QUALITY ASSURANCE PROJECT PLAN
LACBWR License Termination Plan (LTP) Development, Site Characterization and Final Radiation Survey Projects

Project Nos. 164017 **Revision 0**

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ACRONYMS

ANSI	American National Standards Institute
ASL	Approved Supplier List
BDF	Basement Dose Factor
CoC	Chain-of-Custody
DCGL	Derived Concentration Guideline Level
DQA	Data Quality Assessment
DQO	Data Quality Objectives
ETMS	Energy*Solutions* Training Management System
FRS	Final Radiation Survey
HPGe	High Purity Germanium
HTD	Hard to Detect
LACBWR	LaCrosse Boiling Water Reactor
LTP	License Termination Plan
MARLAP	Multi-Agency Radiological Laboratory Analytical Protocols Manual
MARSAME	Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDA	Minimum Detectable Activity
MDC	Minimum Detectable Concentration
NaI	Sodium Iodide
NIST	National Institute of Standards and Technology
NRC	United States Nuclear Regulatory Commission
OJT	On-the-Job Training
ORAU	Oak Ridge Associated Universities
PMP	Project Management Plan
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
ROC	Radionuclides of Concern
TSD	Technical Support Document
TC	Time Composite
WAC	Waste Acceptance Criteria
WRS	Wilcoxan Rank Sum

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) applies to decommissioning project activities performed by the EnergySolutions and its suppliers and subcontractors for the duration of the project activities associated with the development of the Lacrosse Boiling Water Reactor (LACBWR) License Termination Plan (LTP) including Historical Site Assessment, site characterization, demonstration of compliance with license termination criteria and Final Radiation Survey (FRS) design.

The LACBWR is being decommissioned in accordance with the requirements of 10 CFR 50.82 *"Termination of License"* (Reference 8.1). The objective for the decommissioning of the LACBWR site is to reduce residual radioactivity to levels that permit release of the site for unrestricted use and for termination of the license in accordance with the site release criteria set forth in 10 CFR 20, Subpart E, *"Radiological Criteria for License Termination"* (Reference 8.2). As required by 10 CFR 50.82, a LTP will be prepared in accordance with guidance provided in Regulatory Guide 1.179 *"Standard Format and Content of License Termination Plans for Nuclear Power Reactors"* (Reference 8.3). The LTP also relies on guidance given in NUREG-1575, *"Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM)*"* (Reference 8.4) and NUREG-1757, *"Consolidated NMSS Decommissioning Guidance - Characterization, Survey, and Determination of Radiological Criteria,* Volume 2, Rev 1*"* (Reference 8.5) to develop, among other things, a Final Radiation Survey Plan (Chapter 5 of the LTP). The above guidance documents are the Design Bases for the LTP.

The MARSSIM guidance also discusses the need for a quality system to ensure the adequacy of data used to demonstrate that site conditions are acceptable for release of the site from the facility license. Laboratory quality for the analysis samples taken to support characterization is discussed in NUREG-1576, "Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)" (Reference 8.6) and Regulatory Guide 4.15, "Quality Assurance of Radiological Monitoring Programs (Inception Through Normal Operations to License Termination) - Effluent Streams and the Environment" (Reference 8.7). Further, MARSSIM and MARLAP both indicate that a QAPP may be used in addition to, or in lieu of, existing quality systems to ensure data quality is achieved.

This QAPP has been prepared to ensure the adequacy of data being developed and used during the site characterization and FRS process. It supplements the quality requirements and quality concepts presented in GG-QAPG-001, *"Quality Assurance Program"* (Reference 8.8). All radiological survey activities essential to data quality will be implemented and performed using approved procedures. Effective implementation of radiological survey operations will be verified through audit and surveillance activities, including field walk downs by management and radiological engineering staff and program self-assessments, as appropriate. Corrective actions are to be prescribed, implemented, and verified in the event any deficiencies are identified. These measures will apply to any applicable services provided by off-site vendors, as well as on-site sub-contractors.

1.1 Purpose

This QAPP will serve to ensure that site characterization, FRS, and other radiological surveys performed in support of decommissioning are performed using approved written procedures by trained individuals and properly calibrated instruments that are sensitive to the potential radiological contaminants. This plan describes the quality assurance requirements and quality controls needed for sampling and analytical methodologies which limit the introduction of errors into analytical data required to support the release of the LACBWR site for unrestricted use in accordance with NRC requirements. This QAPP will be used to ensure applicable plans, procedures, and instructions have been followed and documented during the performance of characterization activities.

This QAPP also describes the application of quality to the scope of work performed by Energy*Solutions* to develop the LACBWR LTP for submittal to the NRC. When approved by the NRC, the LTP submittal becomes a License Amendment to the LACBWR NRC license DPR-045/Docket No. 50-409.

This QAPP defines the methodology that the Energy*Solutions* project team will meet the quality assurance requirements of 10 CFR 50 Appendix B, *"Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"* as applicable to these tasks.

1.2 Quality Objectives and Criteria for LTP Development

The LTP project involves activities that include design, procurement, sampling, analysis, and data collection that are subject to 10 CFR 50 regulatory requirements. The extent of the quality assurance criteria applicable to tasks associated with the LTP will, as a minimum, be based on their quality classification (see Section 2.3.4 for definitions of Quality Levels). The level of quality rigor applicable to a task is directly proportional to the task's importance to safety.

The LTP consists of 8 major divisions or chapters:

- Chapter 1 - General Information
- Chapter 2 - Site Characterization
- Chapter 3 - Identification of Remaining Site Dismantlement Activities
- Chapter 4 - Site Remediation Plans
- Chapter 5 - Final Radiation Survey
- Chapter 6 - Compliance with Radiological Criteria of License Termination
- Chapter 7 - Updates of the Site Specific Decommissioning Costs
- Chapter 8 – Supplement to the Environmental Report

Portions of Chapter 2, Site Characterization involving radiological survey activities are considered to be Quality Level 3 activities. Chapter 5, Final Radiation Survey contains the development details of FRS Design and is consequently considered a Quality Level 3 activity. Similarly, Chapter 6, Compliance with Radiological Criteria of License Termination contains the

development of Derived Concentration Guideline Levels (DCGLs) and Basement Dose Factors (BDFs) and which form the basis for demonstrating compliance with License Termination Criteria and are also considered a Quality Level 3 activity. The remaining sections and portions of the LTP not dealing with site characterization, FRS or demonstration of compliance with license termination criteria are considered Quality Level 4.

