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Maintenance Plan for the Performance Assessments and Composite Analyses for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada National Security Site, Revision 3.0

Prepared by

Prepared for

U.S. Department of Energy
National Nuclear Security Administration
Nevada Field Office
under Contract Number
DE-NA0003624

March 2019

DISCLAIMER NOTICE

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ACRONYMS AND ABBREVIATIONS

ac	acre(s)
Am	americium
BN	Bechtel Nevada, LLC
CA	composite analysis
CAS	Corrective Action Site
CAU	Corrective Action Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSM	conceptual site model
DAS	Disposal Authorization Statement
DOE	U.S. Department of Energy
DOE M	U.S. Department of Energy Manual
DOE O	U.S. Department of Energy Order
DOE/HQ	U.S. Department of Energy Headquarters
EM	Environmental Management
FFACO	Federal Facilities Agreement and Consent Order
FY	fiscal year
GCD	Greater Confinement Disposal
km	kilometer(s)
LFRG	Low-Level Waste Disposal Facility Federal Review Group
LLWMU	Low-Level Waste Management Unit
LLW	low-level radioactive waste
m	meter(s)
MSTS	Mission Support and Test Services, LLC
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NSTec	National Security Technologies, LLC
NNSS	Nevada National Security Site
NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
PA	performance assessment

R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
Rn	radon
RREMP	Routine Radiological Environmental Monitoring Plan
RTG	radioisotope thermoelectric generator
RWMB	Radioactive Waste Management Basis
RWMS	Radioactive Waste Management Site
SLB	shallow land burial
SOFs	sum of fractions
Sr	strontium
TLD	thermoluminescent dosimeter
UCAQ	unreviewed composite analysis question
UDQ	unreviewed disposal question
UGTA	Underground Test Area
WAC	Waste Acceptance Criteria

EXECUTIVE SUMMARY

U.S. Department of Energy (DOE) Order 435.1, *Radioactive Waste Management*, requires that performance assessments (PAs) and composite analyses (CAs) for low-level radioactive waste (LLW) disposal facilities be maintained by the responsible field office. This plan describes the activities performed to maintain the PA and the CA for the Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs) at the Nevada National Security Site (NNSS). The plan is based on DOE Order 435.1 *Radioactive Waste Management* (DOE 2007), DOE Manual 435.1-1, *Radioactive Waste Management Manual* (DOE 2011), and DOE Standard DOE-STD-5002-2017, *Disposal Authorization Statement and Tank Closure Documentation* (DOE 2017).

The facility's Disposal Authorization Statement (DAS) specifies conditions for the continuing operation of a LLW facility. The DAS is issued based on a review of the facility's PA, CA, the maintenance plan, preliminary closure plan, and preliminary monitoring plan. The DAS specifies the limits and conditions on construction, design, operations, and closure of the low-level waste facility based on these reviews.

The Maintenance Plan uses an Unreviewed Disposal Question (UDQ)/Unreviewed Composite Analysis Question (UCAQ) change control process to identify, evaluate, and control planned or discovered changes affecting the PA, CA, DAS, or other documents composing the Radioactive Waste Management Basis (RWMB). The UDQ/UCAQ process uses the PA and CA GoldSim models to calculate updated results, assess the significance of changes, and to assess the need to revise the PA, CA, or DAS.

In addition to the change control process, the Maintenance Plan requires an annual review of all changes and an annual assessment of the need to revise RWMB documents, plans, and programs. The cumulative effect of all changes is assessed annually by preparing a revised PA and CA baseline model that is used to update PA and CA results. The updated results are used to assess compliance with the PA performance objectives and the CA dose constraint, and to assess the need to revise the PAs, CAs, and other documents, plans, and programs supporting the RWMB. An Annual Summary Report documenting the results and conclusions of the annual review is prepared and submitted to DOE.

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1.0 INTRODUCTION

1.1 Purpose and Scope

U.S. Department of Energy Order (DOE O) 435.1, *Radioactive Waste Management*, and its accompanying manual, DOE Manual (DOE M) 435.1-1, *Radioactive Waste Management Manual*, require a reasonable expectation that radioactive low-level waste (LLW) disposal facilities can meet performance objectives that are protective of public health and the environment. A reasonable expectation of compliance with the performance objectives is provided through the preparation of a performance assessment (PA) and a composite analysis (CA). The PA and CA are long-term prospective risk assessments prepared for the disposal facility itself and the disposal facility along with all other potential sources of interactive radioactive materials, respectively. If the PA and CA provide a reasonable expectation of compliance with all requirements, the U.S. Department of Energy (DOE) issues a Disposal Authorization Statement (DAS) specifying the conditions for operation and closure of the LLW facility. The LLW facility is required to maintain the PA and CA, and address DAS conditions throughout the life of the facility.

The assumptions, data, and conceptual site models (CSMs) used in the PA and CA may change over time as new actions are proposed and implemented, new data are developed, and deviations are discovered. An important purpose of the maintenance process is to identify, control, and evaluate changes that occur over the operational life of the facility after the DAS is issued. Additional Maintenance Plan activities that identify potentially significant changes include annual reviews of operations, the environmental monitoring program, and research and development (R&D) activities. The maintenance process also annually assesses the need to revise or update the PA, CA, DAS, and other documents supporting the Radioactive Waste Management Basis (RWMB). The final purpose of the Maintenance Plan is to track DAS conditions and secondary issues identified during the reviews of the PAs and CAs to ensure that issues are addressed and resolved.

This Maintenance Plan describes the activities necessary to maintain the PAs and CAs for the Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs) at the Nevada National Security Site (NNSS) (Figure 1). The plan is based on requirements and guidance contained in DOE O 435.1 (DOE 2007), DOE M 435.1-1, (DOE 2011), DOE-STD-5002-2017, *Disposal Authorization Statement and Tank Closure Documentation* (DOE 2017), and on conditions described in the particular facility's DASs (DOE 1999, 2000).

