transects across the area while moving the detector in a serpentine fashion (i.e., traditional scanning). The remainder of the survey unit was addressed by taking ISOCS measurements as the project safety team decided those portions of the area were unsafe to traverse while scanning. A couple of areas where relatively high ISOCS measurements were noted were subsequently scanned using traditional scanning methods as well. As previously mentioned, while not ideal for scanning, the NRC staff find use of ISOCS measurements for this purpose to be acceptable, given the circumstances.

Based on the initially reported data, the licensee stated the hypothetical dose in the survey unit was 1.11 mrem/y (0.923 mrem/y based upon the Co-60 and Cs-137 analytical results in the systematic collected samples, plus 0.187 mrem/y from the deselected HTD ROCs). The NRC staff's determination of a bounding hypothetical dose is 5.8 mrem/y (0.923 from the Co-60 and Cs-137 analytical results in the systematic collected samples, plus 2.9 mrem/y bounding dose from HTD ROCs, plus 1 mrem/y bounding dose from the unaddressed and unreported ROCs, and plus 1 mrem/y from a bounding consideration of residual radioactivity in groundwater). Regardless, in both cases the hypothetical dose in the survey unit from residual radioactivity in soil/groundwater is far below the 25 mrem/y unrestricted release criteria.

The survey of OOL01-03-FSR employed similar logic as was employed for the survey of OOL01-03 and the licensee estimated a slightly lower dose based on those survey results of 0.33 mrem/y. The licensee estimates both surveys as contributing less than 1.2 mrem/y hypothetical dose while the NRC staff would bound the hypothetical dose at less than 6 mrem/y. Both the survey of OOL01-03-FSR and the survey of OOL01-03 indicate that the survey unit meets the unrestricted release criteria by being less than 25 mrem/y.

### OOL10-01 (Fuel Oil Storage Tank Area)

The survey unit designated as OOL10-01 was classified by the licensee as a MARSSIM Class 3 unit and is described as an approximately 6,473 m<sup>2</sup> area, which is consistent with MARSSIM, Section 4.6, limitations on survey unit areas. The licensee describes the survey unit as being bounded by OOL10-22 on the north and OOL10-17 on the south, east, and west. Survey unit OOL10-01 consists primarily of the open land areas and it was surveyed prior to the construction of the Waste Management Facility (approximately 1,161 m<sup>2</sup>) and the waste storage pad approximately 2,286 m<sup>2</sup>). A portion of the area was backfilled with reclaimed soil from various locations on-site that had passed through the GARDIAN system to facilitate the construction. A second survey of the surface of that portion of this accessible open land area was performed with the survey unit redesignated as OOL10-01-FSR and yet another of the engineered material pad covering the area designated as OOL10-24-FSR. Structures, such as the Waste Management Facility, was also erected in this area but was previously evaluated by the staff (see ADAMS Accession No. ML21225A774). As such, the FSS of this survey unit can be best described as being several FSSs, one of the initial area footprint, another of the backfilled area or pad after backfilling, and yet others of the structures that were erected. Unlike most other survey units, the NRC staff concludes that an individual could receive a dose from multiple portions of the area of this survey unit (e.g., the soil material plus the structures) and that the dose from some of these surveys should be assumed to be additive to conservatively address the overall hypothetical dose and demonstrate compliance with the unrestricted release criteria.

Because this survey predated the revisions the licensee eventually established with respect to the HTD and ETD ROCs, the licensee used its Data Quality Objectives (DQO) process to only consider Cs-137 in this survey. The licensee also used a DCGL corresponding to one half the NRC screening value as opposed to later site-specific DCGLs (5.5 pCi/g Cs-137 vs 7.9 pCi/g Cs-137). The licensee determined the required number of soil samples using a Type 1 and Type 2 error rate of 0.05 and a relative shift of 2. The licensee determined that the required number of samples was 15 which the NRC staff determined is consistent with Table 5.5 of MARSSIM.

Of the systematic samples collected in this survey, the licensee reported that the maximum Cs-137 analytical result is 0.353 pCi/g and the average is 0.185 pCi/g, equating to 0.85 mrem/y hypothetical dose. The NRC staff verified the licensee's calculations. Eight of the fifteen samples had Cs-137 results greater than the MDC. The licensee reported the measured concentrations of the remaining ETD ROCs in its report and none of those exceeded the MDC values in any sample collected. The licensee considered those ROCs to be negligible as they did not contribute to the hypothetical dose (i.e., had a SOF of <0, on average). Because none of the data exceeded the Cs-137 DCGL, the licensee describes the survey unit as passing based on inspection. The NRC staff concurs that, based solely on the Cs-137 analytical results presented, the data indicate meeting the release criteria by inspection. In contrast, the NRC staff considered all of the ETD ROC data reported by the licensee as well as using the site-specific Cs-137 DCGL value (7.9 pCi/g) and determined that the maximum SOF from the samples was 0.115 and the average SOF was 0.044 (the NRC staff utilized positive average ETD ROC data and set negative average values to "0" instead of summing the negative values), corresponding to 1.09 mrem/y. Including all of the ETD data and approved site-specific DCGLs did not result in significant differences from the licensee's evaluation based on Cs-137 alone and the NRC staff generally agree that the remaining ETD ROCs contribution is relatively negligible, in this case.

The licensee did not address the HTD ROCs in this survey. However, in surveys performed later, the licensee considers the hypothetical dose estimated from the 14 HTD ROCs as being 0.568 mrem/y for Class 3 survey units consistent with Table 4 of Attachment 1 in a recent white paper submitted in response to a RAI (see ADAMS Accession No. ML21063A474, Attachment 1). Table 8 of the same Attachment bounds the hypothetical dose from all HTD ROCs in any survey unit as being 2.9 mrem/y. As described above, the NRC staff believe it more appropriate to conservatively bound the impact of the HTD ROCs at 2.9 mrem/y.

