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TA21-MDAB-PLAN-00013, Rev 1

MDA-B Above Ground Inventory Management Plan

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Procedure Owner: Pete Rice	Signature: Pete Rice	Date: 10/21/2010

Revision History

Revision	Issue Date	Action	Description
TA21-MDAB-PLAN-00013, Rev. 0	6-16-2010	New Document	Describes management of MAR inventory aboveground at the MDA-B
TA21-MDAB-PLAN-00013, Rev. 1	10-21-2010	Revision 1	Revised steps as denoted by Revision Bars to reflect modified MAR limits.

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ACRONYMS

AGIMP	Above Ground Inventory Management Plan
Am	americium
AMAD	activity median aerodynamic diameter
DB	database
DIF	Definitive Identification Facility
DPT	direct-push technology
FIDLER	Field Instrument for Detection of Low Energy Radiation
FL	Field Laboratory
FSP	Facility Safety Plan for Material Disposal Area B
GPS	global positioning system
IM	Information Management
LANL	Los Alamos National Laboratory
MAR	material at risk
MDA B	Material Disposal Area B
NA	not applicable
NaI	sodium iodide
PE-Ci	plutonium-239 equivalent curies
PM	project manager
Pu	plutonium
RCR	removal, characterization, and restoration
ROPC	radionuclide of potential concern
SAP	sampling and analysis plan
SME	subject matter expert
TA	Technical Area
U	uranium
WCSA	Waste Container Storage Area

1. INTRODUCTION

The objective of this above ground inventory management plan (AGIMP) is to define how radioactive material-at-risk (MAR) at the Los Alamos National Laboratory (LANL) Material Disposal Area B (MDA-B) site is controlled during removal, characterization, and restoration (RCR) activities. MAR is the quantity of radioactivity in landfill material removed during excavation activities, and expressed in units of grams of plutonium-239 equivalent curies (PE-Ci). Control of MAR is performed to ensure compliance with the limits established in the *Facility Safety Plan for Material Disposal Area B* (FSP) (MDAB-ABD-1005).

2. PURPOSE AND SCOPE

Compliance with the MAR limits is necessary to provide the proper safety envelope for the protection of site workers, the public, and the environment. The AGIMP addresses the material management requirements related to the generation, handling, characterization, analysis, staging, and movement of MAR, while maintaining compliance with the MAR limits.

The project organization and administration is described in Section 3. The documents that implement the AGIMP are described in Section 4. The AGIMP implementing procedures are listed in Table 1. The Information Management (IM) MAR database (DB) and its associated applications used to track the MAR limits is described in Section 4. The description of the operational areas, the processes used to control the MAR inventory in these areas, and the MAR limits for each of these areas are addressed in Section 5.

3. ORGANIZATION AND ADMINISTRATION

The MAR management for the MDA-B project is under the direct control of the MAR subject matter expert (SME) (assigned by the Shift Operations Manager (SOM)) with support from Data Management, Radiological Control, Waste Management, and other project personnel. In the event that a MAR limit is exceeded, the SME will notify the SOM, the MDA-B project manager (PM), and Technical Area (TA) 21 Facility Operations Director (FOD) as soon as possible, take the necessary actions to restore MAR quantities below the appropriate limits. .

The MAR management personnel supporting the project are properly trained in DB management and the use of the MAR calculator function in the DB. They are responsible for recording the necessary DB information, ensuring that the data is entered into the DB system in a timely manner, ensuring that any hold points and operational limits are evaluated at the required times, and verifying that the results of field screening and laboratory analysis are utilized appropriately. In addition, these personnel ensure that all activities and waste forms are covered by this and other relevant plans, and that the analytes identified in the laboratory reports and by the field screening techniques are covered by the FSP, DB, and relevant MAR limits. These personnel ensure that any issues related to MAR management are relayed to the SOM and Excavation Manager.

4. OPERATIONAL DOCUMENTS

This section identifies the plans and procedures that implement the program for managing MAR during MDA-B RCR activities. The AGIMP implementing plans and procedures are listed in Table 1. These documents are companions to one another and are integrated to ensure MAR management policies and practices are addressed for each step of the MDA-B project.

Table 1, AGIMP Implementing Documents

Document Title	Document Number
Facility Safety Plan for Operation of Remediation Activities at TA-21 Material Disposal Area B	MDAB-ABD-1005
Quality Assurance Plan for the Environmental Programs	EP-DIR-QAP-0001
Sample and Material at Risk Tracking Database	
MDA-B Material at Risk Tracking	TA21-MDAB-DOP-00004
Waste Container Storage Handling Operations	TA21-MDAB-DOP-00006
MDA-B Direct Push Sampling	DOP-0102, R.3
MDA-B Enclosure Operations	TA21-MDAB-DOP-00001

All operations are required to comply with the current version of all applicable plans. These are managed in accordance with the document control process defined in EP-DIR-SOP-4004, *Record Transmittal and Retrieval Process*, TA-21-PLAN-00001, *Document Control and Records Management Plan* and EP-DIR-QAP-0001, *Quality Assurance Plan for the Environmental Programs.* Material management and compliance with the MAR limits are demonstrated via execution of the daily excavation plan, field instrument measurements, contract laboratory sample analysis, material management documentation, and MAR inventory tracking and reporting using the IM MAR DB and its MAR calculator function.