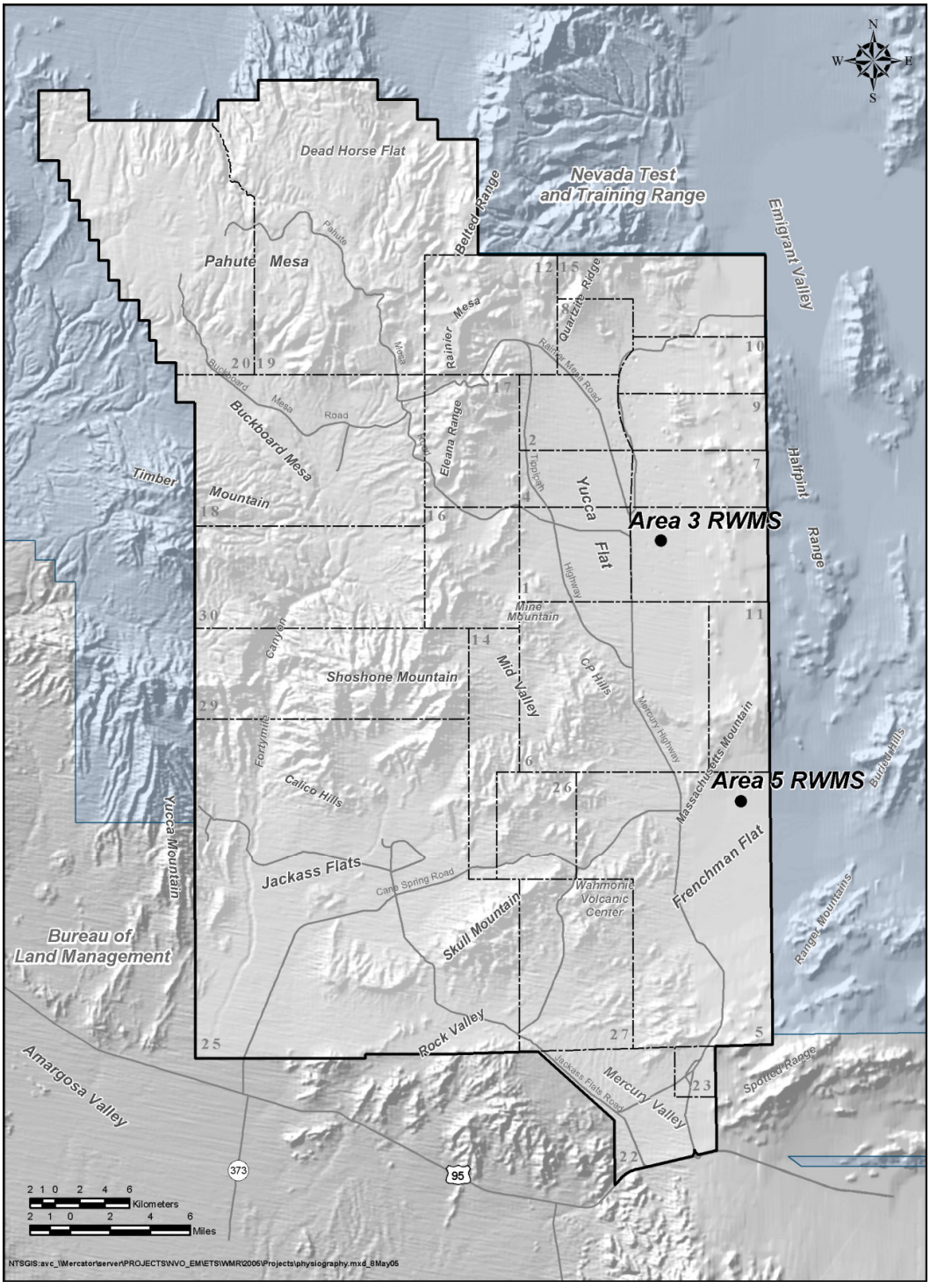

Figure 1. Location of the Area 3 and Area 5 RWMSs on the NNSS

1.2 Approach

The approach of the Maintenance Plan is to use the PA and CA GoldSim models to assess the significance of changes and assess the need to revise the PA, CA, or DAS on a continuous basis as individual changes are planned or discovered. An Unreviewed Disposal Question (UDQ)/Unreviewed Composite Analysis Question (UCAQ) change control process is used to identify, evaluate, and control planned or discovered changes affecting the PA or CA.

In addition to the continuous change control process, the Maintenance Plan requires an annual review of all changes and an annual assessment of the need to revise PA, CA, and documents supporting the RWMB. The cumulative effect of all changes occurring since preparation of the PA and CA is assessed annually by preparing a revised PA and CA baseline model, which is used to update PA and CA results. The updated results are used to assess compliance with the PA performance objectives and the CA dose constraint, and to assess the need to revise the PAs and CAs. The annual review also includes an assessment of the need to revise programs, documents, and plans supporting the Radioactive Waste Management Basis (RWMB). Supporting programs, documents, and plans reviewed on an annual basis include 1) the Maintenance Plan, 2) the Environmental Monitoring Plan and program, 3) the R&D program, 4) the Waste Acceptance Criteria (WAC), 5) the Closure Plans, and 6) institutional control policies. An Annual Summary Report is prepared and submitted to DOE, National Nuclear Security Administration Nevada Field Office (NNSA/NFO) documenting the results and conclusions of the annual review.

1.3 Organization

Revision 3 of the Maintenance Plan was prepared using the guidance contained in DOE-STD-5002-2017, *Disposal Authorization Statement and Tank Closure Documentation* (DOE 2017).

Section 1.0 describes the purpose and scope of the Maintenance Plan and provides an overview of the approach to PA and CA maintenance.

Section 2.0 identifies key assumptions affecting the Area 3 and Area 5 RWMS PA and CA conclusions. Key assumptions are developed from the results of the PA and CA and their uncertainty and sensitivity analyses.

Section 3.0 describes the environmental monitoring programs at the Area 3 and Area 5 RWMSs. The environmental monitoring program is developed to comply with DOE Orders and other applicable state of Nevada and Federal regulations. The design of the environmental monitoring program is also informed by the CSMs, PA, and CA model results, and secondary issues identified during the review of the PAs and CAs.