1.3 Quality Objectives and Criteria for Characterization/FRS Activities

Compliance with this QAPP ensures accuracy and reproducibility when obtaining direct measurements and/or representative samples for the qualification and quantification of radiological contaminants. Data quality must be sufficient to allow comparison with action levels and the unrestricted release criteria for license termination.

The Data Quality Objectives (DQO) process described by MARSSIM is a series of planning steps found to be effective in establishing criteria for data quality and developing survey plans. DQOs are qualitative and quantitative statements derived from outputs of each step of the DQO process that: clarify the study objective, define the most appropriate type of data to collect and determine the most appropriate conditions from which to collect the data. The DQO process allows for systematic planning and is particularly designed to address problems that require a decision between two alternatives. Furthermore, the DQO process is flexible in that the level of effort associated with planning a survey is based on the complexity of the survey and nature of the hazards. Finally, the DQO process is iterative, allowing the survey designer to incorporate new knowledge and modify the output of previous steps to act as input to subsequent steps.

Each characterization/FRS survey design will incorporate survey specific DQOs. Using the DQO process to design surveys will allow the survey designer to define specific data requirements and acceptable levels of decision error during planning before any data is collected. It will also ensure that selected instruments and processes will satisfy the intended purpose. This provides confidence that the survey results are accurate and any sources of uncertainty are identified and controlled.

DQOs are based on the seven-step process which is briefly described below.

Step 1: State the Problem - Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.

Step 2: Identify the Decision - Identify what questions the study will attempt to resolve, and what actions may result.

Step 3: Identify the Inputs to the Decision - Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.

Step 4: Define the Study Boundaries - Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected.

Step 5: Develop a Decision Rule - Define the statistical parameter of interest, specify the action level, and integrate the previous DQO outputs into a single statement that describes the logical basis for choosing among alternative actions.

Step 6: Specify Tolerable Limits on Decision Errors - Define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.

Step 7: Optimize the Design - Evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets all DQOs.

Since the radiological data collected for this project either will or may be used in risk-based corrective actions and remedies, data analytical limits must be set such that applicable federal risk-based action levels and project specific DCGLs, BDFs or action levels can be met. If project data needs change as work progresses, the DQOs may be modified to meet new project requirements.

In addition, Attachment A contains a list of quality assurance procedures that are used to implement the requirements of this QAPP.

2.0 MANAGEMENT

Dairyland Power Cooperative (DPC) is responsible for the overall execution of the LACBWR Decommissioning Project. As the licensee, DPC is responsible for all licensing activities, safety, radiation protection, environmental safety and health, engineering and design, quality assurance, construction management, environmental management, waste management and financial management. DPC interfaces directly with the U.S. Nuclear Regulatory Commission (NRC) and other stakeholders on all issues pertaining to decommissioning project activities at LACBWR.

This section defines the responsibilities of key project members accountable for implementation of this QAPP. Functions and actions can be delegated; however, the responsibility remains with the designated individuals.

2.1 Project Organization

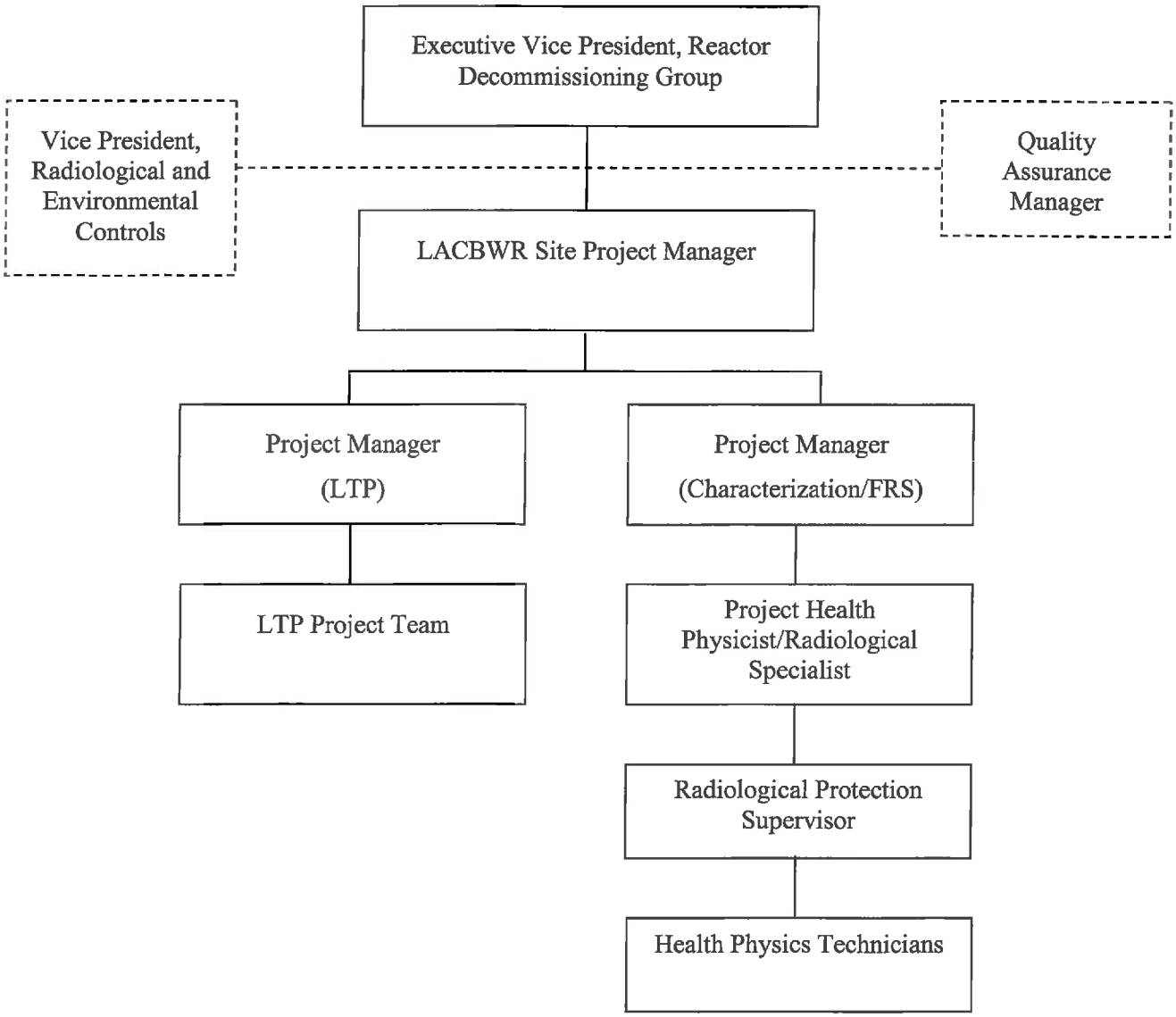
Energy*Solutions* has established the LACBWR Characterization/LTP Projects Organization, within the Reactor Decommissioning Group, with sufficient management and technical resources to fulfill project objectives and goals. The LACBWR Characterization/LTP Project is responsible for:

- Site characterization design, implementation, assessment of results and reporting;
- License Termination Plan development and implementation; and,

- Final Radiation Survey design, implementation, assessment of results and reporting.

Characterization/LTP/FRS encompasses all survey and sampling activities related to the characterization plan. This includes site characterization surveys, FRS and other radiological surveys performed in support of decommissioning. The duties and responsibilities of key Energy*Solutions* managers as well as the various key positions within the Characterization/LTP Organization as they pertain to the implementation of this QAPP are described below. Responsibilities for each of the positions described may be assigned to a designee as appropriate. An organizational chart is provided in Figure 2-1.

Figure 2-1, Characterization, FRS and LTP Development Organization Chart



2.1.1 Executive Vice President, Reactor Decommissioning Group

The Executive VP, Reactor Decommissioning Group, is responsible for leadership and direction of work performed by the Reactor Decommissioning Group.

2.1.2 LACBWR Site Project Manager

The Site Project Manager has overall responsibility for safety, quality and project management at the LACBWR site. This individual is responsible for assignment of Project Managers and provision of Technical Support Personnel to the LACBWR Characterization/LTP Project as well as implementation of the QA Policy and Program to the project. The LACBWR Site Project Manager reports to the Executive Vice President, Reactor Decommissioning Group.

2.1.3 Vice President, Radiological and Environmental Controls

The VP, Radiological and Environmental Controls, is responsible for oversight and support of the Radiation Protection and Environmental programs within the Reactor Decommissioning Group. This individual ensures that activities affecting quality, industrial safety and health, environmental management, radiation safety and security are performed in accordance with approved procedures that provide sufficient detail to meet customer and regulatory requirements. The VP, Radiological and Environmental Controls reports to the Executive Vice President, Reactor Decommissioning Group.

2.1.4 Project Manager

The Project Manager reports to the LACBWR Site Project Manager for:

- The overall responsibilities for all on-site LTP and characterization activities
- The management of personnel assigned to the LACBWR Site Characterization/LTP Projects
- Ensuring all radiological surveys and licensing obligations, as they pertain to site characterization and LTP development, are satisfied.
- The review and approval of project plans and procedures.
- All supporting documents that are subject to controlled distribution requirements.
- Ensuring activities conducted as part of radiological survey and LTP development are performed in accordance with this QAPP.
- Approving personnel access to Characterization/LTP Projects file cabinets and computer data bases.

- Assuring that project personnel are properly indoctrinated, trained, and qualified to all applicable quality and technical requirements.
- The resolution of nonconforming conditions and effective implementation of corrective action commitments.

2.1.5 Quality Assurance Manager

The Quality Assurance Manager reports to the Executive Vice President, Reactor Decommissioning Group and is responsible for:

- Maintaining the Approved Supplier List (ASL)
- Maintaining the "Q-List"
- Maintaining the quality assurance procedure set
- Performing audits or surveillances, as necessary
- Approving Quality Assurance Project Plans.

2.1.6 Project Health Physicist/Radiological Engineer

The Project Health Physicist/Radiological Engineer reports to the Project Manager for:

- Developing/approving characterization/FRS survey packages and sample plans
- Developing/approving characterization release records and final reports
- Resolving and documenting any survey design, instructions, or performance discrepancies
- Performing data review, verification and validation.

2.1.7 LTP Project Team Members

The LTP Project Team Members are those individuals who are responsible individual in each LTP functional area. They report directly to the Project Manager on all LTP Project activities and are responsible for the implementation of the QAPP for the duration of the project and other activities as designated by the Project Manager. Management Team members have full authority and accountability for successful project planning and execution, including effective implementation of the QAPP.

2.1.8 Radiological Protection Supervisor

The Radiological Protection Supervisor reports to the Project Health Physicist/ Radiological Engineer for:

- Control and implementation of survey packages and sample plans as received from the Radiological Health Physicist/Radiological Engineer and to ensure that all quality objectives are achieved.

- Coordination of area turn over and survey area preparation.
- Coordination and schedule Health Physics Technicians to support the schedule.
- Ensure all necessary instrumentation and other equipment is available to support survey activities.
- Maintaining access controls over completed survey areas to ensure data integrity and final configuration.
- Perform data review, verification and validation.

2.1.9 Health Physics Technicians

The Health Physics Technicians report directly to the Radiological Protection Supervisor and are responsible for understanding the requirements included in the Characterization/FRS Plan, all applicable implementation procedures, and this QAPP. The technicians are responsible for the acquisition and documentation of survey data and collection of samples. This data and samples will be obtained in accordance with the requirements and instructions provided in the specific sample plans, packages, instructions and guidance provided by the Radiological Protection Supervisor. Through compliance with survey packages and all applicable program and instrumentation procedures, Health Physics Technicians implement the requirements contained in this QAPP to assure appropriate quality is used in the collection of characterization data.

2.2 Training and Qualifications

Proper training and qualifications are essential to ensuring effective and consistent performance to make certain that quality data will be acquired during characterization activities and that the error attributed to human performance is minimized. Sufficient management and technical resources will be applied to the performance of characterization activities to ensure project objectives are achieved.

General and specific training requirements applicable for each individual within the LACBWR Characterization/LTP/FRS Project will be defined, tracked, and periodically updated as project activities progress and responsibilities change. The Project Manager and the group's designated Training Coordinator will work with the Energy*Solutions* Training Department to utilize the Energy*Solutions* Training Management System (ETMS) and other LACBWR Training Program training, evaluation and documentation processes, as applicable, to support the implementation of a training program for radiological survey and LTP development operations.