The licensee stated that approximately 100 percent of the survey unit was scanned. This is conservative compared to MARSSIM guidance for Class 3 survey units (see Table 5.9 of MARSSIM) which state only that the area should be judgmentally scanned and the licensee's LTP (Table 5-4) requires 1-10 percent of areal scan coverage for Class 3 survey units. The licensee noted in its description of the scanning survey that ~100 percent of the area was scanned by walking transects across the area while moving the detector in a serpentine fashion (i.e., traditional scanning). The licensee collected 11 biased samples, including one engineered material sample, in the survey unit which were subsequently analyzed for ETD ROCs. Four of these samples had Cs-137 detected at greater than the MDC with the maximum Cs-137 concentration being 0.7 pCi/g. The licensee notes that it further investigated two of the sampling locations because the concentrations in biased samples exceeded its investigation levels but no elevations were subsequently identified as a result of these investigations. As such, the licensee concluded, and the NRC staff concur, that no elevated areas of residual radioactivity (i.e., exceeding the release criteria) were identified in the survey unit.

Based on the initially reported data, the licensee stated the hypothetical dose in the survey unit was 0.85 mrem/y (based upon the Cs-137 analytical results in the systematic collected samples). The NRC staff's determination of a bounding hypothetical dose is 5.0 mrem/y (1.09 mrem/y from the ETD ROCs analytical results in the systematic samples collected, plus 2.9 mrem/y bounding dose from HTD ROCs, and plus 1 mrem/y from a bounding consideration of residual radioactivity in groundwater). Regardless, in both cases the hypothetical dose in the survey unit from residual radioactivity in soil/groundwater is far below the 25 mrem/y unrestricted release criteria.

The NRC staff also reviewed the building structure surveys in OO10-01 as well as the waste storage pad survey designated as OO10-24-FSR. The NRC staff's evaluation of the Waste Management Facility surveys (see ADAMS Accession No. ML21225A774) found that the Waste Management Facility contributes a hypothetical dose of, at most, 1.07 mrem/y to a potential occupant. Similarly, the Waste Management Facility pad, discussed in the FSSR for survey unit OOL10-24-FSR in this submittal, was reported by the licensee as contributing 1.11 mrem/y hypothetical dose.

The survey of OOL10-01-FSR employed similar logic as used for the survey of OOL10-01 and the licensee estimates a slightly lower dose based on those survey results of 0.71 mrem/y. As such, the licensee estimates both surveys as contributing less than 1 mrem/y hypothetical dose while the NRC staff would bound the hypothetical dose at less than 5 mrem/y. In addition, the NRC staff would consider the potential dose contribution of occupants based on structural surveys of the waste storage pad or Waste Management Facility to be potentially additive with the dose from the structures located in the survey unit. As such, the hypothetical dose received by an occupant would be expected to be slightly greater than 6 mrem/y (5 mrem/y plus a dose of slightly more than 1 mrem/y from the Waste Management Facility or the Waste Management Facility pad) from residual radioactivity in the structure/pad as well as in soil/groundwater. Because all surveys individually and collectively contribute minimally to the hypothetical dose

and with the final cumulative dose being much less than the unrestricted decommissioning criteria (i.e., < 25 mrem/y), the NRC staff finds the surveys adequate for demonstrating compliance with the unrestricted release criteria.

#### NOL01-02 (Upper Yard)

The survey unit designated as NOL01-02 was classified by the licensee as a MARSSIM Class 1 unit and is described as an approximately 1,105 m<sup>2</sup> area, which is consistent with MARSSIM, Section 4.6, limitations on survey unit areas. The licensee describes the survey unit as abutting NOL01-01 on the north, OOL10-20 on the east, NOL01-03 on the south, and OOL08-03 on the west. Survey unit NOL01-02 contains a portion of the north yard, Solid Radwaste Building Slab, Low Level Radwaste Building Slab, and surrounding areas. The licensee further described this area as an excavation to remove the remaining miscellaneous decommissioning commodities. After the waste materials were removed, the FSS of the excavation was conducted and, after the FSS activities for the excavation were completed, the area was backfilled with reclaimed soil from various locations on-site that had passed through the GARDIAN system. After backfilling of the area was completed, a second survey of the surface of this area was performed with the survey unit redesignated as NOL01-02-FSR. As such, the FSS of this survey unit can be best described as being two FSSs, one of the excavation footprint, and another of the remediated area after backfilling. So long as both surveys demonstrate compliance with the unrestricted release criteria, a weighted average of the two would similarly be expected to meet the criteria.

The licensee's survey design was based on a SOF determination, and a value less than unity would result in meeting the unrestricted dose criteria of 25 mrem/y. The licensee "deselected" the HTD ROCs listed in Table 6-4 of the LTP (assigning a hypothetical dose of 0.187 mrem/y from the HTD ROCs) and leaving seven ETD ROCs to be quantified through sampling/analysis. The licensee's plans for the survey emphasized Co-60 and Cs-137. The licensee determined the required number of soil samples using a Type 1 and Type 2 error rate of 0.05 and a relative shift of 2. The licensee determined that the required number of samples was 21, which the NRC staff determined is conservative compared to Table 5.5 of MARSSIM, which requires 15 samples.

The hypothetical dose estimated from the 14 deselected ROCs was 0.187 mrem/y in the submittal consistent with Table 2 of Attachment 1 in a recent white paper submitted in response to a RAI (see ADAMS Accession No. ML21063A474, Attachment 1). Table 8 of the same Attachment bounds the hypothetical dose from all HTD ROCs in any survey unit as being 2.9 mrem/y. As discussed above, the NRC staff believe it more appropriate to conservatively bound the impact of the HTD ROCs at 2.9 mrem/y, in this case.

Of the systematic samples collected in this survey, the licensee reported that the maximum SOF from the analytical results, based solely on Co-60 and Cs-137 data, is 0.208 and the average is 0.0218, equating to 0.553 mrem/y hypothetical dose. Eight samples had Cs-137 greater than the MDC with none having Co-60 exceeding its MDC. The highest Cs-137 result was 1.52 pCi/g. The NRC staff checked the licensee's calculations and found them correct. Because none of the data exceeded a SOF of unity, the licensee describes the survey unit as passing based on inspection. The NRC staff concurs that, based solely on the analytical results presented, the data indicate meeting the release criteria by inspection.

