

**FINAL STATUS SURVEY AND RELEASE PLAN
FOR THE NORTHWEST CaF₂ STORAGE AREA**

AT

**GENERAL ELECTRIC
NUCLEAR ENERGY PRODUCTION FACILITY**

WILMINGTON, NORTH CAROLINA

May 4, 1995

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TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1
1.1 Purpose	1
1.2 Scope	1
1.3 Objectives	1
2.0 SITE INFORMATION	3
2.1 Site Description	3
2.2 Physical Characteristics at Time of Final Survey	7
3.0 SURVEY INFORMATION	7
3.1 Identification of Contaminants	8
3.2 Area Release Criteria	8
3.3 Survey Report	10
4.0 SURVEY METHODS	11
4.1 Survey Plan	11
4.2 Area Classification	11
4.2.1 Affected Areas	11
4.2.2 Unaffected Areas	11
4.3 Exposure Rate (Walk-Over) Surveys	11
4.4 Soil Sampling	13
4.4.1 Sample Locations	13
4.4.2 Sampling Methods	13
4.4.3 Number of Samples	15
4.5 Groundwater Sampling	15
4.6 Background Determination	16
4.7 Equipment Decontamination	16
4.8 Scope of Analyses/Analytical Methods	17
5.0 HEALTH AND SAFETY	18
5.1 Identification of Potential Hazards	18
5.1.1 Physical Hazards	18
5.1.2 Radiological Hazards	18
5.2 General Worker Training	18
5.3 Protective Equipment	18
5.4 Work Area Radiological Controls	19

TABLE OF CONTENTS (continued)

	<u>Page</u>
5.4.1 Radiation Work Permit	19
5.4.2 Access Control	19
5.4.3 Work Area Radiological Monitoring	19
5.4.4 Personnel Radiation Monitoring	19
5.4.4.1 Dosimetry	19
5.4.4.2 Personnel Contamination Monitoring	19
5.4.4.3 Bioassay Requirements	20
 6.0 QUALITY ASSURANCE	 21
6.1 Organization, Responsibilities, and Qualifications	21
6.1.1 Project Manager	21
6.1.2. Project Quality Assurance Manager	21
6.1.3 Environmental Scientist	21
6.1.4 Sampling Technicians	23
6.1.5 Project Health Physicist	23
6.1.6 Radiological Technicians	23
6.1.7 Subcontractors	24
6.2 Data Quality	24
6.2.1 Data Quality Objectives	24
6.2.1.1 Sensitivity	24
6.2.1.2 Completeness	24
6.2.1.3 Representativeness	24
6.2.2 Project Data Control	25
6.2.3 Instrument Calibration	25
6.2.3.1 Calibration	25
6.2.3.2 Operation Checks	25
6.2.4 Field Sampling Quality Control	26
6.2.4.1 Chain-of-Custody	26
6.2.4.2 Field Quality Control Samples	26
6.2.4.2.1 Equipment Blanks	26
6.2.4.2.2 Field Duplicates/Splits	26
6.2.5 Contract Analytical Laboratory Quality Control	27
6.2.5.1 Quality Assurance Program Requirements	27
6.2.5.2 Data Reduction, Validation, and Reporting	27
6.2.5.2.1 Data Reduction	27
6.2.5.2.2 Data Validation	28
6.2.5.2.3 Data Reporting	29
6.3 Document Control	29
6.3.1 Distribution and Review	29
6.3.2 Storage and Disposition	29

TABLE OF CONTENTS (continued)

	<u>Page</u>
6.3.3 Operating Procedures, Instructions, Forms, Field Logbooks	30
6.3.4 Procurement Control	31
6.4 Preventive Maintenance	31
6.4.1 Field Equipment Program	31
6.4.2 Field Laboratory Program	31
6.5 Audits and Corrective Actions	31
6.5.1 Quality Assurance Audits	31
6.5.2 Corrective Action	32
7.0 INTERPRETATION OF SURVEY RESULTS	33
7.1 Result Reporting Units and Format	33
7.2 Measurement Uncertainty	33
7.3 Comparison of Soil Survey Results to Release Criteria	33
7.3.1 Use of Background Results and Minimum Detectable Activities . . .	33
7.3.2 Elevated Areas of Radioactivity	34
7.3.3 Averaging Results	34
7.3.4 Comparison of Averages	34
7.4 Use of Exposure Rate Measurements	35
7.5 Groundwater Results	35
8.0 TENTATIVE SCHEDULE	36
9.0 REFERENCES	37