4.1 Records Management

The control, verification, and validation of the IM MAR DB and corresponding DB functions supporting the AGIMP are performed as described in LANL procedure "Nuclear or Radiological Facility Safety Software Quality Management" (LANL P1041). Documents and records related to surveys and measurements of material in the field, the IM MAR DB system, MAR management, material staging and movements, MAR limits, laboratory analytical results, and material locations will be managed per TA21-MDAB-DOP-00004. All plans, procedure revisions, IM MAR DB modifications, or updates will also be documented, reviewed, and approved in accordance with TA21-MDAB-DOP-00004 requirements.

4.2 Close-Out Requirements

At the conclusion of the project, the MAR inventory for the MDA-B site, including all operational areas, should be zero. In addition, the MAR inventory recorded in the IM MAR DB should also equal zero for each MDA-B operational area. Any discrepancies will be addressed by the MAR SME, Operations Manager, the Excavation Manager, Waste Management Coordinator, DB support personnel, and PM prior to final project closeout. Documentation for any discrepancies will be approved by the PM.

Additionally, any variances, violations, or FSP/MAR limit issues associated with material management will be addressed and resolved by material management personnel.

The resolution, approval, and actions associated with these issues will be documented and approved by the TA-21 Waste Management Group Leader and the PM. Finally, any outstanding issues identified by the LANL project oversight personnel or relevant governmental regulatory body must also be resolved and documented prior to project closeout. Additional details on project closeout implementation will be provided in the Sample and Material at Risk Tracking Database. All such documentation shall become part of the final project file. Any material management closeout reports generated by the project will also become part of the final project file.

5. INFORMATION MANAGEMENT MAR DATABASE

The IM MAR DB and its corresponding MAR calculator and MAR tracking functions are integral to the successful operation of the MDA-B Project. Implementation details are provided in TA21-MDAB-DOP-00004, *MDAB Material at Risk Tracking.* The IM MAR DB allows management to anticipate the MAR in the material that is to be excavated from unit cells, use field data, and contract laboratory data to track the MAR inventory and ensure MAR limits are not exceeded. An additional IM MAR DB function is to prepare reports that flag unit cells with potentially elevated radioactive material levels that may require special handling or monitoring. If the MAR inventory at an operational area (Section 5.3) reaches 80% of the MAR limit, notification will be made to the MAR SME. If the MAR inventory limits are exceeded, the MAR SME will notify the Radiation Protection Manager and MDA-B Operations Manager (OM), and take the appropriate actions to decrease the MAR inventory below limits. The MAR value will be monitored using field instrumentation, gamma spectroscopy, and laboratory analyses as necessary. As new information is generated, it will be input to the DB, and the MAR value will be compared to the expected MAR value to ensure that the MAR limit is not exceeded.

Reference

5.1 MAR Database Parameters

Prior to the readiness review, the IM MAR DB shall meet all project requirements, including the functions necessary to perform the following operations:

- Converting contract laboratory data to PE-Ci using the conversion factors in Appendix A of this document to quantify MAR.
- Populating unit cells, waste containers, and operational areas within DB with the PE-Ci concentrations and activities.
- Tracking the MAR and comparing it to MAR limits
- Flagging any operational area that approaches or exceeds the MAR limit to initiate management notifications.

Prior to performing pre-excavation characterization activities, the IM MAR DB is populated with the MAR limits for each of the following operational areas defined in the MDA B FSP (MDAB-ABD-1005):

- Each Excavation area
- Definitive Identification Facility (DIF)
- Each Waste Container Storage Area (WCSA)

When characterization data are available, the IM MAR DB is populated with the following data:

- Trench dimensions
- Radiological monitoring, survey, gamma spectroscopy, and any analytical data collected during characterization activities
- The -X, -Y, and -Z coordinates of sample locations.

Prior to excavation, the IM MAR DB is used to calculate and store the following information:

- Dimensions and location of unit cells to be excavated
- Radionuclide inventory expressed as PE-Ci (MAR inventory) concentrations in each unit cell
- Flag unit cells with potential MAR inventories that could result in MAR limits being exceeded.

During MDA-B excavation activities, the IM MAR DB is populated with the following information:

- Radiological monitoring results of the miscellaneous objects, debris, excavation material, and additional characterization analytical data
- The container and sample identification numbers and associated shipping data for waste and samples being sent to the DIF, FL, and waste storage areas

5.1 MAR Database Parameters (continued)

- FL and contract laboratory radiochemistry results for MDA-B samples.

After initiation of MDA-B excavation activities, the IM MAR DB will perform the following:

- Calculate and track MAR inventory in each operational area
- Alert DB users if the MAR reaches 80% of the MAR limit.

The IM MAR DB functionality will be controlled, validated, and verified to ensure that reported data and information functions are being performed correctly. All software functions, sub-routines, input data, and reference information will be controlled and will comply with the requirements of "Nuclear or Radiological Facility Safety Software Quality Management" (LANL P1041) MDA B MAR Management.

5.2 MAR Radionuclide's of Potential Concern

The MAR control restricts the total quantity of radioactive material available for accidental release. From historical data, the MAR consists mainly of uranium, plutonium, and minor amounts of other isotopes. A list of radionuclides of potential concern (ROPCs) was compiled from the *Material Disposal Area B: Process Waste Review (1945 to 1948)* (LA-UR-07-2379) and the FSP (MDAB-ABD-1005). Appendix A lists the MDA-B ROPCs along with the 50-year maximum effective whole-body dose equivalent. Additional radionuclides may be added after the characterization process is initiated. The radionuclide specific 50-year maximum effective dose equivalent data are utilized to convert individual activities to PE-Ci and tracked as MAR. The derivation of the PE-Ci equation is presented in Appendix A.