Individuals performing field survey and sampling activities and reviewing collected data from field measurements or laboratory data reports will be trained

in the use of instruments, devices, and procedures, as applicable to the tasks they will be performing. The training ensures that the personnel assigned to perform characterization activities will have sufficient knowledge to perform the work in accordance with the requirements of the Characterization Plan and associated implementing procedures. Training will be in the form of attendance at formal classroom training; field observations and guidance provided by supervision as personnel start implementing procedures; completion of appropriate on-the-job training (OJT) programs; and/or through reading of certain required procedures. Completion of each type of training will be documented and records will be coordinated with and maintained within the Energy*Solutions* training department.

At a minimum, personnel assigned to acquire characterization survey data will be trained on the following:

- Initial set-up and pre-use response checks with selected instrumentation and associated detectors.
- Proficiency with operating a data-logger instrument and associated detectors.
- Performance of direct static measurements.
- Performance of scanning structural surfaces and open land areas.
- Performance of volumetric material sampling.
- Performance of taking swipes for low energy emitters

Supervisory and technical support personnel will have sufficient education, experience, training, and certification to appropriately qualify personnel in the performance of their assigned tasks. Advanced training or experience in MARSSIM implementation will be required for technical personnel developing, reviewing or approving survey unit classifications, Characterization/FRS plans, or characterization and FRS reports. As appropriate, personnel will undergo MARSSIM training [e.g. Oak Ridge Associated Universities' (ORAU) MARSSIM course] and RESRAD training (e.g. Argonne National Laboratory RESRAD courses) to ensure their proficiency to support MARSSIM-based and RESRAD software application tasks.

2.3 Documents and Records

Each characterization and FRS measurement will be identified by date, instrument, location, and type of measurement. Generation, handling, and storage of the original characterization and FRS design and data packages will be controlled. All completed characterization, FRS and LTP records will be designated as quality documents and, as such, they will be maintained in accordance with Energy*Solutions* document control procedures.

2.3.1 Data Base Control

Data obtained during the performance of characterization and FRS may be analyzed and processed by Excel spreadsheets or more complicated

computer data base programs. Access to any established data bases will be controlled and limited to personnel authorized by the Project Manager.

Any computer software used for data reduction, storage or evaluation will be fully documented and certified by the vendor. In addition, appropriate verification and validation performance tests, as necessary, will be performed prior to use of the data base for characterization data processing. The software will be tested prior to use by an appropriate test data set. Programs developed to assist in calculating characterization data (i.e. Excel spreadsheets) shall also be tested to verify they are correct.

2.3.2 Computer Programs

Computer programs (whether generated, transferred, or purchased) used to calculate or develop important-to-safety shall be subjected to documented verifications or validations, including evaluation of program changes.

Certain specialized computer codes, including RESRAD, RESRAD-BUILD, DUST-MS, Microshield and COMPASS may be used to assess radiation exposures from residual radioactivity, model radioactive source transport and develop sampling locations for Characterization and FRS surveys. These programs are industry standard and have been approved by NRC for use in LTP development at other sites Verification and validation of these programs will be documented.

2.3.3 Quality Assurance (QA) Records

Documents that detail the design and performance of characterization and FRS surveys, contain characterization and FRS survey or measurement data, detail custody of samples, or contain other information affecting performance or completion of characterization and FRS are considered QA records when completed. Characterization and FRS records that contain or affect characterization and FRS quality will be maintained in accordance with Energy*Solutions* document control procedures. In addition:

- Direct access to these records will be limited to personnel authorized by the Project Manager.
- A signature file will be maintained of all personnel authorized direct access to these records.
- Characterization and FRS records will be signed out (by signature or initials) when they are removed from their storage location (e.g. file cabinet and/or room) where they are maintained.
- Positive control is required of characterization and FRS records when they are not secured in the approved storage location.

Positive control is defined as being in the physical possession of an approved individual or placed in a secure locked location where access is controlled to only approved individuals.

2.3.4 Document Control

10 CFR 20.2103(a) requires that records showing the results of surveys and calibrations required by 10 CFR 20.1501 be maintained. These records and other documents that affect characterization and FRS quality will be transmitted to Document Control for processing and retention in accordance with Energy*Solutions* document control procedures.

2.3.5 Procurement Quality

The procurement of materials, equipment, and services for characterization, FRS and LTP development will be performed in a controlled manner which will ensure compliance with applicable regulatory requirements, procedures, quality assurance standards, and regulations. Service requests will be reviewed for technical adequacy and, in order to assure confidence with services provided, verification of supplier's quality assurance program will be performed as needed. Quality-related services, such as instrument calibration and laboratory analysis, will be procured from qualified vendors whose internal QA program is subject to review and approval in accordance with the Energy*Solutions* Quality Assurance Program and is identified on the Energy*Solutions* "Q List". Additionally, regular vendor performance reviews, audits and/or surveillances of these contractors will be performed to provide an adequate level of assurance that the quality activities are being effectively performed.

The LTP project involves activities that include design, procurement, sampling, analysis, and data collection that are subject to 10 CFR 50 regulatory requirements. The extent of the quality assurance criteria applicable to tasks associated with the LTP will, as a minimum, be based on their quality classification. The level of quality rigor applicable to a task is directly proportional to the task's importance to safety.

LTP tasks are classified by LTP Chapter as either Important to Safety or Not-Important to Safety based on their function and the definition of Important to Safety as described below:

<u>Quality Level 1, Critical for Safe Operstion</u>

Items, services, or activities critical to the safe operation of components, systems, or structures. They include those items, services, or activities whose failure could result directly in a condition adversely affecting public health and safety. This classification is the equivalent of Classification Category A in NUREG/CR-6407, *Classification of Transportation Packaging and Dry Spent Fuel Storage System Components According to Importance to Safety*.

Quality Level 2, Major Impact on Safety

Items, services, or activities important to the safe operation of components, systems, or structure. These include those items, services or activities whose failure would not be likely to create a situation adversely affecting public or worker health and safety. This classification is the equivalent of Classification Category B in NUREG/CR-6407.

Quality Level 3, Minor Impact on Safety

Items, services, or activities important to the safe operation of components, systems, or structure. They include those items, services or activities whose failure or malfunction could indirectly result in a condition adversely affecting public or worker health and safety.