Of the ROCs neither deselected nor reported (Nb-94, Eu-152, Eu-154, Np-237, and Am-241), the licensee verbally stated that these ROCs were not detected above their respective MDCs and had negligible dose impact so were not reported. As previously discussed, the NRC staff

assessed the unreported and unaddressed ROCs as generally being conservatively bounded by contributing 1 mrem/y hypothetical dose.

The licensee stated that approximately 100 percent of the survey unit was scanned. This is consistent with MARSSIM guidance for Class 1 survey units when accounting for human error in scanning coverage. The licensee noted in its description of the scanning survey that ~100 percent of the area was scanned by walking transects across the area while moving the detector in a serpentine fashion (i.e., traditional scanning).

The licensee also collected four biased and one investigative sample in the survey unit in areas identified by scanning that were subsequently analyzed for ETD ROCs. Each of these samples had Cs-137 detected at greater than the MDC with the investigative sample having a concentration that exceeded the DCGL (a concentration of 8.56 pCi/g). The licensee noted that pre- and post-sampling measurements were taken using a 2x2 Sodium Iodide (NaI) detector, which indicated the material was in a discrete area that was effectively remediated through sampling. Additional biased samples were taken near the elevated sample location to assess the effectiveness of remediation and contained Cs-137 at less than half the DCGL. The licensee evaluated the elevated area (24 m<sup>2</sup> area) as provided in the Attachment to the submittal and found the overall compliance SOF to be 0.18, which corresponds to a hypothetical dose of 4.5 mrem/y. The NRC staff checked the licensee's calculations and found that the licensee erroneously included negative average concentrations in its determinations (it is acceptable to utilize sample negative analytical results to establish an average concentration, but not to use an unrealistic negative average concentration to demonstrate compliance). The NRC calculated a compliance SOF value of 0.207, corresponding to 5.175 mrem/y, by setting negative average concentrations to "0" for all ETD ROCs. The NRC staff also note that the licensee neglected to incorporate the dose contribution from elevated areas into its estimate of compliance dose consistent with Section 8.5.2 of MARSSIM.

Based on the initially reported data, the licensee stated the hypothetical dose in the survey unit was 0.74 mrem/y (0.553 mrem/y based upon the Co-60 and Cs-137 analytical results in the systematic collected samples, plus 0.187 mrem/y from the deselected HTD ROCs). The NRC staff's determination of a bounding hypothetical dose is 9.1 mrem/y (5.175 mrem/y from the ETD ROC analytical results (including Co-60 and Cs-137) in the elevated area assessment, plus 2.9 mrem/y bounding dose from HTD ROCs, and plus 1 mrem/y from a bounding consideration of residual radioactivity in groundwater). While the licensee did not correctly calculate the elevated area dose nor incorporate it into its compliance dose estimate, in both cases, the hypothetical dose in the survey unit from residual radioactivity in soil/groundwater is significantly less than the 25 mrem/y unrestricted release criteria.

The survey of NOL01-02-FSR used a similar logic as was employed for the survey of NOL01-02 and the licensee estimated a slightly lower dose based on those survey results of 0.32 mrem/y. As such, the licensee estimates both surveys as contributing less than 1 mrem/y hypothetical dose while the NRC staff would bound the hypothetical dose at less than 10 mrem/y. Both surveys indicate that the survey unit meets the unrestricted release criteria by being less than 25 mrem/y.

#### NOL01-04 (East Yard Excavation)

The survey unit designated as NOL01-04 was classified by the licensee as a MARSSIM Class 1 unit and is described as an approximately 621 m<sup>2</sup> area, which is consistent with MARSSIM, Section 4.6, limitations on survey unit areas. The licensee describes the survey unit as abutting



NOL01-05 on the north, NOL01-07 and the Cutter Soil Mix (CSM) wall on the east, and NOL01-06 on the south. Survey unit NOL03-01 consists of an open excavation to remove remaining decommissioning commodities. After the waste materials were removed, the FSS of the excavation was conducted and the area was backfilled with reclaimed soil from various locations on-site that had passed through the GARDIAN system. After backfilling of the area was completed, a second survey of the surface of this area was performed with the survey unit redesignated as NOL01-04-FSR. As such, the FSS of this survey unit can be best described as being two FSSs, one of the excavation footprint, and another of the remediated area after backfilling. So long as both surveys demonstrate compliance with the unrestricted release criteria, a weighted average of the two would similarly be expected to meet the criteria.

The licensee's survey design was based on a SOF determination and a value less than unity would result in meeting the unrestricted dose criteria of 25 mrem/y. The licensee "deselected" the HTD ROCs listed in Table 6-4 of the LTP (assigning a hypothetical dose of 0.187 mrem/y from the HTD ROCs) and leaving only seven ETD ROCs to be quantified through sampling/analysis. The licensee's plans for the survey emphasized Cs-137 and Co-60. The licensee determined the required number of soil samples using a Type 1 and Type 2 error rate of 0.05 and a relative shift of 1.43. The licensee determined that the required number of samples was 20, which the NRC staff determined is consistent with Table 5.5 of MARSSIM.

The hypothetical dose estimated from the 14 deselected HTD ROCs was 0.187 mrem/y in the submittal consistent with Table 2 of Attachment 1 in a recent white paper submitted in response to a RAI (see ADAMS Accession No. ML21063A474, Attachment 1). Table 8 of the same Attachment bounds the hypothetical dose from all HTD ROCs in any survey unit as being 2.9 mrem/y. As described previously, the NRC staff believe it more appropriate to conservatively bound the impact of the HTD ROCs at 2.9 mrem/y, in this case.

Of the systematic samples collected in this survey, the licensee reported that the maximum SOF from the analytical results, based solely on Co-60 and Cs-137 data, is 0.0274 and the average is 0.0044, equating to 0.113 mrem/y hypothetical dose. Only two samples had Cs-137 greater than the MDC with none of the Co-60 results exceeding the MDC. The NRC staff checked the licensee's calculations and found them correct. Because none of the data exceeded a SOF of unity, the licensee describes the survey unit as passing based on inspection. The NRC staff concurs that, based solely on the analytical results presented, the data indicate meeting the release criteria by inspection.