Based on the FSP, the total radioactive material inventory for the MDA-B trenches is calculated to be 12.4 PE-Ci. Assuming this is uniformly distributed throughout; the calculated trench volume yields a concentration of 7.5E-4PE-Ci/m^3. The average calculated MAR concentration, data from the direct-push technology (DPT) sampling effort, and field radioactive counting techniques deployed prior to and during excavation, will be used to establish the initial MAR content of the excavation areas and containers of excavated debris. Initial MAR calculations will be adjusted based on real-time radiation counts (disintegrations per minute) detected above background during excavation and container loading operations. The final MAR content calculations for waste containers will be adjusted appropriately based on contract laboratory results acquired as part of waste characterization sampling.

5.3 MAR Limits

The MDA-B FSP (MDAB-ABD-1005) defines MAR limits for the MDA-B RCR activities and the multiple barriers or controls used to provide successive layers of protection or defense in depth. The MDA-B MAR limit is lower than the DOE-STD-1027 threshold quantity for Hazard Category 3 so that radioactive material releases are minimized to radiological levels. The MAR limits established in the MDA-B FSP separate the MDA-B Project into different operational areas. The FSP also establishes separation distances. These distances will be maintained to prevent an accident in one area from causing an accident in another area. The areas, MAR limits for each area and required separation distances, are shown in Table 2. Figure 1 illustrates the management of MAR at the MDA-B site.

Reference

5.3 **Mar Limits** (continued)

TA21-MDAB-PLAN-00010, *Excavation Control Plan* limits the volume of waste to be excavated in order to maintain the MAR within limits specified for the excavation areas. This is performed by dividing the MAR limit by the best available radiological inventory concentration. For example, assuming that uniform distribution of the estimated total inventory of 12.4 PE-Ci in the entire waste volume yields a concentration of 7.5E-4 PE-Ci/m^3, the impacted volume would be 200 m^3. This is based on the smallest estimated total trench volume of 16,515 m^3 (21,600 yd^3), which yields the highest concentration. The nominally estimated total trench volume is 18,350 m^3 (24,000 yd^3). The excavated volume will be increased or decreased as necessary to maintain compliance with the limit. A particular survey unit volume, excavation, and waste container loading in the areas will be managed through the processing of unit cells contained therein.

Unit cells are defined as a landfill volume with dimensions of 10 × 10 × (Z) ft, where (Z) is the landfill thickness from the upper surface to bottom, with an estimated range of 5 to 15 ft. It is anticipated that the target excavation volume, including the dig face and the loaded waste containers, will not exceed 100 yd^3.

Table 2. MDA-B Area MAR Limits and Separation Distances.

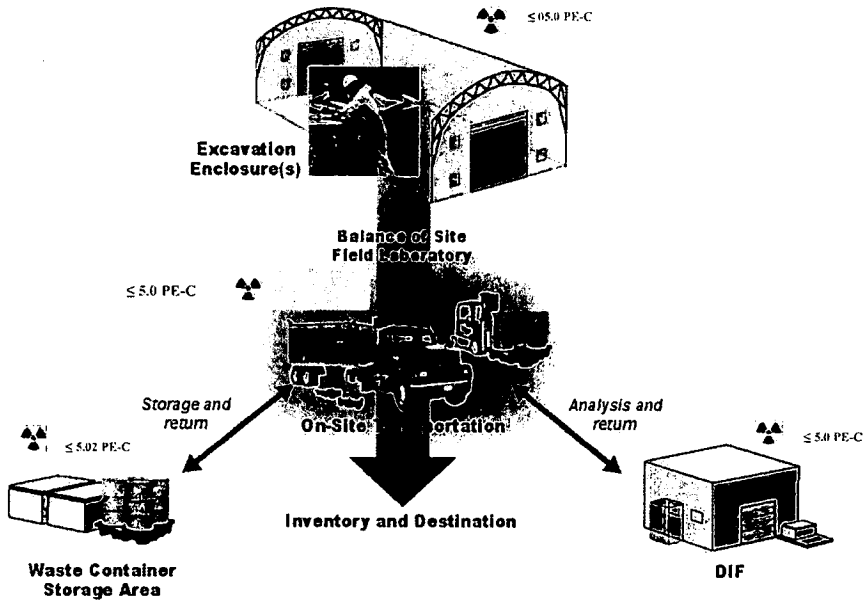
Area	MAR Limit (PE-Ci)	Separation Distances (ft)			
		Excavation Area	DIF	WCSA[a]	Public Boundary
Each Excavation Area (no more than 6)	5.0	60	60	60	NA
DIF	5.0	60	NA	60	NA
Each WCSA	5.0	60	60	NA	NA
No MAR	0.0	NA	NA	NA	NA
Clean Staging Area	0.0	NA	NA	NA	NA

NA = Not applicable.

a. WCSA and/or TA-21 WCSA(s)

b. Excavation areas are separated from each other based on the requirements of DOE-STD-1088 and NFPA 80A. A separation distance between the excavation area and the public boundary is not required, because the distance is restricted by the physical location of the MDA-B waste disposal units and DP Road. A best practice will be to maximize this distance.

Figure 1. MAR management on the MDA-B Project.



5.4 MAR Characterization

The MDA-B survey unit volumes are located within an area comprising approximately 6 acres and encompass multiple disposal trenches and disturbance areas. Integrated MAR management will be performed for each excavation area, DIF and each WCSA. Initially, data used in MAR calculations shall be collected in accordance with the "MDA-B Direct Push Sampling" (DPT sampling and analysis plan [SAP]) (DOP-0102, R.3). This technique is providing a first-look at conditions in the subsurface of MDA-B, by acquiring samples from inside of and adjacent to the disposal trenches. Other "pre-excavation" data collection methods will include surface radiation surveys and down-hole gamma logging, as described in Section 5.5[5].