Quality Level 4, Not Important to Safety

Applicable to items and services not meeting any of the criteria for QL-1, QL-2 or QL-3, which are those general services systems, standard industrial activities or systems that are not relied upon for worker protection, do not contain radiological or hazardous materials requiring specialized controlled storage environments, and have no safety function or components.

2.3.6 Procedures, Technical Support Documents, Instructions and Drawings

The performance of characterization and FRS, and the development of the LTP, will require procedures and Technical Support Documents (TSD), as necessary, for personnel training, survey design, survey and sampling implementation, data collection, data review, data reporting, chain of custody, instrument calibration and maintenance, data verification, dose modeling, DCGL, BDF or other parameters needed to show compliance with release criteria, and record storage. These documents will be developed to ensure compliance with the Characterization Plan and applicable regulatory guidance documents and will meet applicable quality requirements, including a standardized process for their development, review, approval and revision.

The LTP Project Team shall develop a standardized approach for the project to initiate, perform, document, check, approve, revise, and retain the TSDs supporting the LTP as well as the LTP Chapters.

3.0 DATA GENERATIONAND ACQUISTION

The characterization and FRS survey process provides data to demonstrate that all radiological parameters satisfy the established guideline values and conditions. The characterization and FRS processes consists of four principal elements: planning, design, implementation, and assessment.

3.1 Survey Planning

Survey planning is addressed through the implementation of the DQO process. Each survey package will be generated through the development of DQOs specific to the survey area or survey unit that will undergo assessment. Specific decisions will be used to establish the necessary inputs that will be considered for survey design. The following are examples of decisions that may be addressed through the DQO process:

- Provide the basis for initial classification (e.g. MARSSIM-based Class 1, 2 or 3).
- Provide the basis for identification and distribution of Radionuclides of Concern (ROC).
- Provide the basis for a surrogate relationship for Hard-to-Detect (HTD) ROCs.
- Provide the basis for extent of remediation of surface soils.
- Provide the basis for the extent of remediation of subsurface soils.
- Provide the basis for the extent of remediation of sub-grade structures.
- Evaluate variability of existing residual radioactivity to support FSS survey design.
- Evaluate the neutron activation of concrete that is intended for beneficial reuse.
- Evaluate the residual radioactivity on concrete that is intended for beneficial reuse.
- Provide the basis for the background threshold activity for ROCs.
- Provide sufficient radiological data to determine compliance with a Waste Acceptance Criteria (WAC) for a disposal site.
- Demonstrate compliance with the dose-based unrestricted release criteria.

3.2 Survey Design

During the generation of a characterization and FRS survey package, specific survey and sampling processes will be designed and established for each survey area or survey unit. Survey design is the element in the process that determines the data and/or information inputs that are necessary to address the decisions for the survey. The survey design will include information relevant to the decision, including (but not limited to) the size of area to be scanned, the number and location of samples, smears and static measurements, and the type(s) of

instruments and sampling devices to be used, including required sensitivities or detection levels. Examples of additional types of inputs that may be considered during survey design are:

- Survey unit classification and the basis for the classification
- Historical incidents or accidents involving radioactive material
- Evidence of previous radioactive material storage or the burial of radioactive material
- The anticipated ROC
- Types of media to be sampled
- Action levels or release criteria
- Sample frequency, size, and types of measurements (systematic and biased)
- Instrumentation and required sensitivity (MDC)
- Analytical requirements for physical samples
- QC Samples
- Past documented radiological surveys of areas
- Former staff member recollections of past operations/ areas of the site

Alternate actions based on the decision rule will also be included in the survey design . Survey designs will identify any check or hold points in the process necessary to ensure the quality of samples or data collected in the field is maintained. Changes to the survey design will be subject to the same review and approval processes as the original survey design.

3.3 Survey Implementation

Characterization and FRS survey packages and sample plans will be implemented in accordance with written, approved procedures that will ensure effective, technically correct and safe operations and data quality. Characterization and FRS procedures and survey packages will describe the methods and techniques used for the collection of direct measurements and media samples.

3.3.1 Methods for Direct Measurements and Radiological Sample Analysis

The type and frequency of direct survey measurements or media samples for analysis are determined by the DQOs in the specific survey package and sample plan. Characterization and FRS measurements include surface scans, direct static surface measurements, and gamma spectroscopy of volumetric materials. Table 3-1 presents a brief summary of the types of instrumentation that may be used to obtain these measurements.

Table 3-1 Examples of Survey Measurements and Instrumentation

Measurement	Instrument Type
Scanning: • Alpha • Beta • Gamma	• Gas proportional, Zinc Sulfide plastic scintillation • Gas proportional, Geiger-Mueller, Plastic scintillation • NaI (Tl) scintillation
Direct (Gross) Activity: • Alpha • Beta	• Gas proportional, Zinc Sulfide plastic scintillation • Gas proportional, Geiger-Mueller, Plastic scintillation
Radionuclide-specific: • Alpha • Low Energy Beta • Gamma	• Radiochemical separation and alpha spectroscopy • Liquid Scintillation • HPGe* detector based gamma spectrometer, NaI (Tl) scintillation

*HPGe – High Purity Germanium.

The on-site radiological laboratory will normally be used for gamma spectroscopy and gross alpha/beta removable contamination counting, in accordance with approved procedures. Energy*Solutions* will also ensure the quality programs of any off-site vendor laboratories that are used for the receipt, preparation and analysis of submitted characterization and FRS samples provide the same level of quality. In all cases, analytical methods will be established to ensure that required MDA values are achieved. All analytical data will be carefully reviewed prior to its use and incorporation into a characterization report.

3.3.2 Types of Media Sampled

A wide range of media may be sampled and analyzed for characterization and FRS surveys. The types of different media that may be sampled include, but are not limited to the following:

- Surface Soil
- Subsurface Soil
- Sediment
- Volumetric Concrete
- Water
- Asphalt
- Surface Wipes
- Air

There are two methods for the acquisition of volumetric media samples, grab samples and composite samples. Both are defined below. The appropriate sample collection technique will be determined based on the survey package and its DQOs.

3.3.2.1 Grab Sample

An individual sample collected from a single location at a specific time or period of time.