Section 4.0 describes R&D activities supporting the Area 3 and Area 5 RWMS PAs and CAs. R&D activities are based on identified PA and CA uncertainties and sensitivities, and secondary issues identified during review of the PA and CA.

Section 5.0 describes reviews and analysis conducted under the PA Maintenance Plan.

Section 6.0 describes the schedule and frequency of PA Maintenance Plan reviews and analyses.

Section 7.0 lists references cited in the report.

Appendix A describes how the Maintenance Plan meets the requirements of DOE-STD-5002-2017.

2.0 KEY ASSUMPTIONS

Key assumptions are PA and CA assumptions or design specifications judged to have a major impact on the disposal facility's performance and the reasonable expectation of meeting the DOE M 435.1-1 performance objectives. Proposed or discovered changes to key assumptions require evaluation under the UDQ/UCAQ change control process. There are no changes to the key assumption from those in the existing DASs.

Key assumptions are expected in subject areas related to facility siting and design, waste disposal operations, waste characteristics and inventory, closure plans, land use plans, and inventories of interacting source of residual radioactive materials (Table 1).

Table 1. PA/CA Subject Areas and Their Key Assumptions or Specifications

Subject Area	Sub-Category	Key Assumption or Specification
Facility Siting and Design	Disposal Cell Design	Area 5 RWMS shallow land burial (SLB) disposal cell floor depth 4 to 9 meters (m) below existing grade
		Waste disposed ≥ 1.2 m below existing grade
		Thickness of backfill/cover ≥ 2.5 m
		Area 5 RWMS disposal cells limited to Area 5a
		Area 3 RWMS disposal cells limited to the U-3ax, U-3bl, U-3ah, U-3at, and U-3bh subsidence craters
	Flood Control	Flood control berms and channels designed to prevent run-on from a 25-year precipitation event
		Disposal cells located outside 100-year flood hazard zone
Operations	Waste Form and Packaging	Waste volume reduced to the extent practicable
	WAC	Disposed waste complies with WAC requirements
		WAC Appendix E radionuclide reporting requirements are implemented (NNSA/NFO 2016)
	Procedures and Systems	Verification of waste characteristics and WAC compliance (e.g., the radionuclide content, prohibited wastes)
		Disposed waste inventory recorded and records maintained
		Disposal cell covers, flood control structures, fencing, markers, and warning signs inspected and maintained during operations and for 30 years post-closure
		Waste containers placed in disposal cells to minimize voids
Waste Characteristics and Inventory	Waste Inventory	Area 5 RWMS SLB radionuclide WAC Action Level sum-of-fractions (SOFs) ≤ 1
	Waste Characteristics	Waste not capable of generating external temperatures > 300°C when buried in alluvium
		Waste not capable of generating external temperatures > 30°C in nearest waste package

Subject Area	Sub-Category	Key Assumption or Specification
Closure Plan	Engineered Barriers	Evapotranspirative closure cover installed
		Closure covers constructed to plan with respect to cover thickness, materials used, elevation above grade, compaction, slope, and site drainage
	Other Design Features	Systems for performance monitoring installed
		Closure covers revegetated with native desert shrubs at densities observed in undisturbed areas within 10 years of final closure
		Site perimeter fence, warning signs, and markers installed
Land Use Plans	Future Land Use	The Frenchman Flat and Yucca Flat remain under Federal control in perpetuity
		PA and CA point of assessment is at 100 m from buried waste
	Institutional Control	NNSA/NFO maintains a written comprehensive policy to implement, maintain, and enforce institutional controls that restrict access to, and use of, the NNSS and to ensure the continuity of appropriate institutional controls in the future
		NNSA/NFO maintains written policy to ensure that institutional controls are passed to successor organizations and to notify local, state, and federal authorities of the end of control or the cessation of funding to maintain controls
		Post-closure inspection and maintenance plans are implemented
CA Sources of Residual Radioactive Contamination	Federal Facility Agreement and Consent Order (FFACO) Corrective Actions	Location and distribution of residual radioactive contamination remains as assumed in the CA
		Radionuclide identity and inventory at Corrective Action Sites (CASs) as assumed in the CA
		Condition of natural and engineered barriers at FFACO CASs as assumed in the CA
		NNSA/NFO documents, maintains, and enforces FFACO CAS land use restrictions
	End State Configuration	Current and future NNSS operational facilities will not become sources of residual radioactive contamination

3.0 MONITORING

The NNSS *Routine Radiological Environmental Monitoring Plan* (RREMP) (BN 1998) is the basis for all NNSS-wide environmental surveillance, site-specific effluent monitoring, and operational monitoring conducted by various missions, programs, and projects. The RREMP design process used existing and historical site information, regulatory requirements, the PA CSM, as well as PA and CA model results to design the Area 3 and Area 5 RWMS pre-closure environmental monitoring programs.

The pre-closure Area 3 and Area 5 RWMS monitoring programs were developed to meet the regulatory requirements of DOE Orders and other state of Nevada and Federal regulations and agreements including:

- DOE O 435.1, DOE M 435.1-1, and DOE O 458.1, "Radiation Protection of the Public and the Environment*"* (DOE 2013)
- Title 40, CFR Part 264, "Resource Conservation and Recovery Act (RCRA), Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*"* (CFR 2012a)
- Title 40, CFR Part 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*"* (CFR 2012b)
- Title 40, CFR Part 61, "National Emission Standards for Hazardous Air Pollutants*"* (NESHAPS) (CFR 2011a)
- Title 40, CFR Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High Level and Transuranic Radioactive Waste" (CFR 2011b)
- FFACO closure requirements for Corrective Action Unit (CAU) 110, Area 3 U-3ax/bl Disposal Unit, and CAU 111, Area 5 WMD Retired Mixed Waste Pits

Pre-closure compliance monitoring activities includes air monitoring, radon-222 (^{222}Rn) flux monitoring, and groundwater detection monitoring. Pre-closure performance activities are selected to provide early detection of contaminant releases or changing trends in performance and confirm PA assumptions regarding the hydrologic conceptual model, subsidence, thermal conductivity of alluvium, and biotic transport. No changes are planned for the pre-closure monitoring plan. The pre-closure monitoring plan includes no special monitoring programs or monitoring-related oversight activities.