Of the ROCs neither deselected nor reported (Nb-94, Eu-152, Eu-154, Np-237, and Am-241), the licensee verbally stated that these ROCs were not detected above their respective MDCs and had negligible dose impact so were not reported. As previously discussed, the NRC staff assessed the unreported and unaddressed ROCs as generally being conservatively bounded by contributing 1 mrem/y hypothetical dose.

The licensee stated that approximately 100 percent of the survey unit was scanned. This is consistent with MARSSIM guidance for Class 1 survey units when accounting for human error in scanning coverage. The licensee noted in its description of the scanning survey that ~96.5 percent of the area was scanned by walking transects across the area while moving the detector in a serpentine fashion (i.e., traditional scanning). The remainder of the survey unit was addressed by taking ISOCS measurements as the project safety team decided those portions of the area were unsafe to traverse while scanning. As previously mentioned, while not ideal for scanning, the NRC staff find use of ISOCS measurements for this purpose to be acceptable, given the circumstances.

The licensee collected 5 biased and 14 investigative samples in the survey unit in areas identified by scanning and which were subsequently analyzed for ETD ROCs. Eight of these samples had Cs-137 detected at greater than the MDC with two exceeding the DCGL. One of these samples also had detectable Co-60 at a concentration exceeding the DCGL as well as detectable Am-241. Both of the elevated samples were investigative samples identified through scanning. Similar to other elevations identified through scanning, most of the materials were remediated through sampling as demonstrated by pre- and post-sampling measurements. One elevated area was given additional remediation with post remediation sampling to demonstrate that it was remediated to levels below the DCGL. The licensee evaluated the two elevated areas (each 1 m<sup>2</sup>) as provided in the Attachment to the submittal and derived a SOF compliance value of 0.1 and 0. The NRC staff reviewed the licensee's calculation and found the licensee erroneously included negative average concentrations, as previously discussed, in its assessments as the NRC calculated a SOF value of 0.138, corresponding to a dose of 3.45 mrem/y, for the 1<sup>st</sup> elevated area, and a SOF value of 0.064, corresponding to a dose of 1.6 mrem/y, for the 2<sup>nd</sup> elevated area for a combined elevated areas hypothetical dose of 5.05 mrem/y (3.45 + 1.6). The NRC staff also noted that the licensee did not consolidate the average contamination level along with both elevated areas to derive a compliance SOF estimate such as was intended per MARSSIM Section 8.5.2 nor a corresponding compliance dose estimate.

Based on the initially reported data, the licensee stated the hypothetical dose in the survey unit was 0.30 mrem/y (0.113 mrem/y based upon the Co-60 and Cs-137 analytical results in the systematic collected samples, plus 0.187 mrem/y from the deselected HTD ROCs). The NRC staff's determination of a bounding hypothetical dose is 9.1 mrem/y (0.113 mrem/y from the Co-60 and Cs-137 analytical results in the systematic collected samples, plus 5.1 mrem/y from the elevated area assessments, plus 2.9 mrem/y bounding dose from HTD ROCs, and plus 1 mrem/y from a bounding consideration of residual radioactivity in groundwater). While the licensee did not calculate the elevated areas contribution correctly nor include that in a compliance dose estimate, in both cases the hypothetical dose in the survey unit from residual radioactivity in soil/groundwater is significantly below the 25 mrem/y unrestricted release criteria.

The survey of NOL01-04-FSR followed similar logic as was employed for NOL01-04 and the licensee estimated a slightly lower dose based on those survey results of 0.27 mrem/y. As such, the licensee estimates both surveys as contributing less than 1 mrem/y hypothetical dose while the NRC staff would bound the hypothetical dose at less than 10 mrem/y. Both surveys indicate that the survey unit meets the unrestricted release criteria by being less than 25 mrem/y.

#### NOL01-05 (North Yard)

The survey unit designated as NOL01-05 was classified by the licensee as a MARSSIM Class 1 unit and is described as an approximately 1,036 m<sup>2</sup> area, which is consistent with MARSSIM, Section 4.6, limitations on survey unit areas. The licensee describes the survey unit as abutting NOL01-03 to the north, NOL01-08 to the east, the CSM wall to the south, and OOL03-02 to the west. Survey unit NOL01-05 contains a portion of the north yard and the Liquid Radwaste Building footprint and is described as an excavation to remove any remaining miscellaneous decommissioning commodities. After the waste materials were removed, the FSS of the excavation was conducted, and once completed, the area was backfilled with reclaimed soil from various locations on-site that had passed through the GARDIAN system. After backfilling

of the area was completed, a second survey of the surface of this area was performed with the survey unit redesignated as NOL01-05-FSR. As such, the FSS of this survey unit can be best described as being two FSSs, one of the excavation footprint, and another of the remediated area after backfilling. So long as both surveys demonstrate compliance with the unrestricted release criteria, a weighted average of the two would similarly be expected to meet the criteria.

The licensee's survey design was based on a SOF determination and a value less than unity would result in meeting the unrestricted dose criteria of 25 mrem/y. The licensee "deselected" the HTD ROCs listed in Table 6-4 of the LTP (assigning a hypothetical dose of 0.187 mrem/y from the HTD ROCs) and leaving only seven ETD ROCs to be quantified through sampling/analysis. The licensee's plans for the survey emphasized Cs-137 and Co-60. The licensee determined the required number of soil samples using a Type 1 and Type 2 error rate of 0.05 and a relative shift of 1.4. The licensee determined that the required number of samples was 20 which the NRC staff determined is consistent with Table 5.5 of MARSSIM.

The hypothetical dose estimated from the 14 deselected ROCs was 0.187 mrem/y in the submittal consistent with Table 2 of Attachment 1 in a recent white paper submitted in response to a RAI (see ADAMS Accession No. ML21063A474, Attachment 1). Table 8 of the same Attachment bounds the hypothetical dose from all HTD ROCs in any survey unit as being 2.9 mrem/y. As previously described, the NRC staff believe it more appropriate to conservatively bound the impact of the HTD ROCs at 2.9 mrem/y, in this case.