As appropriate, MAR correlations for these data are derived; they may be used to formally augment sample data. Additional data acquisition will be spelled out in sampling plans for the characterization of overburden and layback material and waste characterization. All data will be used in preparing the excavation control plan used to manage the throughput of MAR at all operational areas of MDA-B.

As field excavation is initiated, implementing procedures will be deployed to verify and update MAR calculations for material at the point of excavation, in accordance with the TA21-MDAB-DOP-00004, *MDA-B Material at Risk Tracking*.

5.4 **MAR Characterization** (continued)

When the analytical sample data are received, the MAR levels in the respective intermodals will be updated, if necessary. These procedures are described in Section 5.6. If threshold criteria associated with these procedures are exceeded, the MAR DB will be updated accordingly. As possible, these data will be used to support calculation of specific waste container MAR for both onsite transportation MAR compliance and offsite transportation manifest/waste acceptance criteria compliance. If excavated waste material shows noncompliance with threshold criteria, then discrete waste container sampling will be implemented as described in Section 5.6. Container sampling and sample analysis will be prioritized based on levels above threshold criteria to prevent potential MAR limit violations. Similarly, these data shall be used to calculate MAR for the DIF and WCSA as described in Sections 5.8 and 5.9, respectively.

5.5 MDA-B Pre-Excavation Characterization Activities

[1] Pre-excavation Characterization Documentation

The quantities, locations, and specific hazardous materials buried in the MDA-B trenches are unknown. For that reason, radiological surveys, historical data, DPT (Geoprobe®) sampling, and sampling of overburden and layback material was used during pre-excavation characterization. Pre-excavation characterization was performed in accordance with the following documentation; this may not be an all inclusive list:

- DOP-0102, R.3, *MDA-B Direct Push Sampling*
- TA21-MDAB-PLAN-00017, *Sampling Analysis Plan*
- *Sample and Material at Risk Tracking Database*
- LA-P121, *LANL Radiation Protection Program*
- EP-ERSS-SOP-5058, *Sample Control and Field Documentation*
- MDAB-TPR-7413, Performing Down-Hole Gamma Logging with Portable Survey Instrumentation
- OP-09-10, *Operation of the Gamma Spectroscopy System*

These procedures covered the physical process of collecting samples, performing initial visual and field radiological surveys, labeling, packaging, uploading survey and global positioning data to the MAR DB, and submitting the samples to the FL or contract laboratory for analyses used to estimate/quantify MAR.

Characterization activities are summarized in this document because the data collected from the analysis of pre-excavation characterization samples are very important in establishing initial MAR controls.

The MAR calculations use DPT sample results analyzed using onsite gamma spectrometry and confirmatory contract analyses.

Contract laboratory techniques included both gamma spectrometry and radiochemistry. Secondary data sources were anticipated to result from field measurements, including surface gamma walkover surveys and down-hole logging, as appropriate. The following sections provide a brief description of the survey and sampling methodologies.

5.5 MDA-B Pre-excavation Characterization Activities (continued)

[2] Pre-Excavation Characterization MAR Tracking

The MDA-B FSP established a MAR limit (0.15 PE-Ci) for BOS activities that was applicable at all times. This included the site characterization DPT and associated FL activities. Pre-excavation characterization activities were not expected to generate significant quantities of radioactivity. As stated above, the anticipated mean concentration throughout the waste is approximately 7.5E-04 PE-Ci/m^3.

Typical DPT cores (2-in. diameter × 60-in. length) generate approximately 2 L of material based on a 70% recovery. This equates to approximately 1.5E-06 PE-Ci/DPT core. Therefore, it would have required 1.0E–05 DPT cores to equal the BOS MAR limit of 0.15 PE-Ci.

The MAR tracking is based on the following assumptions:

- From historical data, the MAR consists mainly of uranium, plutonium, and minor amounts of other isotopes. A list of ROPCs was compiled from the *Material Disposal Area B: Process Waste Review (1945 to 1948)* (LA-UR-07-2379) and the FSP (MDAB-ABD-1005). Appendix A lists the MDA-B ROPCs along with the 50-year maximum effective whole-body dose equivalent factors used to convert activities to PE-Ci.

- The aged (70 years) mixture of plutonium material (Pu), uranium material (U), and other minor isotopes results in a total activity (PE-Ci) that consists primarily (greater than 90%) of U-234, Pu-238, Pu-239, Pu-240, Pu-241, and americium (Am) -241 on an activity basis, assuming an original mixture 90% plutonium and 10% uranium and aging the concentrations published in the literature (e.g., "Guide of Good Practices for Occupational Radiological Protection in Plutonium Facilities" [DOE-STD-1128]).

- The ratio of the total plutonium and uranium to Am-241 [(Pu + U)/Am-241] is not greater than 10:1. This is supported by Assumption 2 and previous LANL plutonium data. The *Documented Safety Analysis for TA-54, Area G*, Appendix 3I, presents tabulated aged (52 years) plutonium (LANL 2003).

- Any sample may be assigned a MAR value based on the actual analysis rather than using a ratio as described in Assumption 3. Typically, the plutonium minimal detectable activity for a field gamma instrument is too high to utilize this approach in a timely manner.

- A sample may be assigned a MAR value (PE-Ci) from the analytical results if available.