The closure plans for the Area 3 RWMS and Area 5 RWMS (NSTec 2007, 2008) describe the specific pre- and post-closure monitoring programs for the waste disposal facilities. A separate plan (NNSA/NFO 2017) addresses the Area 5 RWMS groundwater monitoring program. The current pre-closure monitoring program is summarized in Table 2.

Table 2. Summary of Area 3 and Area 5 RWMS Pre-Closure Monitoring Programs

Monitoring Element	Area 3 RWMS	Area 5 RWMS
Vadose zone monitoring (Continuous sampling– daily and hourly measurements)	• Measurements of soil water content at four locations in U-3ax/bl disposal unit cover • Eight drainage lysimeters for water balance in operation since 2001	• Measurements of soil water content and water potential in four waste disposal unit covers • Measurements of soil water content in four waste disposal unit floors • Two weighing lysimeters (vegetated and bare) for water balance in operation since 1994
Groundwater monitoring (Biannual sampling)	• None	• RCRA detection monitoring at three wells
^{222}Rn monitoring (Sampling at 3 – 4-year intervals)	• ^{222}Rn flux measurements from waste covers (various locations)	• ^{222}Rn flux measurements from waste covers (various locations)
Meteorology monitoring (Continuous sampling – daily and hourly measurements)	• Air temperature at 3 and 9.5 m • Relative humidity at two heights • Wind speed and direction at two heights • Barometric pressure • Solar radiation • Precipitation	• Air temperature at 3 and 9.5 m • Relative humidity at two heights • Wind speed and direction at two heights • Barometric pressure • Solar radiation • Precipitation
Direct radiation monitoring (Continuous sampling – 3 month measurements)	• Thermoluminescent dosimeters (TLDs) at nine locations	• TLDs at 12 locations
Biota monitoring (Sampling at 3 – 4-year intervals)	• Sampling vegetation, small mammals, and animal burrow spoils for tritium, gamma-emitting radionuclides, strontium-90 (^{90}Sr), americium-241 (^{241}Am), and plutonium • Plant density of U-3ax/bl closure cover	• Sampling vegetation, small mammals, and animal burrow spoils for tritium, gamma-emitting radionuclides, ^{90}Sr, ^{241}Am, and plutonium • Plant density on 92-acre (ac) Low-Level Waste Management Unit (LLWMU) closure cover
Subsidence monitoring (Measurements at 1 – 2-year intervals)	• Quarterly inspection of operational covers • U-3ax/bl closure cover surveyed at eight locations on a 2-year interval	• Quarterly inspection of operational covers • 92-ac LLWMU closure cover surveyed annually at 52 locations

Monitoring Element	Area 3 RWMS	Area 5 RWMS
Air monitoring (Continuous sampling – quarterly composites of two week samples)	• Atmospheric moisture sampling for tritium and air particulates sampled at three locations	• Atmospheric moisture sampling for tritium at two locations; air particulates sampled at two locations
Soil temperature monitoring around radioisotope thermoelectric generators (RTGs) (Continuous sampling)	• None	• Vertical and horizontal sensor arrays around four RTGs in Pit 5
Lined mixed waste disposal unit leachate monitoring (Sampled as leachate generated)	• None	• RCRA lined mixed waste cell leachate monitored for toxicity characteristic contaminants, polychlorinated biphenyls, specific conductance, pH, and tritium

The post-closure monitoring plan will be designed at closure based on conditions and applicable regulations. The post-closure monitoring plan is expected to be reduced relative to the pre-closure monitoring. The closure plans identify subsidence monitoring, vadose zone monitoring, biota monitoring, and groundwater monitoring as expected areas of post-closure focus.

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4.0 RESEARCH AND DEVELOPMENT

R&D activities are selected based on issues identified during prior PA and CA reviews (i.e., secondary issues) and the results of model uncertainty and sensitivity analyses. The Area 3 RWMS PA review identified a need for additional water balance data as a secondary issue. Both the Area 3 and Area 5 RWMS PA reviews identified inconsistencies between PA models as a secondary issue. Ongoing R&D activities at the Area 3 and Area 5 RWMSs are conducted to increase confidence in PA water balance assumptions and to develop and improve the PA and CA models and model consistency, and to reduce parameter uncertainty.

In addition to ongoing long-term R&D activities, short-term or temporary projects may arise to reduce uncertainties and in response to new data needs. Prior R&D short-term efforts include measurement of the ^{222}Rn effective diffusion coefficient in Area 5 RWMS cover material and the measurement of RTG heat generation to calibrate heat transfer models. In 2017, a three-year R&D activity investigating methods to re-establish native vegetation on Area 5 RWMS closure covers was initiated.

The Area 3 RWMS Drainage Lysimeter Facility is used for water balance studies. The facility consists of eight 2.4-m deep drainage lysimeters. The lysimeters are subject to six treatments created by combining three vegetation treatments (bare, invader plants, and native plants) and two precipitation treatments (natural precipitation, three times natural precipitation). The lysimeters record depth profiles of water content, water potential, and temperature. Plant cover is also recorded. An on-site weather station records precipitation and multiple parameters related to reference evapotranspiration. The Area 3 RWMS lysimeter studies have the following goals:

- Increase confidence in water balance assumptions by observing temporal variability in precipitation and reference evapotranspiration that occurs in highly variable desert environments over long periods of time
- Increase understanding of the effects on water balance of increased infiltration that may occur with subsidence of closure covers below grade
- Increase understanding of the response of native and invader plant species to natural and enhanced infiltration

R&D activities at the Area 5 RWMS include monitoring of the Area 5 Weighing Lysimeter Facility. The Area 5 Weighing Lysimeter Facility consists of two 2-m deep precision weighing lysimeters. One lysimeter is vegetated with native plants, while the other is maintained in a bare, unvegetated state. The lysimeters and on-site weather station record the same parameters as the Area 3 RWMS Drainage Lysimeter Facility. The Area 5 RWMS lysimeter studies have the following goals:

- Increase confidence in water balance assumptions by observing temporal variability in precipitation, water storage, and reference evapotranspiration that occurs in highly variable desert environments over long periods of time
- Increase understanding of the effects of native vegetation on water balance

5.0 PLANNED REVIEW AND ANALYSIS

5.1 Status of DAS Conditions/Limits

5.1.1 Area 3 RWMS DAS Conditions

A combined Area 3 RWMS PA and CA document was prepared in 1997 (Shott et al. 1997). The DOE Low-Level Waste Disposal Facility Federal Review Group (LFRG) conducted a review and recommended formal authorization for disposal operations with conditions. Following LFRG's recommendation, DOE Headquarters (DOE/HQ) issued the DAS for the Area 3 RWMS on October 20, 1999 (DOE 1999).