Of the systematic samples collected in this survey, the licensee reported that the maximum SOFs from the analytical results, based solely on Co-60 and Cs-137 data, is 0.0495 and the average is 0.00453, equating to 0.123 mrem/y hypothetical dose. Only two samples had Cs-137 greater than the MDC with no detectable Co-60 being identified in any sample. The NRC staff checked the licensee's calculations and found them correct. Because none of the data exceeded a SOF of unity, the licensee describes the survey unit as passing based on inspection. The NRC staff concurs that, based solely on the analytical results presented, the data indicate meeting the release criteria by inspection.

Of the ROCs neither deselected nor reported (Nb-94, Eu-152, Eu-154, Np-237, and Am-241), the licensee verbally stated that these ROCs were not detected above their respective MDCs and had negligible dose impact so were not reported. As previously discussed, the NRC staff assessed the unreported and unaddressed ROCs as generally being conservatively bounded by contributing 1 mrem/y hypothetical dose.

The licensee stated that approximately 100 percent of the survey unit was scanned. This is consistent with MARSSIM guidance for Class 1 survey units when accounting for human error in scanning coverage. The licensee noted in its description of the scanning survey that ~87 percent of the area was scanned by walking transects across the area while moving the detector in a serpentine fashion (i.e., traditional scanning). The remainder of the survey unit was addressed by taking ISOCS measurements as the project safety team decided those portions of the area were unsafe to traverse while scanning. As previously mentioned, while not ideal for scanning, the NRC staff find use of ISOCS measurements for this purpose to be acceptable, given the circumstances. The licensee collected one biased and four investigative samples in the survey unit in areas identified by scanning that were subsequently analyzed for ETD ROCs. Only one of these samples had Cs-137 detected at greater than the MDC and it had a SOF of 0.09 (based solely on Cs-137 and Co-60 results). As such, the licensee concluded, and the NRC staff concur, that no elevated areas of residual radioactivity (i.e., exceeding the release criteria) were identified in the survey unit.

Based on the initially reported data, the licensee stated the hypothetical dose in the survey unit was 0.31 mrem/y (0.123 mrem/y based upon the Co-60 and Cs-137 analytical results in the systematic collected samples, plus 0.187 mrem/y from the deselected HTD ROCs). The NRC staff's determination of a bounding hypothetical dose is 5.0 mrem/y (0.123 mrem/y from the Co-60 and Cs-137 analytical results in the systematic samples collected, plus 2.9 mrem/y bounding dose from HTD ROCs, plus 1 mrem/y bounding dose from the unaddressed and unreported ROCs, and plus 1 mrem/y from a bounding consideration of residual radioactivity in groundwater). Regardless, in both cases the hypothetical dose in the survey unit from residual radioactivity in soil/groundwater is far below the 25 mrem/y unrestricted release criteria.

The survey of NOL01-05-FSR employed similar strategies as for the survey of NOL01-05 and the licensee estimated a slightly higher dose based on those survey results of 0.39 mrem/y. As such, the licensee estimates both surveys as contributing less than 1 mrem/y hypothetical dose while the NRC staff would bound the hypothetical dose at less than 6 mrem/y. Both surveys indicate that the survey unit meets the unrestricted release criteria by being less than 25 mrem/y.

#### NOL01-07 (Turbine Building Footprint)

The survey unit designated as NOL01-07 was classified by the licensee as a MARSSIM Class 1 unit and is described as an approximately 425 m<sup>2</sup> area, which is consistent with MARSSIM, Section 4.6, limitations on survey unit areas. The licensee describes the survey unit as abutting the CSM wall to the north, OOL03-02 to the west, NOL01-06 to the south, and NOL01-04 to the east. Survey unit NOL01-07 is further described as an excavation to remove any remaining miscellaneous decommissioning commodities. After the waste materials were removed, the FSS of the excavation was conducted and the area was backfilled with reclaimed soil from various locations on-site that had passed through the GARDIAN system. After backfilling of the area was completed, a second survey of the surface of this area was performed with the survey unit redesignated as NOL01-07-FSR. As such, the FSS of this survey unit can be best described as being two FSSs, one of the excavation footprint, and another of the remediated area after backfilling. So long as both surveys demonstrate compliance with the unrestricted release criteria, a weighted average of the two would similarly be expected to meet the criteria.

The licensee's survey design was based on a SOF determination and a value less than unity would result in meeting the unrestricted dose criteria of 25 mrem/y. The licensee "deselected" the HTD ROCs listed in Table 6-4 of the LTP (assigning a hypothetical dose of 0.187 mrem/y from the HTD ROCs) and leaving only seven ETD ROCs to be quantified through sampling/analysis. The licensee's plans for the survey emphasized Co-60 and Cs-137. The licensee determined the required number of soil samples using a Type 1 and Type 2 error rate of 0.05 and a relative shift of 1.67. The licensee determined that the required number of samples was 17, which the NRC staff determined is consistent with Table 5.5 of MARSSIM.

The hypothetical dose estimated from the 14 deselected ROCs was 0.187 mrem/y in the submittal consistent with Table 2 of Attachment 1 in a recent white paper submitted in response to a RAI (see ADAMS Accession No. ML21063A474, Attachment 1). Table 8 of the same Attachment bounds the hypothetical dose from all HTD ROCs in any survey unit as being 2.9 mrem/y. As previously described, the NRC staff believe it more appropriate to conservatively bound the impact of the HTD ROCs at 2.9 mrem/y, in this case.

Of the systematic samples collected in this survey, the licensee reported that the maximum SOF from the analytical results, based solely on Co-60 and Cs-137 data, is 0.298 and the average is 0.0202, equating to 0.513 mrem/y hypothetical dose. Only three samples had Cs-137 greater than the MDC with no sample having detectable Co-60. The NRC staff checked the licensee's calculations and found them correct. Because none of the data exceeded a SOF of unity, the licensee describes the survey unit as passing based on inspection. The NRC staff concurs that, based solely on the analytical results presented, the data indicate meeting the release criteria by inspection.