3.3.2.2 Composite Samples

A sample collected over a temporal or spatial range that typically consists of a series of discrete, equal samples (or "aliquots") which are combined or "composited". There are three types of composite samples for this project:

- Time Composite (TC) - a sample comprised of a varying number of discrete samples (aliquots) collected at equal time intervals during the compositing period. The TC sample is typically used to sample wastewater or streams.
- Areal Composite - sample composited from individual, equal aliquots collected on an areal or horizontal cross-sectional basis. Each aliquot is collected in an identical manner. Examples include sediment composites from quarter-point sampling of streams and soil samples from within grids.
- Vertical Composite - a sample composited from individual, equal aliquots collected from a vertical cross section. Each aliquot is collected in an identical manner.

3.3.3 Sample Handling and Custody

Responsibility for custody of samples from the point of collection through the determination of the sample analytical results is established by implementing procedures for Sample Identification and Chain-of-Custody (CoC) that will ensure that sample custody is maintained and the validity and control of material samples are intact. Samples (soil, smears, scrapings, etc.) that require measurement or counting (i.e. not a field measurement) shall, at all times, be positively controlled or, have controlled custody by sample log or in accordance with CS-FO-PR-003, "*Soil Surveys; Collection of Water, Sediment, Vegetation and Soil Samples and Chain-Of-Custody Procedure*" (Reference 8.9). If the procedure is used, a CoC form should be filled out for all such samples. The person that acquired the sample is responsible for the care and custody of the sample until it is transferred or properly dispatched or, the sample has

been placed in secured storage. As few people as possible should handle the sample.

Samples will be labeled with a unique identification number and the date, location, and time of collection. This number will be used for the CoC and for the reporting of counting/measurement data. How samples may be identified will be designated in the survey package or sample plan or the aforementioned procedure guidelines may be followed.

Prior to leaving the positive control of the person archiving the sample on the site prior to shipment for offsite radiological analyses, samples will be accompanied by a properly completed CoC form or documented in a sample log. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the CoC form or in a sample tracking log. The CoC form or the log will document transfer of custody of the sample(s) from the archive location, to an off-site vendor laboratory, Secure storage will be provided for archived samples.

Samples sent to an off-site laboratory will be properly packaged for shipment, with a signed CoC form enclosed in each sample box or cooler. Shipping containers will be secured with appropriate custody seals for shipment to the laboratory. The original CoC form will accompany the shipment, and a copy will be retained for the project file. Commercial carriers are not required to sign off on the custody form as long as the CoC forms are sealed inside the sample container and the custody seals remain intact. The samples sent off site for analysis will be returned to the site for archived storage following analysis unless used up during the particular analysis task(s) at the offsite lab.

3.3.4 Analytical Methods for Radiological Contaminants

Samples will be analyzed for radiological contaminants by the on-site radiological laboratory or in some cases, by a qualified off-site radiological laboratory. The analysis of radiological contaminants will use standard approved and generally accepted methodologies or other comparable methodologies.

For radiochemical analyses, the MDA is determined based on normal factors and conditions which influence measurement. The MDA is used to evaluate the capability of a method relative to the required detection limit. Sample size, count duration, tracer recovery, detector background and detector efficiency all contribute to determining the sample MDA. The MDA for a radionuclide by radiochemical measurement is determined from the blank/background variability associated with the appropriate detector, the detector efficiency, sample aliquot size and chemical yield. The background variability is proportional to the sample count time.

3.4 Survey Assessment

Data validation is the systematic process of ensuring that the precision and accuracy of direct and analytical data are adequate for their intended use. Validation shall be performed in accordance with the procedure outlines in Section 6.2 and information gathered during this validation process will be documented.

The data generated from all on-site and off-site analytical laboratories shall undergo independent peer review and evaluation.

4.0 QUALITY CONTROL SURVEYS AND SAMPLES

Quality Control (QC) surveys and samples are performed primarily as verification that the original characterization and FRS results are valid. QC surveys may include replicate surveys, field blanks and spiked samples, split samples, third party analysis and sample recounts. Field blanks and sample recounts apply to loose surface and material sampling surveys. Spiked samples and split samples apply to material sampling surveys. Third party analysis applies to material samples counted by a different laboratory than normally used. QC survey results are evaluated and compared to the original characterization or FRS survey results by the responsible Project Health Physicist/Radiological Engineer in accordance with the appropriate acceptance criteria.

4.1 Duplicate and Split Samples

The collection of duplicate samples or split samples will be the primary means of assessing survey precision and accuracy when collecting volumetric and/or material samples for characterization and FRS. A duplicate sample is a second complete sample taken at the same location and same time as the original. A split sample is when the original sample aliquot is separated into two aliquots and analyzed as separate samples.

4.1.1 Frequency

For the characterization and FRS of surface and subsurface soils, asphalt, and sediment, a split sample analysis will be performed on 5% of the soil samples taken in a survey unit with the locations selected at random. For all other materials such a volumetric concrete, oils or liquids, the frequency will be determined by the responsible Project Health Physicist/Radiological Engineer. Duplicate samples, as necessary, will be acquired in accordance with the direction in the specific survey package or sample plan or as directed by the responsible Project Health Physicist/Radiological Engineer.

During the performance of Site Characterization and FRS, approximately 5% of the total number of split samples taken will be sent for analysis by a qualified off-site laboratory.

4.1.2 Acceptance Criteria

The NRC Inspection Procedure No. 84750 *"Radioactive Waste Treatment, and Effluent and Environmental Monitoring"* (Reference 8.10) will be used to determine the acceptability of split and duplicate sample analyses. The sample results will be compared to determine accuracy and precision as follows:

- Divide each sample result by its associated uncertainty to obtain the resolution. [Note: the uncertainty is defined as the relative standard deviation (σ)].
- Divide each sample result by the corresponding split or duplicate result to obtain the ratio.
- The split or duplicate sample results are in agreement if the value of the ratio falls within the limits shown in Table 4-1 for the corresponding resolution.

Table 4-1
Acceptance Criteria

Resolution	Acceptable Ratio
<4	0.4-2.5
4-7	0.5-2.0
8-15	0.6-1.66
16-50	0.75-1.33
51-200	0.80-1.25
>200	0.85-1.18

Agreement is ultimately determined when the same conclusion is reached for each compared result. If the split sample or duplicate sample results do not agree, then further evaluations will be performed.

4.2 Field Blanks and Spiked Samples

Field blanks are obtained by bringing an adequate volume of uncontaminated material, of the same media as the media being sampled, to the field. A sample will be collected from the uncontaminated material using the standard collection procedures. Field blank samples will be handled as a standard characterization or FRS sample through collection, preparation and analysis.