The DAS for the Area 3 RWMS identified one PA condition and two CA conditions. The PA condition required preparation of a revised PA document that resolved six secondary issues (Table 3). The CA conditions required preparation of a revised CA document that addressed the impacts of contaminated groundwater from Underground Test Areas (UGTAs) and resolved a secondary issue. All DAS conditions and the secondary issues identified in the DAS were resolved when the final PA and CA document (Shott et al. 2001) was issued (DOE 2002a).

Table 3. Area 3 RWMS DAS Conditions

DAS Condition Number	Issue Description	Resolution	Response
DAS Condition PA-1.0	*Provide a revised PA that resolves six secondary issues: (PA-1.1 – PA-1.6)*	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001).	DAS conditions closed in 2002 (DOE 2002a).
DAS Condition PA-1.1	*"Lack of justification for excluding particular exposure scenarios based on exhumed waste"*		
DAS Condition PA-1.2	*"Inadequate justification for omission of surface water"*		
DAS Condition PA-1.3	*"Lack of sensitivity analysis regarding the assumed 250 years of institutional control"*		
DAS Condition PA-1.4	*"Need for clarification of the RCRA/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulatory involvement, if any, in low-level waste disposal at Area 3"*		
DAS Condition PA-1.5	*"Need for clarification of the location of the point of maximum exposure"*		
DAS Condition PA-1.6	*"Need for better explanation of the borehole and field data within the framework of the no-recharge conceptual model"*		

DAS Condition Number	Issue Description	Resolution	Response
DAS Condition CA-1	*"Provide to LFRG, within eight months of the date of issuance of this disposal authorization statement, a revision to the composite analysis that includes qualitative assessment including an options analysis of the effect of groundwater contamination resulting from underground nuclear testing. Before any portion of the Nevada Test Site is considered for a reduction in institutional control, Nevada Operations Office will have quantified the potential dose from the underground testing residues and taken measures to mitigate the dose, as appropriate."*	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001).	DAS conditions closed in 2002 (DOE 2002a).
DAS Condition CA-2	*"Resolution of the following secondary issues identified in the review of the composite analysis: Need for a better explanation of the borehole and field data within the framework of the no-recharge conceptual model."*		

A special analysis updating the Area 3 RWMS deterministic PA and CA model with results from a probabilistic GoldSim PA model was prepared in 2012 (NSTec 2012).

5.1.2 Area 5 RWMS DAS Conditions

A PA was prepared for the Area 5 RWMS and submitted to DOE/HQ for review in July 1995 (Shott et al. 1995). After a review by the DOE PA Peer Review Panel, the Area 5 RWMS PA was accepted with conditions (DOE 1996). The PA document was subsequently revised, incorporating changes as directed by the reviewers, and published (Shott et al. 1998).

A CA for the Area 5 RWMS was completed in February 2000 (BN 2000). The LFRG reviewed both the CA and the revised PA in fiscal year (FY) 2000. Upon the LFRG's recommendation, DOE/HQ issued a conditional DAS for the Area 5 RWMS on December 5, 2000, and required that the specified conditions be addressed within one year of the DAS's issuance (Table 4) (DOE 2000). To resolve these conditions, NNSA/NFO submitted a PA and a CA addendum report in November 2001 (BN 2001a, b). Both addenda were approved in May 2002, with DAS conditions met and all DAS conditions closed.

Table 4. Area 5 RWMS DAS Conditions

DAS Condition Number	Issue Description	Resolution	Response
DAS Condition PA-1	*"The specific radionuclide concentration or inventory limits shall be imposed on Pit 6 to ensure that performance objectives will not be exceeded. A quantitative dose estimate shall be calculated using the reduced inventory to determine compliance with the performance objective."*	An addendum to the Area 5 RWMS PA was issued in November 2001 (BN 2001b).	The DAS conditions were closed in 2002 (DOE 2002b).
DAS Condition PA-2	*"The closure plan shall require a closure cap thickness of at least 4 meters as stated in Section 5.1 of the 1998 PA to ensure that performance objectives for the agricultural scenario will not be exceeded. A quantitative dose estimate shall be calculated using the 4 meter cap to demonstrate compliance with the performance objectives."*		
DAS Condition CA-1	*"The CA for the RWMS shall either be revised or an addendum issued within one year of the date of the issuance of this DAS to incorporate the Supplemental Information. The revised CA or addendum shall be submitted to the LFRG. Nevada Operations Office shall address all secondary issues and issues identified in Appendix B of the Review Team Report through the maintenance program."*	An addendum to the Area 5 RWMS CA was issued in November 2001 (BN 2001c).	The DAS conditions were closed in 2002 (DOE 2002b).
DAS Condition CA-2	*"Consistent with the site's Land-Use Plan and the conditions identified in the Area 3 DAS before any portion of the Nevada Test Site is considered for a reduction in institutional controls, Nevada Operations Office will have quantified the potential dose from the underground testing residues."*		

A second addendum to the Area 5 RWMS PA was issued in 2005 that updates the deterministic PA model with results from a probabilistic GoldSim PA model. Addendum 2 to the Area 5 RWMS PA was approved by the LFRG without conditions and issued in June 2006 (BN 2006).