Of the ROCs neither deselected nor reported (Nb-94, Eu-152, Eu-154, Np-237, and Am-241), the licensee verbally stated that these ROCs were not detected above their respective MDCs and had negligible dose impact so were not reported. As previously discussed, the NRC staff assessed the unreported and unaddressed ROCs as generally being conservatively bounded by contributing 1 mrem/y hypothetical dose.

The licensee stated that approximately 100 percent of the survey unit was scanned. This is consistent with MARSSIM guidance for Class 1 survey units when accounting for human error in scanning coverage. The licensee noted in its description of the scanning survey that ~81 percent of the area was scanned by walking transects across the area while moving the detector in a serpentine fashion (i.e., traditional scanning). The remainder of the survey unit was addressed by taking ISOCS measurements as the project safety team decided those portions of the area were unsafe to traverse while scanning. As previously mentioned, while not ideal for scanning, the NRC staff find use of ISOCS measurements for this purpose to be acceptable, given the circumstances.

The licensee collected four biased and one investigative sample in the survey unit in areas identified by scanning that were subsequently analyzed for ETD ROCs. Two of these samples had detectable Cs-137 and Co-60 with the highest having a SOF of 0.88 (based solely on Cs-137 and Co-60 results). As such, the licensee concluded, and the NRC staff concur, that no elevated areas of residual radioactivity (i.e., exceeding the release criteria) were identified in the survey unit.

Based on the initially reported data, the licensee stated the hypothetical dose in the survey unit was 0.70 mrem/y (0.513 mrem/y based upon the Co-60 and Cs-137 analytical results in the systematic samples collected, plus 0.187 mrem/y from the deselected HTD ROCs). The NRC staff's determination of a bounding hypothetical dose is 5.3 mrem/y (0.513 mrem/y from the Co-60 and Cs-137 analytical results in the systematic collected samples, plus 2.9 mrem/y bounding dose from HTD ROCs, plus 1 mrem/y bounding dose from the unaddressed and unreported ROCs, and plus 1 mrem/y from a bounding consideration of residual radioactivity in groundwater). Regardless, in both cases the hypothetical dose in the survey unit from residual radioactivity in soil/groundwater is far below the 25 mrem/y unrestricted release criteria.

The survey of NOL07-01-FSR employed similar logic as was employed for the survey of NOL07-01 and the licensee estimated a slightly lower dose based on those survey results of 0.26 mrem/y. As such, the licensee estimates both surveys as contributing less than 1 mrem/y hypothetical dose while the NRC staff would bound the hypothetical dose at less than 6 mrem/y. Both surveys indicate that the survey unit meets the unrestricted release criteria by being less than 25 mrem/y.

## Conclusions

The licensee's FSS design criteria, implementation of the DQO process, and survey approach/methods were reviewed, and final results were assessed against the licensee's approved release criteria. While some deficiencies were noted (often the licensee failed to address all ROCs in the LTP, adequately consider the extent of backfill, or evaluate elevated areas properly), the NRC staff found these inconsistencies to be of relatively minor consequence to the finding that the unrestricted release criterion were met because staff could conclude it to be very unlikely the unaddressed ROCs or depth of backfill would have significant dose impact relative to the materials and analytes reported, and proper consideration of elevated areas did not result in a survey unit exceeding the release criteria (i.e. >25 mrem/y).

The NRC staff find the data in the licensee reports submitted in Enclosures 1, 2, and 3 to the letter dated June 8, 2021 (ADAMS Accession No. ML21160A224), as submitted by letter dated July 13, 2021 (ADAMS Accession No. ML21194A441), and as submitted by letter dated August 9, 2021 (ADAMS Accession No. ML21221A135) demonstrate meeting the unrestricted use criteria found in 10 CFR 20.1402 for all 64 survey units addressed in the submittals. The NRC staff's findings are supported by confirmatory surveys conducted by Oak Ridge Institute for Science and Education (ORISE) (an independent NRC contractor, see ADAMS Accession No. ML16250A432, ML16250A433, ML16300A275, and ML20021A128) in which scanning surveys and sampling was performed in these land areas with no findings in excess of the release criteria.

The NRC staff concludes that: 1) the FSSs were effectively conducted in accordance with the LTP, as amended, even though some scanning surveys were less than optimal due to inaccessibility. The NRC staff independently evaluated data in the FSSRs and, in concurrence with the approved revised LTP, found the data adequate even though the licensee failed to address all site ROCs in some reports or assess elevated areas properly; (2) the FSSR and RAI responses contain the information identified in NUREG-1757, "Consolidated NMSS Decommissioning Guidance," Section 4.5; and (3) the FSS results demonstrate that the residual radioactivity in the 64 survey unit(s) addressed in the submittals meet the radiological criteria for unrestricted release identified in the LTP. The NRC staff's conclusion is based on its review of the licensee's FSSRs, survey release records, responses to RAIs, and the results of confirmatory surveys conducted by ORISE.

Table 1. Summary of 64 Survey Units Final Status Surveys

Accession No.	Survey Unit	Classification	Matrix	Area (m <sup>2</sup> )	Area Scanned	Survey Hypothetical Dose (mrem/y)	Any Elevations?	Elevation Dose (mrem/y)	HTD Dose (mrem/y)	Licensee Reported Dose (mrem/y)	Unaddressed ROCs	NRC bounding dose estimate (mrem/y)
ML21160A224	OOL02-02 FSR	1	soil	432	~100%	0.04	N	N/A	0.187	0.23	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.94
ML21160A224	OOL03-01	1	soil	1977	~100%	0.46	N	N/A	0.187	0.65	Eu-152, Eu-154, Am-241, Nb-94, Np-237	5.36
ML21160A224	OOL03-01-FSR	1	soil	1976	~100%	0.136	N	N/A	0.187	0.33	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.04
ML21160A224	OOL03-02	1	soil	1996	~100%	0.285	N	N/A	0.187	0.48	Eu-152, Eu-154, Am-241, Nb-94, Np-237	5.19
ML21160A224	OOL03-02-FSR	1	soil	1854	~100%	0.145	N	N/A	0.187	0.34	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.05
ML21160A224	OOL04-01	1	soil	1978	~100%	2.55	N	N/A	0.187	2.74	Am-241, Nb-94, Np-237	7.45