5.5 MDA-B Pre-excavation Characterization Activities (continued)

[3] Gamma Walkover Surveys

Gamma walkover surveys were performed prior to DPT sampling, as necessary, to identify areas of elevated activity in surface and shallow subsurface soils and to fill in data gaps from previous walkover efforts. The walkovers were performed as described in the "LANL Radiation Protection Program" (Field Gamma Surveys) (LA-P121) using standard sodium iodide (NaI) detectors (e.g., Field Instrument for Detection of Low Energy Radiation [FIDLER], 2 × 2). A differentially corrected global positioning system (GPS) was utilized during the NaI surveys to allow for geospatial correlation and imaging of the survey data.

[4] Subsurface Soil Sampling (Direct-Push Technology) and Analysis

The MAR characterization was intended to define the amount of activity (PE-Ci) that may be excavated or containerized at any one time with an emphasis on the activity found in waste. Therefore, the subsurface soil sampling design followed the method approved for subsurface soils in the FSP (MDAB-ABD-1005). The design incorporated provisions for assessing each of the isotopes of concern (Appendix A) in the measurement protocols employed. It considered the historical knowledge of past uses of the various areas of the MDA-B site and available historical data collected for a variety of reasons during past sampling activities.

In consideration of the historical uses of the site and the radiological characterization surveys performed in the past, the site surface area will be demarcated into 10- × 10-ft grids. Pre-excavation soil samples will be collected at pre-determined systematic DPT locations. The pre-determined systematic sample locations and quantities were presented in the DPT SAP (DOP-0102, R.3). Biased sample locations were selected during the DPT sampling based on historical information, in-process data, gamma walkover surveys, and professional judgment.

The number of samples required to achieve a given level of confidence in the data could only be defined if the standard deviation or variance of the activity is known or can be estimated. Usually, a two-phase sampling plan is used to address the lack of information on the population variance. A reasonable number of samples are initially obtained during the scoping phase and evaluated with respect to the mean activity and an "estimated" standard deviation. If the estimate is too low, then additional measurements are needed. Increasing the number of measurements will reduce the standard error of the mean, thus allowing greater confidence in the estimated population mean. The DPT SAP (DOP-0102, R.3) identified all locations on the 10 × 10-ft grid and a methodology for collecting initial sample quantities as well as any additional sample quantities. The sample quantities were derived from standard statistical equations based on historical data, previous characterization projects, and available literature (e.g., Gilbert 1987; EPA et al., 2000).

5.5[4] Subsurface Soil Sampling (Direct-Push Technology) and Analysis (continued)

Each waste trench (1–10) was considered a separate survey unit volume. Above each survey unit volume, a number of locations were systematically distributed over the surface in accordance with the FSP requirements. The FSP prescribed grid (10 × 10 ft) results in a population total of approximately 1,200 grid locations. At statistically predetermined locations selected from the total population, a soil core was collected through the entire depth (Z) ft of the landfill. The entire core was utilized to develop descriptive statistics (mean, median, standard deviation, variance) representative of the 10- × 10- × (Z)-ft unit cell. The unit cells within a survey unit volume were combined to estimate the survey unit volume descriptive statistics. Finally, this information was utilized to specify any additional number of samples required to satisfy the MAR characterization requirements at a specified (e.g., 95%) confidence level.

The DPT cores were extracted from each unit cell and received initial visual, radiological, and hazards categorization surveys in the field in accordance with the procedures described above prior to being transferred to the offsite laboratory. Before opening the cores, a more detailed radiological survey was performed following receipt at the offsite laboratory to identify anomalous areas within the core that may have elevated activity. The cores were opened in the offsite laboratory, surveyed for radiological material, and screened for various chemicals and volatile organics using a photoionization detector and other portable instrumentation as necessary. Sample cores were also visually inspected and logged to identify anomalous materials in the cores.

The DPT MAR analysis was performed via gamma spectroscopy. The gamma spectroscopy system was calibrated with geometries that match sample characteristics (OP-09-10). These analyses provided quantitative information of sufficient quality for MAR characterization. The calibration setup ensured the ability to analyze samples more rapidly compared to analytical laboratory methods. The quality assurance data quality objectives are provided in the SAP.

[5] Down-Hole Gamma Logging

Down-hole gamma logging was performed as prescribed by MDAB-TPR-7413, *Performing Down-Hole Gamma Logging with Portable Survey Instrumentation* at DPT locations to provide data regarding the variation in gamma fluence with depth. A 1-minute integrated measurement was typically performed using a 1- × 1-in. NaI detector. Measurements were collected at 1-ft intervals or as physical limitations permit.

[6] DPT Characterization Data Management Process

Radiological data was submitted to the MAR DB where the data was stored as PE-Ci. The MAR DB function applied the PE-Ci data to populate the trench unit cell where the Geoprobe® sample was collected and calculated the mean radionuclide and PE-Ci concentrations, total activity in the unit cell for detected radionuclides, and the total PE-Ci activity for the unit cell.

5.5[6] Subsurface Soil Sampling (Direct-Push Technology) and Analysis (continued)

The DPT data was analyzed to ensure they met the project objectives. All data was verified and validated in accordance with Los Alamos National Security, LLC Environmental Restoration data validation procedures prior to use in the MAR DB. A preliminary data review was performed to learn about the structure of the data by identifying patterns, relationships, or potential anomalies. Finally, necessary statistical evaluation of the data was performed to support the objectives. Sample locations that failed to meet the quality requirements were clearly identified. These locations were further characterized during excavation operations.