A PA for the transuranic waste disposed in four greater confinement disposal (GCD) boreholes at the Area 5 RWMS was prepared by Sandia National Laboratories to demonstrate consistency with the requirements of 40 CFR Part 191 (Cochran et al. 2000). The LFRG reviewed and conditionally accepted the GCD PA in FY 2001. The single condition was to meet the 40 CFR Part 191.14 Assurance Requirements. NNSA/NFO has no plans to revise the GCD PA as all GCD boreholes are operationally closed. The condition to meet the 40 CFR Part 191.14 Assurance Requirements will be addressed through the maintenance program as an Area 5 RWMS secondary issue.

5.2 LFRG Key and Secondary Issues

The Area 3 and Area 5 RWMS DASs require that minor or secondary issues identified in the LFRG Review Reports be addressed as part of the maintenance program. The implementation of this plan will assure that these secondary issues are addressed. Table 5 lists the Area 3 RWMS secondary issues that are being tracked and resolved through the maintenance program.

Table 5. Area 3 RWMS Secondary Issues Addressed by the Maintenance Plan

Secondary Issue Number	Issue Description	Resolution	Response
Secondary Issue PA-1	*Inconsistencies exist between conceptual models for the Area 5 RWMS PA and CA, the Area 3 RWMS PA and CA, and the GCD PA.*	The Area 3 and Area 5 RWMSs PAs and CAs used different models that had inconsistencies. Development of consistent models implemented in GoldSim will resolve inconsistencies.	Inconsistencies resolved with development of GoldSim PA and CA models for the Area 3 and Area 5 RWMSs
Secondary Issue PA-2	*Conduct site monitoring and site characterization studies as required to increase confidence in the results of the PAs.*	Monitoring programs and R&D at both the Area 3 and Area 5 RWMSs are ongoing, and data are being incorporated into the GoldSim PA models; impact on the uncertainty and confidence in results are presented in Annual Summary Reports.	Environmental monitoring and R&D is expected to continue throughout the operational period at the Area 3 and Area 5 RWMSs. Results are reviewed and summarized annually. Environmental monitoring is expected to continue during post-closure period. Post-closure R&D is dependent on review of closure PA and CA.

Secondary Issue Number	Issue Description	Resolution	Response
Secondary Issue PA-3	*Monitoring systems need to be deployed and data gathered and evaluated to distinguish between interacting sources at the Area 3 RWMS.*	The monitoring systems deployed at the Area 3 RWMS are described in the closure plan (NSTec 2007) and Annual Summary Reports. Except for tritium, interacting CASs and disposed waste have distinct radionuclide compositions that are readily distinguishable.	Environmental monitoring results are evaluated and summarized annually. Except for tritium, activity ratios of detected radionuclides match FFACO Soil Site CASs near the Area 3 RWMS. Environmental monitoring is expected to continue into the post-closure period.
Secondary Issue CA-1	*Need for better explanation of the borehole and field data within the framework of the no-recharge conceptual model.*	Revised Area 3 RWMS PA and CA issued December 2001 (Shott et al. 2001).	Issue closed in 2002 (DOE 2002a).
Secondary Issue CA-2	*No discussion of the data quality objective process.*	Revised Area 3 RWMS PA and CA issued December 2001 (Shott et al. 2001).	Issue closed in 2002 (DOE 2002a).
Secondary Issue CA-3	*Limited discussion of land use planning.*	Revised Area 3 RWMS PA and CA issued December 2001 (Shott et al. 2001).	Issue closed in 2002 (DOE 2002a).
Secondary Issue CA-4	*Lack of comparison of modeling results with site monitoring results.*	Revised Area 3 RWMS PA and CA issued December 2001 (Shott et al. 2001).	Issue closed in 2002 (DOE 2002a).
Secondary Issue CA-5	*The maintenance program must include periodic assessment of changes in potentially interacting sources (UGTAs, industrial sites) and impacts on the CAs.*	FFACO corrective actions are reviewed annually as part of the maintenance plan and summarized in the Annual Summary Report.	Final assessment of the effects of FFACO corrective actions on the CA is awaiting final closure of the UGTA CAU 97, Yucca Flat/Climax Mine, currently scheduled for 2020.
Secondary Issue CA-6	*The maintenance program must include periodic assessment of changes in land-use restrictions and impacts on the CAs.*	NNSA/NFO institutional control policies and FFACO corrective actions, including land use restrictions, are reviewed annually as part of the maintenance plan and summarized in the Annual Summary Report.	Final assessment of the effects of FFACO land use restrictions on the CA is awaiting final closure of the UGTA CAU 97, Yucca Flat/Climax Mine, currently scheduled for 2020.

Table 6 lists the Area 5 RWMS secondary issues that are being tracked and resolved through the maintenance program.

Table 6. Area 5 RWMS Secondary Issues Addressed by the Maintenance Plan

Secondary Issue Number	Issue Description	Resolution	Response
Secondary Issue PA-1	*Inconsistencies exist between conceptual models for the Area 5 RWMS PA and CA, the Area 3 RWMS PA and CA, and the GCD PA.*	The Area 3 and Area 5 RWMSs PAs and CAs used different models that had inconsistencies. Development of consistent models implemented in GoldSim will resolve inconsistencies.	Inconsistencies resolved with development of GoldSim PA and CA models for the Area 3 and Area 5 RWMSs.
Secondary Issue GCD PA-1	*An engineered barrier will be added, and the assurance requirements of 40 CFR 191 must be met for the GCD boreholes.*	Plans for the final closure of the GCD boreholes according to 40 CFR 191.14 Assurance Requirements will be developed in an assurance document.	The 40 CFR 191.14 Assurance Requirements will be met at the conclusion of DOE Environmental Management (EM) control of site, currently scheduled for 2030.
Secondary Issue CA-1	*The maintenance program must include periodic assessment of changes in potentially interacting sources (Underground Test Areas [UGTAs], industrial sites) and impacts on the CAs.*	FFACO corrective actions are reviewed annually as part of the maintenance plan and summarized in the Annual Summary Report.	All but one FFACO CAU within 10 kilometers (km) of the Area 5 RWMS are closed. A UCAQ Evaluation of FFACO corrective actions concluded that the closures have no impact on the CA (MSTS 2018a). Annual reviews will continue, but major CA changes are not anticipated.
Secondary Issue CA-2	*The maintenance program must include periodic assessment of changes in land-use restrictions and impacts on the CAs.*	NNSA/NFO institutional control policies and FFACO corrective actions, including land use restrictions, are reviewed annually as part of the maintenance plan and summarized in the Annual Summary Report.	All but one FFACO CAU within 10 km of the Area 5 RWMS are closed. A UCAQ Evaluation of FFACO corrective actions, including land use restriction, concluded that the closures have no impact on the CA (MSTS 2018a). Annual reviews will continue throughout the preclosure period.