Accession No.	Survey Unit	Classification	Matrix	Area (m <sup>2</sup> )	Area Scanned	Survey Hypothetical Dose (mrem/y)	Any Elevations?	Elevation Dose (mrem/y)	HTD Dose (mrem/y)	Licensee Reported Dose (mrem/y)	Unaddressed ROCs	NRC bounding dose estimate (mrem/y)
ML21160A224	OOL04-01-FSR	1	soil	1978	~100%	0.081	N	N/A	0.187	0.27	Eu-152, Eu-154, Am-241, Co-60, Nb-94,	4.98
ML21160A224	OOL08-01	1	soil	1912	~100%	0.09	N	N/A	0.187	0.28	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.99
ML21160A224	OOL08-01-FSR	1	soil	1912	~100%	0.087	N	N/A	0.187	0.28	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.99
ML21160A224	OOL08-02	1	soil	1147	~100%	0	N	N/A	0.187	0.18	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.9
ML21160A224	OOL08-02-FSR	1	soil	1147	~100%	0.209	N	N/A	0.187	0.4	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.11
ML21160A224	OOL08-03	1	soil	1718	~100%	0.031	N	N/A	0.187	0.22	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.93



Accession No.	Survey Unit	Classification	Matrix	Area (m <sup>2</sup> )	Area Scanned	Survey Hypothetical Dose (mrem/y)	Any Elevations?	Elevation Dose (mrem/y)	HTD Dose (mrem/y)	Licensee Reported Dose (mrem/y)	Unaddressed ROCs	NRC bounding dose estimate (mrem/y)
ML21160A224	OOL08-03-FSR	1	soil	1147	~100%	0.116	N	N/A	0.187	0.31	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.02
ML21160A224	OOL08-04-FSR	1	soil	1622	~100%	0.061	N	N/A	0.187	0.25	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.96
ML21160A224	OOL08-05-FSR	1	soil	1283	~100%	0.1	N	N/A	0.187	0.29	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.00
ML21160A224	OOL08-06-FSR	1	soil	1940	~100%	0.116	N	N/A	0.187	0.31	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.02
ML21160A224	OOL10-18	1	soil	902	~100%	0.073	N	N/A	0.187	0.27	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.97

Accession No.	Survey Unit	Classification	Matrix	Area (m <sup>2</sup> )	Area Scanned	Survey Hypothetical Dose (mrem/y)	Any Elevations?	Elevation Dose (mrem/y)	HTD Dose (mrem/y)	Licensee Reported Dose (mrem/y)	Unaddressed ROCs	NRC bounding dose estimate (mrem/y)
ML21160A224	OOL10-18-FSR	1	soil	1004	~100%	0.074	N	N/A	0.187	0.27	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.97
ML21160A224	OOL10-25	3	soil	8997	~60%	0.137	N	N/A	0.568	0.71	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.04
ML21160A224	OOL-10-25-FSR	3	soil	4152	~90%	0.076	N	N/A	0.568	0.65	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.98
ML21160A224 Intake Canal	OOL02-01	1	soil	1972	0%	0.86	N	N/A	0.187	1.05	N/A	4.76
ML21160A224 Intake Canal	OOL06-01	2	soil	2156	0%	0.341	N	N/A	0.12	0.46	N/A	4.24
ML21160A224 Intake Canal	OOL11-01	3	soil	2436	0%	0.306	N	N/A	0.568	0.874	N/A	4.21

Accession No.	Survey Unit	Classification	Matrix	Area (m <sup>2</sup> )	Area Scanned	Survey Hypothetical Dose (mrem/y)	Any Elevations?	Elevation Dose (mrem/y)	HTD Dose (mrem/y)	Licensee Reported Dose (mrem/y)	Unaddressed ROCs	NRC bounding dose estimate (mrem/y)
ML21160A224	OOL01-01	1	soil	1624	~100%	0.243	N	N/A	0.187	0.44	Eu-152, Eu-154, Am-241, Nb-94, Np-237	5.14
ML21160A224	OOL01-01-FSR	1	soil	1624	~100%	0.086	N	N/A	0.187	0.28	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.99
ML21160A224	OOL01-02	1	soil	1018	~100%	1.013	N	N/A	0.187	2.91	Eu-152, Eu-154, Am-241, Nb-94, Np-237	5.91
ML21160A224	OOL01-02-FSR	1	soil	1004	~100%	0.1437	N	N/A	0.187	0.34	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.04
ML21160A224	OOL01-03	1	soil	1319	~100%	0.918	Y/N	N/A	0.187	1.11	Eu-152, Eu-154, Am-241, Nb-94, Np-237	5.82
ML21160A224	OOL01-03-FSR	1	soil	986	~100%	0.1358	N	N/A	0.187	0.33	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.04

Accession No.	Survey Unit	Classification	Matrix	Area (m <sup>2</sup> )	Area Scanned	Survey Hypothetical Dose (mrem/y)	Any Elevations?	Elevation Dose (mrem/y)	HTD Dose (mrem/y)	Licensee Reported Dose (mrem/y)	Unaddressed ROCs	NRC bounding dose estimate (mrem/y)
ML21160A224	OOL05-01	2	soil	448	~100%	0.104	N	N/A	0.12	0.23	Eu-152, Eu-154, Am-241, Nb-94, Np-237	5.00
ML21160A224	OOL07-01	1	soil	1585	~100%	0.2473	N	N/A	0.187	0.44	Eu-152, Eu-154, Am-241, Nb-94, Np-237	5.15
ML21160A224	OOL07-01-FSR	1	soil	1622	~100%	0.1386	N	N/A	0.187	0.33	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.04
ML21160A224	OOL07-02	1	soil	472	~100%	0.0288	N	N/A	0.187	0.22	Am-241, Nb-94, Np-237	4.93
ML21160A224	OOL07-02-FSR	1	soil	472	~100%	0.1472	N	N/A	0.187	0.34	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.05
ML21160A224	OOL07-03	1	soil	1967	~100%	0.1725	N	N/A	0.187	0.36	Eu-152, Eu-154, Am-241, Nb-94, Np-237	5.07
ML21160A224	OOL07-03-FSR	1	soil	1968	~100%	0.1136	N	N/A	0.187	0.31	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.01