List of Figures

	<u>Page</u>
Figure 2-1 GE-Wilmington Facility Map	4
Figure 2-2 Location of Northwest CaF ₂ Storage Area	5
Figure 2-3 General Arrangement of Northwest CaF ₂ Storage Area	6
Figure 3-1 Groundwater Monitoring Wells in the Location of Northwest CaF ₂ Storage Area	9
Figure 4-1 Grid Layout for Northwest CaF ₂ Storage Area	12
Figure 4-2 Sampling Locations Within Each Grid	14
Figure 6-1 Project Organization	22

1.0 INTRODUCTION

The General Electric Nuclear Energy Production Facility (GE-Wilmington) is preparing to remove approximately 70,000 cubic feet of calcium fluoride (CaF₂) material from the Northwest CaF₂ Storage Area at our facility in Wilmington, North Carolina. The CaF₂ will be relocated to storage buildings in the Controlled Access Area (CAA). The CaF₂ relocation is planned to begin in October 1995.

Following CaF₂ relocation from the Northwest CaF₂ Storage Area, plans are to reduce residual radioactivity to levels that permit release of this site for unrestricted use. A final status survey will be performed pursuant to Nuclear Regulatory Commission (NRC) guidance to demonstrate the site meets release criteria. Methods for performing the final status survey are described in this plan.

This plan is intended to provide sufficient information for the NRC to approve the proposed methods for performing the final survey and demonstrating compliance with release criteria. This document was prepared using guidance in the NRC *Manual for Conducting Radiological Surveys in Support of License Termination* (Draft NUREG/CR-05849) [Reference 9.1].

1.1 Purpose

The purpose of the final status survey is to demonstrate that residual radioactivity levels at the Northwest CaF₂ Storage Area satisfy the NRC criteria for future use without licensing restrictions and radiological controls.

1.2 Scope

This plan addresses the Northwest CaF₂ Storage Area located in the northwest quadrant of the GE-Wilmington facility. The area to be surveyed includes the storage pits, a section of the service road, and specific portions of the surrounding area. Additional areas may be surveyed, as necessary.

The final status survey effort includes sampling and analysis of soil and groundwater for radiological contaminants as well as surface exposure rate measurements.

1.3 Objectives

The objectives of the final status survey are to demonstrate that:

- residual uranium soil concentrations are less than the NRC unrestricted release limit of 30 pCi/g as specified in NRC Branch Technical Position,

Disposal or Onsite Storage of Residual Thorium or Uranium from Past Operations, Option 1, (Reference 9.1), and;

- reasonable efforts have been made to identify and remove areas of elevated activity.