The PE-Ci concentration distribution and GPS data in the MAR DB are used to (a) define the trench excavation geometry and sequence, (b) determine the location and size of impacted volumes, (c) initiate management of MAR, (d) establish specific controls to ensure the MAR limits are not exceeded, and (e) verify safety management controls in accordance with the following documentation:

- MDAB-ABD-1005, *Facility Safety Plan for Material Disposal Area B*
- TA21-MDAB-PLAN-00010, *MDA-B Excavation Control Plan*
- SSHASP
- LA-P121, *LANL Radiation Protection Program*

The primary output of the pre-excavation characterization process was the assignment of statistically derived MAR quantities to variable size survey unit volumes, such that the current 5.0 PE-Ci limit is not exceeded during excavation operations. Each survey unit volume will be composed of a number of unit cells assumed to contain a concentration represented by the mean of the DPT sample results for the entire survey unit volume.

5.6 Managing MAR in the Excavation Areas

[1] Daily Excavation Plan

Radiological characterization data, unit cell size and location, trench dimensions, and initial PE-Ci concentration statistical summary data associated with the waste trenches are initially generated during pre-excavation activities and will be available in the MAR DB via the Daily Excavation Plan. Prior to the start of excavation, this data is evaluated to (a) determine location and size of the impacted volume of radioactive material buried in the trench, (b) verify specific health and safety controls during excavation, (c) identify DPT characterization data gaps, and (d) initiate management of the MAR. Field radiological surveys will be used to monitor day-to-day activities and to supplement existing data. Each day, prior to the start of excavation, the MAR value as determined by the DB MAR calculator will be evaluated for the unit cells to be excavated. This information will be used to determine the excavation sequence, additional characterization requirements, and safety controls. The total MAR for each excavation area includes the aboveground containerized waste in the excavation area and the anticipated MAR from the material to be excavated. Excavation will begin if the total MAR is less than 5.0 PE-Ci for all of the excavation areas combined.

5.6 Managing MAR in the Excavation Areas (continued)

[2] Controls for Maintaining MAR Limits

NOTE: *The controls for maintaining MAR below the MAR limits during excavation are summarized below.*

Prior to the start of excavation, evaluate the MAR DB data for the following information:

- The MAR for the unit cells to be excavated to ensure the excavation sequence and safety controls are adequate
- DPT data gap analysis results for indication of whether additional characterization samples/surveys are required
- The total MAR of above ground containerized waste in each excavation area.
- Total MAR for each excavation area, including the anticipated MAR to be excavated, will be tracked continuously. Excavate if the total MAR is less than 4.0 PE-Ci (80% of MAR limit) for the excavation area; otherwise, before initiating excavation, reduce the above grade or anticipated below grade MAR volume.
- Radiological monitoring will be performed continuously during operations and throughout the excavation area to confirm that the concentrations of radioactive material in excavated materials remain within the anticipated MAR inventory. Radiological scan efficiencies will be determined using standard methodologies as prescribed in Nuclear Regulatory Guide NUREG 1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*.
- When waste is placed in containers (e.g., roll-offs, B-12 boxes, or other approved containers), the IM MAR DB is queried for an estimate of the PE-Ci activity being placed in the container; for example, the activity in a 12-yd^3 roll-off is that volume times the average PE-Ci concentration in the waste material (MAR is tracked by container identification number).

[3] Excavation Area MAR Surveys and Samples

Soil removal will be started using an excavator in accordance with TA21-MDAB-DOP-00001, *MDA-B Enclosure Operations*. Soils will be loaded into the intermodal container. A local area gross gamma scan survey will be conducted and input to the MAR DB/MAR calculator to verify activity does not exceed anticipated/required levels for the specified landfill volume.

As objects such as intact drums, construction material, waste containers, machinery, laboratory equipment, or other debris are encountered, the accessible surfaces of these objects will initially be surveyed. Once an object is identified, it will be removed as expeditiously as possible within the constraints of the Environmental, Safety, and Health and Engineering controls. These objects may require special handling, including remote operations, overpack, application of fixatives, special containment, or other applicable controls and techniques. Hazardous items may require special handling and may be transported for further analysis, or analysis may be performed in-situ pending any constraints (e.g., size, condition, hazard analysis).

5.6[3] Managing MAR in the Excavation Areas (continued)

Interstitial waste zone soil will be sampled (in a biased manner to include any visually obvious discolorations or sludge within the debris/waste. To make this determination, project personnel will monitor and visually examine (video) waste zone material after it is placed in a staging area. After examination, the interstitial soil samples will be sent to the FL.

Process knowledge indicates that buried waste may contain free liquids. Free liquids may require sampling, or the affected soil may require sampling. Initial analysis of these samples will be performed in the FL for the MAR inventory; however, additional analysis offsite may be required to fully characterize MAR or support waste characterization and industrial hygiene.

The IM MAR DB will be updated either to reflect any change in the MAR inventory in each of the excavation areas or MAR removed from each excavation area for onsite transportation. At the end of each shift, the dig face/excavation area will be monitored, and the exposed material will be placed in a stable configuration.

5.7 Managing MAR During Onsite Transportation

The following actions serve as controls and must be performed with regard to intra-site transfers:

- Prior to transfer, perform an inquiry of the IM MAR DB for the MAR in the shipment and at the destination point.
- Delay shipping if the MAR in the receiving point plus the MAR of the shipment exceeds 5.0 PE-Ci. Before shipping, update the IM MAR DB by adding the MAR in the shipment to the point-of-destination (MAR Sample and Material at Risk Tracking Database).
- Once the waste is delivered to its destination, update the IM MAR DB inventory by subtracting the MAR of the shipment from the point-of-origin MARs.

5.8 Managing MAR at the Definitive Identification Facility

The DIF is located within the eastern portion of the nuclear facility boundary. The combined MAR limit for the DIF and onsite transportation is 5.0 PE-Ci. The DIF, if necessary, is used for the management and sampling of nonconforming items removed from the excavation. Operations are scheduled to begin without a DIF, and one will be supplied only if excavation conditions require its use.