Accession No.	Survey Unit	Classification	Matrix	Area (m <sup>2</sup> )	Area Scanned	Survey Hypothetical Dose (mrem/y)	Any Elevations?	Elevation Dose (mrem/y)	HTD Dose (mrem/y)	Licensee Reported Dose (mrem/y)	Unaddressed ROCs	NRC bounding dose estimate (mrem/y)
ML21160A224	OOL07-04	1	soil	1522	~100%	0.07325	N	N/A	0.187	0.2	Eu-152, Eu-154, Am-241, Nb-94, Np-237	4.97
ML21160A224	OOL07-04-FSR	1	soil	1522	~100%	0.1316	N	N/A	0.187	0.32	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.03
ML21194A441	OOL10-01	3	soil	6473	~100%	0.585443	N	N/A	0.568	0.85		4.49
ML21194A441	OOL10-01-FSR	3	soil	3020	~100%	0.133228	N	N/A	0.568	0.71		4.03
ML21194A441	OOL10-13	3	soil	38087	~9%	0.16519	N	N/A	0.568	0.74		4.07
ML21194A441	OOL10-17	3	soil	53129	~15%	0.163608	N	N/A	0.568	0.74		4.06
ML21194A441	OOL10-17-FSR	3	soil	53129	~13%	0.170886	N	N/A	0.568	0.74		4.07
ML21194A441	OOL10-20	2	soil	7990	~57%	0.032911	N	N/A	0.12	0.16		3.93
ML21194A441	OOL10-20-FSR	2	soil	7990	~56%	0.065823	N	N/A	0.12	0.19		3.97
ML21194A441	OOL10-22	3	soil	4885	~59%	0.080063	N	N/A	0.568	0.65		3.98
ML21194A441	OOL10-22-FSR	3	soil	4885	~46%	0.122785	N	N/A	0.568	0.7		4.02
ML21194A441	OOL10-26-FSR	2	soil	1890	~100%	0.09019	N	N/A	0.12	0.22		3.99

Accession No.	Survey Unit	Classification	Matrix	Area (m <sup>2</sup> )	Area Scanned	Survey Hypothetical Dose (mrem/y)	Any Elevations?	Elevation Dose (mrem/y)	HTD Dose (mrem/y)	Licensee Reported Dose (mrem/y)	Unaddressed ROCs	NRC bounding dose estimate (mrem/y)
ML21194A441	OOL10-24-FSR	2	concrete	2286	~100%	1.1125	N	N/A	N/A	1.11		1.11
ML21221A135	NOL01-01	1	soil	1116	~100%	0	N	N/A	0.187	0.187	Eu-152, Eu-154, Am-241, Nb-94, Np-237	4.90
ML21221A135	NOL01-01-FSR	1	soil	1103	~100%	0.051	N	N/A	0.187	0.24	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.95
ML21221A135	NOL01-02	1	soil	1105	~100%	0.545	Y	4.25	0.187	0.74	Eu-152, Eu-154, Am-241, Nb-94, Np-237	9.08
ML21221A135	NOL01-02-FSR	1	soil	1105	~100%	0.126	N	N/A	0.187	0.32	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.03
ML21221A135	NOL01-03	1	soil	986	~100%	0	N	N/A	0.187	0.187	Eu-152, Eu-154, Am-241, Nb-94, Np-237	4.90
ML21221A135	NOL01-03-FSR	1	soil	956	~100%	0.114	N	N/A	0.187	0.31	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.01

Accession No.	Survey Unit	Classification	Matrix	Area (m <sup>2</sup> )	Area Scanned	Survey Hypothetical Dose (mrem/y)	Any Elevations?	Elevation Dose (mrem/y)	HTD Dose (mrem/y)	Licensee Reported Dose (mrem/y)	Unaddressed ROCs	NRC bounding dose estimate (mrem/y)
ML21221A135	NOL01-04	1	soil	621	~100%	0.11	Y	5.05	0.187	0.3	Eu-152, Eu-154, Am-241, Nb-94, Np-237	9.06
ML21221A135	NOL01-04-FSR	1	soil	619	~100%	0.076	N	N/A	0.187	0.27	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.98
ML21221A135	NOL01-05	1	soil	1036	~100%	0.113	N	N/A	0.187	0.31	Eu-152, Eu-154, Am-241, Nb-94,	5.01
ML21221A135	NOL01-05-FSR	1	soil	1036	~100%	0.202	N	N/A	0.187	0.39	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.10
ML21221A135	NOL01-06	1	soil	1942	~100%	2.47	N	N/A	0.187	2.66	Am-241, Nb-94, Np-237	7.37
ML21221A135	NOL01-06-FSR	1	soil	1942	~100%	0.109	N	N/A	0.187	0.3	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	5.01
ML21221A135	NOL01-07	1	soil	425	~100%	0.505	N	N/A	0.187	0.7	Eu-152, Eu-154, Am-241, Nb-94, Np-237	5.41

Accession No.	Survey Unit	Classification	Matrix	Area (m <sup>2</sup> )	Area Scanned	Survey Hypothetical Dose (mrem/y)	Any Elevations?	Elevation Dose (mrem/y)	HTD Dose (mrem/y)	Licensee Reported Dose (mrem/y)	Unaddressed ROCs	NRC bounding dose estimate (mrem/y)
ML21221A135	NOL01-07-FSR	1	soil	415	~100%	0.071	N	N/A	0.187	0.26	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.97
ML21221A135	NOL01-08	1	soil	961	~100%	0.036	N	N/A	0.187	0.23	Eu-152, Eu-154, Am-241, Nb-94, Np-237	4.94
ML21221A135	NOL01-08-FSR	1	soil	959	~100%	0.087	N	N/A	0.187	0.28	Eu-152, Eu-154, Am-241, Co-60, Nb-94, Np-237	4.99