2.0 SITE INFORMATION

2.1 Site Description

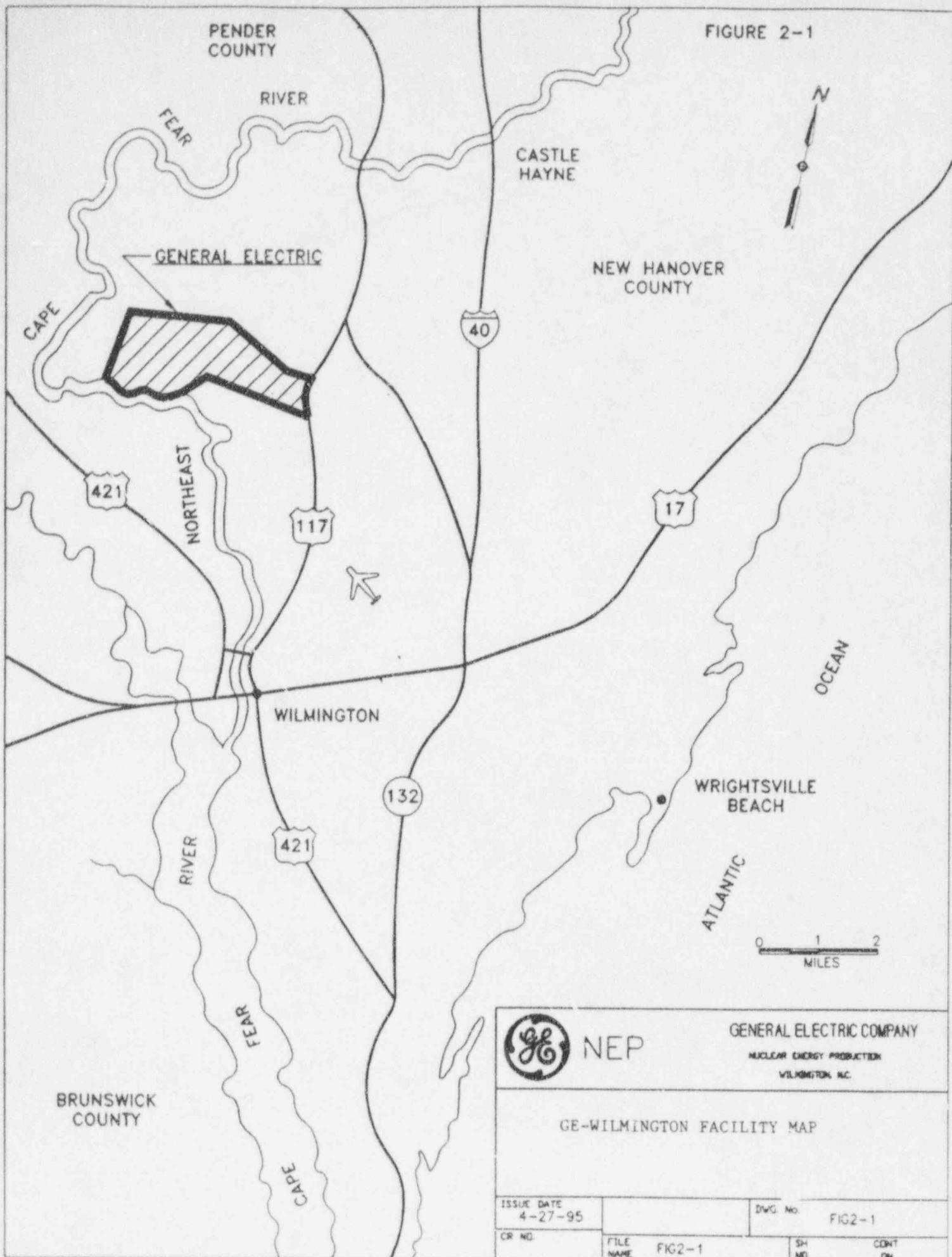
The facility is situated on a 1,664-acre site in New Hanover County, approximately six miles north of the city of Wilmington (Figure 2-1). New Hanover County is located in the southeastern corner of the state in the coastal plains region. The County is bound by the Atlantic Ocean and by Perder and Brunswick Counties. The region around the site is sparsely settled, and the land is characterized by heavily timbered tracts occasionally penetrated by short roads. Farms, single-family dwellings, and light commercial activities are located chiefly along highways.

The major portion of the site is bordered on the east by U.S. Highway 117 and on the west by the Northeast Cape Fear River. Fourteen acres lie to the east of U.S. 117 and are undeveloped except for water wells and an employee park. The northern and southern boundaries, marked by fences, are surveyed lines through undeveloped forest and marsh lands. Of the total 1,664 acres, approximately 350 acres have been developed.

The Northwest CaF₂ Storage Area is made up of seven shallow trenches located in the Northwest quadrant of the facility (Figure 2-2). The seven pits are within a fenced area measuring 218 by 239 by 243 by 204 feet and contain approximately 70,000 cubic feet of CaF₂ material (Figure 2-3). The maximum depth of the storage pits is approximately nine feet; average depth is about five feet.

The Northwest CaF₂ Storage Area is located on the eastern flank of a relic sand dune currently being mined by GE for borrow material. Natural ground elevations in this area of the site range from nearly 40 feet above mean sea level (ft, msl) in the vicinity of the sand dune to an elevation of approximately 22 to 26 ft, msl in the immediate vicinity of the storage area. The land surface in the vicinity of the storage area generally slopes from the northern property boundary to the south. There is considerable topographic relief within the fenced storage area related to cuts and fills associated with the stored materials.