A summary of how MAR is controlled at the DIF to ensure the MAR limits are not exceeded is described as follows:

- Perform DIF waste operations in accordance with TA21-MDAB-DOP-00019, *Definitive Identification Facility (DIF) Operations for the MDA-B at TA-21.*
- Prior to onsite transfer, perform an inquiry of the IM MAR DB for the MAR of the shipment (samples) and the MAR in onsite transportation and at the DIF
- Delay shipping to the DIF if the DIF MAR plus the MAR in the shipment exceeds 4.0 PE-Ci.
- Transport waste only if the transport can be accomplished in full compliance with the requirements of TA21-MDAB-DOP-00006 and TA21-MDAB-DOP-00014.

5.8 Managing MAR at the Definitive Identification Facility (continued)

- Once the waste is delivered to the DIF, update the IM MAR DB inventory by subtracting the shipment MAR from the point-of-origin MARs.

5.9 Managing MAR at the Waste Container Storage Area

The WCSA is located near the east end of MDA-B and provides a location to stage waste containers prior to offsite shipment. Staging includes inspection, document processing, and coordination with transportation and receiving organizations. Wastes that have been processed/stabilized and packaged may be stored at the WCSA. Depending on project needs, more than one WCSA may be established.

The following controls are established to ensure the risks related to MAR located at the WCSA(s) are managed to an acceptable level:

- The WCSA is located at least 18.3 m (60 ft) from any excavation areas
- The WCSA is separated from the DIF by at least 18.3 m (60 ft)
- The MAR limit for the WCSA is 5.0 PE-Ci.

A summary of how MAR is controlled at the WCSA to ensure the MAR limit is not exceeded is described as follows:

- Prior to onsite transfer, perform an inquiry of the IM MAR DB for the MAR associated with the shipment and the MAR at the WCSA.
- Delay shipping to the WCSA if the MAR in the WCSA plus the MAR in the shipment exceeds 4.0 PE-Ci.
- Transport waste only if the transport can be accomplished in full compliance with the requirements of TA21-MDAB-DOP-00006 and TA21-MDAB-DOP-00014.
- Once the waste is delivered to the WCSA, update the IM MAR DB inventory by subtracting the shipment MAR from the point-of-origin MAR
- Store waste in accordance with of TA21-MDAB-DOP-00006 and TA21-MDAB-DOP-00014.

6. EXCEEDENCE

If the MAR limits are exceeded, activities shall be terminated within the specific area (except those necessary to restore MAR limits), the MAR limit shall be restored within 8 hours, and a corrective action plan will be developed within 2 working days of discovery (MDAB-ABD-1005).

7. REFERENCES

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MDAB-ABD-1005, *Facility Safety Plan for Material Disposal Area B*

TA21-MDAB-DOP-00004, *MDA-B Material at Risk Tracking*

TA21-MDAB-DOP-00019, *Definitive Identification Facility (DIF) Operations for the MDA-B at TA-21*

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8. APPENDIX A
RADIONUCLIDE-SPECIFIC WEIGHING FACTORS

The *Facility Safety Plan for Material Disposal Area B* (MDAB-ABD-1005) requires radioactive material be tracked in units of plutonium-39 equivalent curies (PE-Ci). Given that the Waste Isolation Pilot Plant also requires that waste generators express the content of waste in terms of PE-Ci (DOE 2008), the transuranic waste acceptance criteria for the Waste Isolation Pilot Plant is used as the reference. Given the distribution of known radioisotope activities, the PE-Ci is calculated using radionuclide-specific weighting factors. The weighting factors are defined in terms of the ratio of the inhalation dose from plutonium-239 (Pu-239) to the inhalation dose from each radionuclide in the waste stream. The value for the PE-Ci is defined as the ratio of the 50-year effective dose equivalent, due to the inhalation of Pu-239 particulates, with a 1.0 μm activity median aerodynamic diameter (AMAD) and a Class W pulmonary clearance from the lung to the 50-year effective dose equivalent, due to the inhalation of the radionuclide in the waste, assuming a 1.0 μm AMAD particle size distribution and the pulmonary clearance class resulting in the highest 50-year effective dose equivalent. The 50-year effective dose factors are the values listed in *Internal Dose Conversion Factors for Calculation of Dose to the Public* (DOE 1988). See Table A-1 for radionuclides of potential concern anticipated in material excavated at Material Disposal Area B. Any additional radionuclides and their respective weighting factors will be documented, and the PE-Ci will be calculated accordingly. The PE-Ci is expressed mathematically for a specified radionuclide mixture as:

$$(\text{PE-Ci}) = {}_{i=1\text{ to }K}\Sigma\, A_i/WF_i \qquad \text{(A-1)}$$

where

K	=	number of isotopes in the waste stream
A_i	=	activity (curies) of isotope (i) in the waste stream
WF_i	=	E_0/E_i, radionuclide specific weighting factors
E_0	=	(rem/μCi), 50-year effective whole-body dose commitment due to the inhalation of Pu-239 particulates with a 1.0 μm AMAD and a weekly pulmonary clearance class
E_i	=	(rem/μCi), 50-year effective whole-body dose commitment due to the inhalation of radionuclide (i) particulates with a 1.0 μm AMAD and the pulmonary clearance class resulting in the highest 50-year effective whole-body dose commitment.

Table A-1. Weighting factors for the isotopes that may potentially be in the MDA B waste.