4.2.1 Frequency

Field blanks will not be performed on a routine basis. Field blanks will only be performed when directed by the Project Health Physicist/Radiological Engineer.

4.2.2 Acceptance Criteria

The acceptance criteria for field blank samples are that no plant derived radionuclides are detected. If the analysis of the field blank shows the presence of plant derived radionuclides, then further evaluations will be performed.

5.0 INSTRUMENT QUALITY

Radiation detection and measurement instrumentation for characterization and FRS is selected to provide both reliable operation and adequate sensitivity to detect the radionuclides identified at the site at levels sufficiently below the action levels or release criteria. Detector selection is based on detection sensitivity, operating characteristics and expected performance in the field.

5.1 Instrument Control

The receipt, inspection, issue, control and accountability of portable radiological instrumentation used for characterization will be performed in accordance with an approved procedure. All portable radiological instrumentation and/or detectors addressed by this procedure shall be tracked by means of an inventory system and assigned a unique identification number. An instrument history file shall be established to contain data for each portable radiological instrument or detector that will be and has been used to acquire characterization survey data. The instrument history file will contain a log of the maintenance and use history of the instrument, a copy of all calibration certificates and data sheets and records of daily response checks and control charts.

Maintenance and repair to characterization and FRS portable radiological instrumentation may be performed onsite by qualified personnel with experience in the maintenance and repair of instrumentation or off-site by a qualified vendor. Minor repair is defined as any repair that will not affect the calibration or efficiency of the instrument. Instruments and detectors used for the acquisition of characterization data shall be re-calibrated prior to use in the field if any major maintenance or repairs are performed that could affect the efficiency of the instrument and/or detector.

Portable radiological instrumentation and/or detectors will remain in the custody of the assigned technician, and positive control will be maintained, until collected data has been documented and the instrument has been returned to inventory. Log sheets and other forms used to record field data shall remain in the custody of the responsible individual.

5.1.1 Response Checks

Response checks shall be performed on all radiological instrumentation and/or detectors used for characterization/FRS and prior to and following use, not to exceed the end of the shift in which the instrument was used.

Response checks that may be performed include but are not limited to ensuring:

- The instrument is in good physical condition.
- A current and valid calibration label is affixed to the instrument.
- The instrument satisfactorily zero adjusts (if applicable).
- The instrument satisfactorily battery checks (if applicable).
- All detector parameters on the instrument display are correct for the detector in use.
- A satisfactory operational response within an acceptable range to a radioactive source of known activity.

If the instrument does not pass the response test, then the instrument will be removed from service. In cases where the failed response test was performed post-use, the Project Health Physicist/Radiological Engineer or designee will be notified. The data acquired by the instrument since the last response check will be considered as suspect and invalid unless proven otherwise.

5.1.2 Placing an Instrument Out-of-Service

Instruments tagged and removed from service for calibration, repair or failure of a response test shall be physically segregated from those instruments available for issue. All instruments removed from service shall be labeled by attaching a "DO NOT USE" tag.

5.2 Instrument/Equipment Calibration and Frequency

All portable radiological instruments used for characterization and FRS shall be calibrated prior to first use, following any major repair, maintenance, or modifications that could affect calibration, after failure of a performance test requiring adjustments or repairs (that could affect calibration) to correct the failure, and every twelve (12) months.

Instruments will be calibrated using sources traceable to the National Institute of Standards and Technology (NIST) in accordance with approved procedures and instructions. At a minimum, portable radiological instrumentation and/or detectors used for characterization shall be calibrated in accordance with ANSI N323A-1997, "Radiation Protection Instrumentation Test and Calibration, Portable Survey Instrumentation" (Reference 8.11). This requirement shall be clearly marked on the purchase requisition if an off-site vendor is used for these services. Following calibration, all radiological instrumentation and/or detectors used for characterization shall have a label affixed to the instrument and/or detector indicating current calibration status.

5.3 Data Management

Survey data control from the time of collection through evaluation will be specified by procedure and survey package instructions. Manual data entries will be verified by a second individual.

6.0 DATA VALIDATION AND USABILITY

Data validation is the systematic process of ensuring that the precision and accuracy of the analytical data are adequate for their intended use. The Data Quality Assessment (DQA) method is the approach used to perform this process. For Site Characterization and FRS, DQA activities will be performed in accordance with an approved procedure.

6.1 Data Review, Verification and Validation

The DQA process is an evaluation method used during the assessment phase to ensure the validity of characterization results and demonstrate achievement of the survey objectives. The decision rule for characterization is the acquisition of the necessary quantity and quality of data to address the decision question. The use of DQA, like the DQO process, is a critical component in ensuring the acquisition of quality data that is accurate and reproducible.

- Review the DQOs and Sampling Design
- Conduct a Preliminary Data Review
- Draw Conclusions from the Data

Review of the DQOs and survey plan designs includes verification and validation of collected data to determine whether or not the quality of the data (accuracy, precision, and sensitivity) satisfies the survey objectives. The DQA process is the primary evaluation tool to determine that data are of the right type, quality and quantity to demonstrate that the dose from residual radioactivity in each survey unit is less than the annual dose criterion for license termination.

6.2 Verification and Validation Methods

Data generated through characterization field activities or laboratory operations will be reduced and validated prior to reporting. Characterization and FRS analytical data should not be disseminated by the laboratory or considered final until it has been subjected to data validation in accordance with an approved procedure.

6.2.1 Data Reduction

The results of all direct measurements will be documented in the applicable specific characterization or FRS survey package. All data will be legible. If errors are made, results will be legibly crossed out, initialed and dated by the responsible person(s), and corrected in a space adjacent to the original (erroneous) entry. For material samples, positive control of

the sample from the time of acquisition to the time of analysis will be verified.

Typically, the greatest uncertainty in a measurement is often a result of the sampling process and inherent variability in the environmental media rather than the analytical measurement. Therefore, analytical data validation will be performed only to the level necessary to minimize the potential of using false positive or false negative results in the decision-making process.

All calculations will be verified by a peer review. Errors will be noted and corrections will be made, but the original notations will be crossed out legibly. Analytical results for soil samples should be calculated and reported as activity per unit weight (e.g. ρCi/g).