5.3 Annual Review and Summary Report

An annual review of the Area 3 and Area 5 RWMS disposal facilities, their operations, and supporting documentation shall be conducted to determine if the following statements are true:

- The LLW Disposal Facility PA and associated CA assumptions and conclusions remain valid based on consideration of all changes identified or planned
- The reasonable expectation that the LLW Disposal Facility will meet the performance objectives identified in DOE O 435.1, *Radioactive Waste Management*, remains valid
- The DAS, based on interpretation of the data collected, monitoring results, and other information, remains valid

An annual review shall occur at the conclusion of each FY that addresses any planned or discovered changes occurring in the prior FY. The UDQ/UCAQ process should identify most significant changes. Completed UDQ Evaluations, UCAQ Evaluations, and special analyses shall be reviewed to identify any significant changes implemented or discovered in the prior FY. The changes shall be evaluated for inclusion in the inventory or PA and CA models, as appropriate.

The waste inventory and volume disposed and disposal cells receiving waste during the prior FY shall be determined. Completed UDQ Evaluations, UCAQ Evaluations, and special analyses shall be reviewed to identify changes or discoveries that affect past waste disposals. The current forecast of future waste volume shall be obtained and used to update the future waste inventory and volume. The Area 3 and Area 5 RWMS inventories models shall be updated with any new data developed. Updated estimates of closure waste inventory and volume shall be prepared and compared with inventory and volume analyzed in the PAs and CAs. The SOFs for disposed waste shall be calculated for all disposal units with PA derived WAC Action Levels.

Waste disposal operations including the siting, design, and construction of new disposal units shall be reviewed. The location and dimensions of new disposal cells shall be obtained and waste capacity and disposal cell area estimated. New disposal cell designs and dimensions shall be compared with PA models and assumptions for consistency.

The FFACO program shall be reviewed for significant changes regarding new CAUs discovered or corrective actions completed at CAUs potentially interacting with the Area 3 or Area 5 RWMSs. Established FFACO land use restrictions at CAUs interacting with the Area 3 or Area 5 RWMSs shall be reviewed for changes.

The Environmental monitoring program shall be reviewed for significant changes. Environmental monitoring results shall be reviewed for compliance with regulatory requirements, consistency with the CSM, unexpected results, or changes in long-term trends.

The results of R&D performed by the site operator and other external research groups shall be reviewed for consistency with the CSM and model parameters.

The RWMB and supporting documents shall be reviewed for significant changes. Important supporting documents include the Maintenance Plan, the Closure Plans, WAC, the NNSS Institutional Control Policy, and Environmental Impact Statements.

Secondary issues identified during PA and CA reviews shall be evaluated to determine if the issue has been resolved by the maintenance program.

At the conclusion of the annual review, important changes should be implemented in the Area 3 and Area 5 RWMSs inventory models and PA and CA models. The models will be used to update PA and CA results and assess the impact of changes in FYs that changes occur. The analysis results will also be used to assess the likelihood of continuing compliance with the DOE M 435.1-1 PA performance objectives and CA dose constraint. The overall results of the review will be used to assess the need to revise the PAs, CAs, or DASs.

An Annual Summary Report shall be prepared documenting the results and conclusions of the annual review. The Annual Summary Report shall be submitted to NNSA/NFO for review and approval.

6.0 PLANNED MAINTENANCE ACTIVITIES AND SCHEDULES

Maintenance Plan activities occur on a continuous basis, at a regular frequency, or on an as-needed basis. On a continuous basis the maintenance program shall review all proposed activities, discoveries, or new information under the UDQ/UCAQ process (MSTS 2018b). Environmental monitoring and R&D activities also occur on a continuous basis.

The following PA and CA maintenance activities are performed periodically:

- Development of PA and CA models and release of baseline models for application
- Annual reviews of facility operations
- Annual review of documents, plans, and programs supporting the RWMB
- Preparation of Annual Summary Report

Document revision activities are scheduled on an as needed basis. Document revision activities include:

- Preparation of PA and CA revisions or updates
- Revision of the Maintenance Plan and Closure Plans

The schedule of activities is summarized in Table 7. Maintenance activities will continue throughout the operational life of each RWMS and beyond, as necessary. The decision to continue the PA maintenance activities during the post-closure period will be determined at facility closure. Development of the PA and CA models, which is a continuous improvement process, is scheduled annually. Except the PA and CA revisions and the Maintenance Plan revision, all PA activities are scheduled annually. All maintenance activities are fully funded under the PA and CA Task as described in the Environmental Management Information System.

Table 7. The Schedule of Maintenance Activities

Activity	Activity Frequency and Completion
Compliance and performance monitoring	Continuous monitoring, results reported annually on calendar year basis throughout pre-closure period. Post-closure monitoring frequency to be determined.
R&D activities	R&D activities are ongoing in the pre-closure period, results reported annually on calendar year basis throughout pre-closure period. R&D activities in post-closure period dependent on closure PA and CA.
Updating of inventory and PA/CA models	Review annually, update when significant changes occur until final closure.
Conduct annual reviews	Annually at conclusion of each FY until final closure.
Prepare Annual Summary Report	Annually at conclusion of each annual review until final closure.