Isotope	E_i Isotope Inhalation Dose Coefficient (rem/μCi)	E_0 Pu-239 Inhalation Dose Coefficient (rem/μCi)	WF_i PE-Ci Weighting Factor	Isotope	E_i Isotope Inhalation Dose Coefficient (rem/μCi)	E_0 Pu-239 Inhalation Dose Coefficient (rem/μCi))	WF_i PE-Ci Weighting Factor
Pb-211	8.00E-03	5.1E+02	6.38E+04	Pa-234m	7.4E-04	5.1E+02	6.89E+05
Ra-223	7.60E+00	5.1E+02	6.71E+01	Pu-236	1.6E+02	5.1E+02	3.19E+00
Ac-227	8.70E-03	5.1E+02	5.86E+04	Pu-238	4.8E+02	5.1E+02	1.06E+00
Pa-231	1.30E+03	5.1E+02	3.92E-01	Pu-239	5.1E+02	5.1E+02	1.00E+00
Pa-233	8.60E-03	5.1E+02	5.93E+04	Pu-240	5.1E+02	5.1E+02	1.00E+00
U-233	1.30E+02	5.1E+02	3.92E+00	Pu-241	1.0E+01	5.1E+02	5.10E+01
U-234	1.3E+02	5.1E+02	3.92E+00	Pu-242	4.8E+02	5.1E+02	1.06E+00
U-235	1.2E+02	5.1E+02	4.25E+00	Am-241	5.2E+02	5.1E+02	9.81E-01
U-236	1.2E+02	5.1E+02	4.25E+00	Am-243	6.2E+02	5.1E+02	8.23E-01
U-238	1.2E+02	5.1E+02	4.25E+00	Cm-242	1.7E+01	5.1E+02	3.00E+01
Np-237	4.9E+02	5.1E+02	1.04E+00	Cm-244	2.7E+02	5.1E+02	1.89E+00
Th-227	1.6E+01	5.1E+02	3.19E+01	Cf-252	1.3E+02	5.1E+02	3.92E+00
Th-229	2.0E+03	5.1E+02	2.55E-01	Cs-137	3.2E-02	5.1E+02	1.59E+04
Th-230	3.2E+02	5.1E+02	1.59E+00	Sr-90	1.3E+00	5.1E+02	3.92E+02
Th-231	8.1E-04	5.1E+02	6.30E+05	Y-90	8.2E-03	5.1E+02	6.22E+04
Th-234	2.5E-02	5.1E+02	2.04E+04				

Received

OCT 21 2010

FOD-9 DCC

Document Action Request

Section 1 – Originator Request

Document No.: TA21-MDAB-PLAN-00013	Revision No.: 1
Title: MDA-B Aboveground Inventory Management Plan	Page 1 of 2

Description of requested action (Attach numbered additional sheets if needed.):
See attached markup

Originator Name (print):	Z#:	Organization:	Date:
John Schmitt	238313	TA-21 Ops	9/21/2010

Section 2 – Responsible Manager Approval for Processing

☐ New Procedure ☐ Minor Revision ☒ Major Revision ☐ Deactivation ☐ Cancellation ☐ Perform Concurrent Periodic Review?

☒ Approved ☐ Disapproved (return to originator) Comments: None

Signature:	Print Name, Title:	Z#:	Date:
Pete Rice	Pete Rice	214458	9/21/2010

Section 3 – Hazard Grading

Hazard Determination: ☒ Low ☐ Moderate ☐ High/Complex

Document is authorized to serve as IWD? ☐ Part I only ☐ Full IWD ☒ N/A

Section 4 – Required Reviews (see P315, Ch 16, Section 16.5.3)

Discipline:	Name:	Signature:	Date:
RadCon	Martin Peifer	/s/ Martin J. Peifer	9.30.10
Operations	Bob Harder	[illegible]	10-21-10
Engineering	Gerald Fordham	/s/ Gerald Fordham	10-15-10
EC	Win Chromec	/s/ Frank W. Chromec	9.30.10
QA	Larry Maassen	Larry Maassen	10.9.10
Safety	~~Henry Kanaa~~ Robert Elgin	Robert Elgin	10-20-10

Validation Required: ☐ Yes ☒ No ☐ Waive Comment:

Scope of Validation: ☐ Entire Procedure ☐ Change Only

Validation Method: ☐ Walkdown ☐ Simulation ☐ Tabletop ☐ First Time Use

Training Determination completed?: ☑ Yes ☑ N/A Completed by: Pamela Flores

USQ/USI Number (if needed):	Signature:	Z#:	Date:
NA	Valine Rhodes 10/20/2010	112609	10-21-10

Section 5– Final Approvals

☒ Release ☐ Hold Details:

Responsible Manager Signature:	Print Name, Title:	Z#:	Date:
Pete Rice	Pete Rice, MDAB Operations Manager	214458	10-21-10
Additional Approval Signature:	Print Name, Title:	Z#:	Date:

/s/ is used to indicate that the signature is on file
THE SIGNATURE(S) or Email(s) are part of the Document History File (DHF)

DAR Continuation

Document No.: TA21-MDAB-PLAN-00013	Revision No.:
Title: MDA-B Aboveground Inventory Management Plan	Page 2 of 2

Description of Requested Action (continued from Section 1)

See attached markup

Approval/Disapproval Comments (continued from Section 2)

None

Required Reviews (continued from Section 4)

Discipline:	Name:	Signature:	Date:
Waste Management	Susan Ramsey	Susan S. Ramsey	10-21-10
Security	Sidney Branch	/s/ Sidney Branch	10-15-10

Validation Comments (continued from Section 4

Release/Hold Details (continued from Section 5)