Acceptable data will be entered into the applicable specific characterization or FRS survey package closure report. The closure report will also qualify any unacceptable data. Narratives will be prepared which will include information concerning data outside the acceptance limits, and any other anomalous conditions encountered during the analysis of the measurement or sample result. Quality control data (e.g. split samples) will be compared to the acceptance criteria.

6.2.2 Data Validation

Data validation procedures shall be performed for both field and laboratory operations. Procedures to validate direct field measurement data primarily include checking for transcription errors and review of Characterization or FRS survey package instructions.

6.2.2.1 Processes Used to Validate Data

Processes to validate direct field measurement data primarily include checking for transcription errors and a review of survey package instructions. Upon receiving a survey record or analyses report of data intended for characterization or FRS, the responsible Project Health Physicist/Radiological Specialist will perform a validation of the survey data to ensure that the data results are valid. Each specific sample or measurement result will be assessed individually. Data validation is accomplished through a review and assessment of the following:

- Verification that the unique sample identification number for each sample or measurement is consistent between the sample analysis report, the CoC form (if applicable) and the survey package and/or sample plan instructions.
- Verification that the recorded sample date and time for each sample or measurement is consistent with the CoC form and the survey record.

- Verification that the data is complete and that there are no missing results or supporting data, including but not limited to MDC, uncertainty, background, or methods of analysis.
- Verification that the MDC of the instrument used for analysis was adequate to detect all ROC or gross activity at the investigation levels specified in the survey package for that survey unit.
- Verification of the absence of anomalies in the sample or measurement results, or in the supporting data, including but not limited to MDC, uncertainty, deviation from established procedure or analysis flags.
- For data collected with a data logging instrument, verification that the data has been downloaded with a unique file name.
- Verification that survey data results are presented in units appropriate for comparison to the action level or release criteria. As applicable, convert the units for the reported data to the appropriate units by correcting for survey instrument background, efficiency, geometry, detector area, and/or measurement size.

Once analysis or measurement results have been validated, they can be placed in the survey package for data evaluation. The individual performing the validation will indicate that the data is valid by documenting the validation process in the survey package.

6.2.2.2 Data Reporting

Field data reporting will be conducted principally through the execution and completion of survey packages and/or sample plans.

Radiological data from laboratory analysis is not considered official or reportable data until the validation activity has been concluded. The Project Manager and Project Health Physicist/Radiological Specialist will perform a final review of all report summaries and narratives to determine whether the data meets project requirements.

7.0 ASSESSMENT AND OVERSIGHT

Radiological Protection Supervisor and Project Health Physic Technicians will perform periodic surveillances of field sampling activities. Aspects to be assessed include, but are not limited to, survey performance, data retrieval, data evaluation, quality control, and document control. All assessment results and any discrepancies found will be

documented, tracked to resolution, and reported to project management. Any assessment results showing negative trends, equipment, or performance failures and discrepancies shall warrant a condition report in accordance with CG-AD-PR-001, *"TES Condition Reporting"* (Reference 8.12). This program will be utilized to identify conditions adverse to quality and to support the development of corrective actions.

7.1 Corrective Actions

Corrective action is the process of identifying, recommending, approving and implementing measures to unacceptable procedures or out of quality control performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. Any nonconformance with the requirements of the Site Characterization Plan, this QAPP or approved procedures will be identified, corrected, and properly documented.

Corrective action in the field may be necessary when the sample population is changed (e.g. more/less samples, sampling locations other than those specified in the survey package), or when sampling procedures and/or field analytical procedures require modification due to unexpected conditions. Project personnel will be responsible for reporting all suspected technical or quality non-conformances or suspected deficiencies of any activity or issued document by reporting the situation to the responsible Radiological Specialist or Project Manager. These personnel will be responsible for assessing the suspected problems in consultation with the Project Manager on making a decision based on the potential for the situation to impact the quality of the data. If it is determined that the situation warrants corrective action, a condition report will be initiated in accordance with CG-AD-PR-001.

Corrective action(s) should only be implemented after approval by the Project Manager and the Vice President, Radiological and Environmental Controls. Any corrective actions will be implemented and documented in the applicable survey package.

Non-conformance items or issues are dealt with through processes defined in quality assurance procedures.

7.2 Reports to Management

The Director of Radiological Services will be responsible for all reports and deliverables associated with technical based characterization activities. Summary level reports of characterization results, including QA and QC related checks and results will be generated quarterly. These reports will summarize key characterization tasks accomplished and also communicate the results of field and laboratory reviews, the achievement of specific data quality objectives, and a summary of any corrective actions that were implemented, and its impact on survey quality. Whenever necessary, updates on training provided, changes in key personnel, anticipated problems in the field or laboratory that could affect data quality, along with proposed solutions, will be also be reported. Any

ongoing or planned program procedural changes or QAPP modifications will also be highlighted. This report will be distributed to the appropriate management for review.

8.0 REFERENCES

8.1 10 CFR 50.82 *"Termination of License"*

8.2 10 CFR 20, Subpart E, *"Radiological Criteria for License Termination"*

8.3 Regulatory Guide 1.179, Rev 1 *"Standard Format and Content of License Termination Plans for Nuclear Power Reactors"* – June 2011

8.4 NUREG-1575, *"Multi-Agency Radiation Survey and Site Investigation Manual"* (MARSSIM) - August 2000

8.5 NUREG-1757, *"Consolidated NMSS Decommissioning Guidance - Characterization, Survey, and Determination of Radiological Criteria"* Volume 2, Revision 1 – September 2002

8.6 NUREG-1576, *"Multi-Agency Radiological Laboratory Analytical Protocols Manual"* (MARLAP) – August 2001

8.7 Regulatory Guide 4.15, *"Quality Assurance or Radiological Monitoring Programs (Inception Through Normal Operations to License Termination) - Effluent Streams and the Environment"* – July 2007

8.8 GG-QAPG-001, *"Quality Assurance Program"*

8.9 CS-FO-PR-003, *"Soil Surveys; Collection of Water, Sediment, Vegetation and Soil Samples; and Chain-of-Custody"*

8.10 NRC Inspection Procedure No. 84750, *"Radioactive Waste Treatment, and Effluent and Environmental Monitoring"* – March 1994

8.11 ANSI N323A-1997, *"Radiation Protection Instrumentation Test and Calibration, Portable Survey Instrumentation"* – April 1997

8.12 CG-AD-PR-001, *"TES Condition Reporting"*