Activity	Activity Frequency and Completion
Area 3 RWMS PA revisions or updates	Review annually, revise or update as needed and at final site closure.
Area 5 RWMS PA revisions or updates	Review annually, revise or update as needed and at final site closure.
Area 3 RWMS CA revisions or updates	Review annually, revise or update as needed and at final site closure. Revision/update planned after final closure of CAU 97 in 2020.
Area 5 RWMS CA revisions or updates	Review annually, revise or update as needed and at final site closure.
40 CFR 191.14 assurance requirements document	Complete at end of DOE EM control of the Area 5 RWMS in 2030.
Maintenance Plan review and revision	Review annually, revise as needed throughout pre-closure period.
Closure Plan review and revision	Review annually, revise as needed throughout pre-closure period.
Environmental Monitoring Plan review and revision	Review annually, revise as needed throughout pre-closure period.
Review WAC and Institutional Control Policy	Review annually
Review FFACO corrective actions and land use restrictions	Review annually, revise CA as needed throughout pre-closure period.

A final PA and CA are scheduled for each facility at final closure. Disposal activities at the Area 3 RWMS were in stand-by from July 2006 through FY 2018. Disposal operations resumed in FY 2019. The Area 3 RWMS special analysis assumes facility closure in FY 2025 (NSTec 2012).

The Area 5 RWMS will be closed in phases. The 92-acre LLWMU was closed in 2012. Closure of the Northern Expansion Area is expected before 2025. There is no formal closure date for the Western Expansion Area. The current Area 5 RWMS PA assumes closure in FY 2028, but operation of the Western Expansion Area beyond 2028 is considered likely. DOE EM responsibility for the Area 5 RWMS is expected to end in 2030 with transfer to the National Nuclear Security Administration.

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Appendix A: Maintenance Plan Review Criteria

Table A.1 Maintenance Plan Review Criteria from the DOE Technical Standard – "Disposal Authorization Statement and Tank Closure Documentation" (DOE 2017)

Number	Review Criteria	Criteria Met (Y/N)	Comments
MA-1	Describe the purpose and scope of the PA/CA maintenance program and provide an overview of the approach, including the site-established priorities for maintenance activities for the PA and CA, Monitoring Plan (MonP), and Closure Plan (CP). Summarize the relationship of the PA/CA Maintenance Plan (MP) with other relevant documents associated with the disposal facility. The PA and CA MP should be reviewed annually by the site and updated as needed to address priorities based upon new information or proposed changes, the status of any DAS conditions/limitations and LFRG issues.	Y	Section 1.2 describes the purpose and scope of the Maintenance Plan. Section 1.3 describes the Maintenance Plan approach including the documents, plans, and programs that require review.
MA-2	Describe key assumptions regarding major aspects of the disposal facility including design, operations, waste form/inventory, and closure, essential to the performance expectations and maintenance of the PA and CA and CP until the facility is released from DOE control. It should identify major assumptions such as land use(s), point of assessment (POA), and any interacting end-state facility/waste site configurations and inventories [including decontamination and decommissioning (D&D), RCRA, and CERCLA actions not directly related to the disposal facility.	Y	Section 2.0 describes key PA and CA assumptions in the areas of facility siting and design, operations, waste characteristics and inventory, closure plans, and interacting CA sources of residual radioactive contamination.
MA-3	Provide an overview of the monitoring program and describe any planned changes to the PA and CA MonP, special monitoring studies, or monitoring-related oversight activities (e.g., site-wide groundwater model consistency committee reviews).	Y	Section 3.0 describes the environmental monitoring program.

Number	Review Criteria	Criteria Met (Y/N)	Comments
MA-4	Describe any ongoing or planned R&D activities associated with managing and/or reducing the uncertainty associated with the PA/CA/CP. Each activity should be linked to a specific need related to the PA and CA, change control, or resolution of LFRG conditions or review issues.	Y	Section 4.0 describes the R&D activities. The drivers and goals of R&D activities are identified.
MA-5	Describe all planned and/or ongoing reviews including the disposal facility annual summary report (ASR); review of PA, CA, and other DAS technical basis documents, UDQE/Special Analysis as well as reviews of RWMB, or by DOE and other regulatory authorities [U.S. Environmental Protection Agency (EPA)/state/ Nuclear Regulatory Commission (NRC)].	Y	Section 5.0 describes reviews and analyses conducted under the Maintenance Plan including the Annual Summary Report, review of the PA and CA, and supporting program documents.
MA-6	Identify any conditions/limits identified in the DAS; including a proposed schedule for resolution/compliance for each. A description of other conditions imposed by the Program Secretarial Officers that require the PA and CA MP to track should be included. A schedule should be developed for resolution of DAS Conditions/Limits (e.g., revision of the MonP within 1 year of issuance of the DAS).	Y	Sections 5.1.1 and 5.1.2 identify DAS conditions. All DAS conditions are currently closed. Section 5.2 identifies key and secondary issues from PA and CA reviews, and identifies expected date of completion.
MA-7	Identify the DAS conditions/limits most commonly linked to key or secondary issues identified in the LFRG Review Report for the PA and CA or other DAS technical basis documents. Additionally, this section should specify expectations regarding the actions necessary to resolve any outstanding LFRG review secondary issues.	Y	All DAS conditions are currently closed. Section 5.2 identifies key and secondary issues from PA and CA reviews, and identifies the planned actions for resolution.
MA-8	Provide a listing of planned maintenance activities and their proposed schedule (funding estimates/expectations) for each of the four essential maintenance components (compliance and performance monitoring, R&D activities, periodic reviews and analyses, and revision of the PA and CA).	Y	Planned maintenance activities and their schedules are described in Section 6.0.

Number	Review Criteria	Criteria Met (Y/N)	Comments
MA-9	Describe any planned or ongoing revisions of the DAS, PA, CA, PA and CA MonP, WAC, UDQE, UCAQE, CP, or RWMB. The annual review and assessment of the PA and CA MP should be scheduled in coordination with the ASR so than any revisions to the DAS technical basis documents and the results of those revisions are reported in the ASR.	Y	Planned revisions to the PA, CA, DAS, and other program supporting documentation are described in Section 6.0.
MA-10	Identify references cited in the PA and CA MP.	Y	References are listed in Section 7.0.
MA-11	Include appendices as necessary to provide details supporting the PA and CA MP.	Y	Compliance with the Maintenance Criteria is assessed in Appendix A.

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