FIGURE 2-1

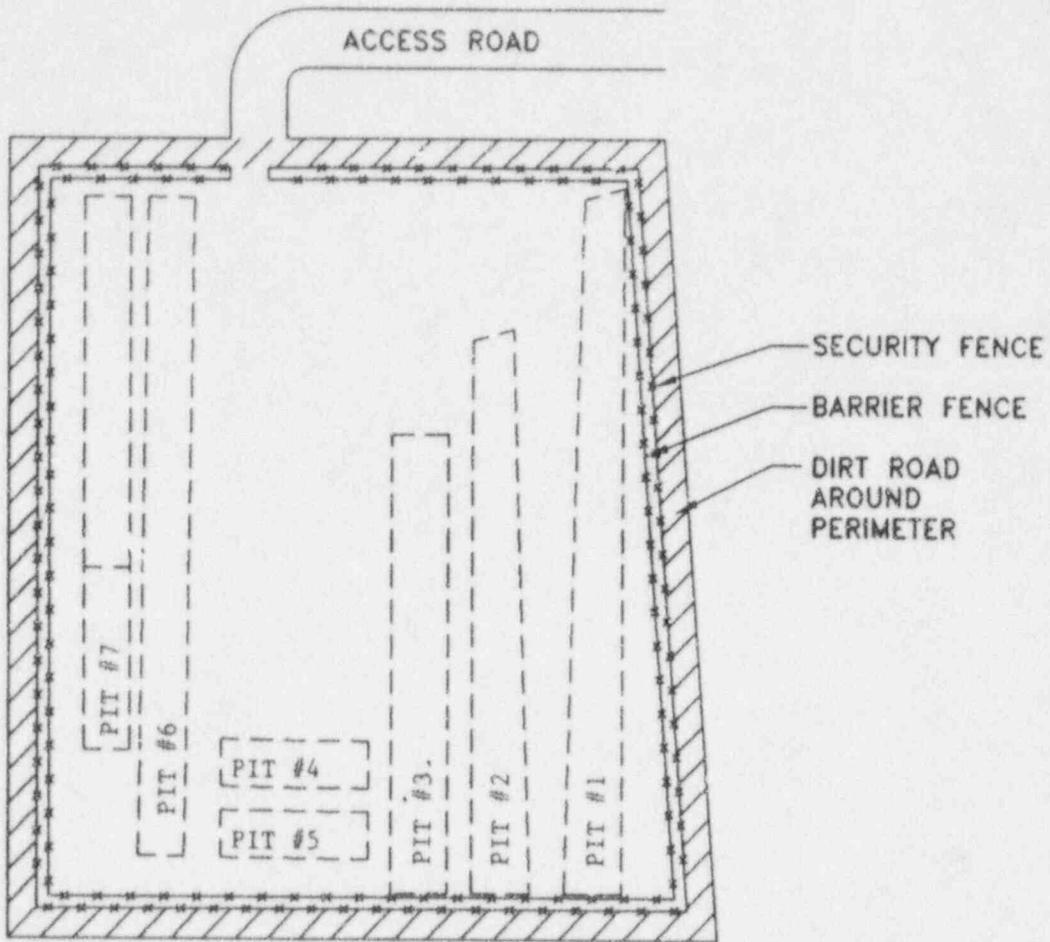


 **NEP** GENERAL ELECTRIC COMPANY
 NUCLEAR ENERGY PRODUCTION
 WILMINGTON, NC.

GE-WILMINGTON FACILITY MAP

ISSUE DATE 4-27-95	DWG. No. FIG2-1
CR. NO.	FILE NAME FIG2-1
	SH. NO. CONT. ON

FIGURE 2-3



	NEP		GENERAL ELECTRIC COMPANY NUCLEAR ENERGY PRODUCTION WILMINGTON, N.C.	
	GENERAL ARRANGEMENT OF NORTHWEST CaF ₂ STORAGE AREA			
ISSUE DATE 4-27-95			DWG. NO. FIG2-3	
CR. NO.	FILE NAME FIG2-3	SH. NO.	CONT. ON	

The subsurface soils in the vicinity of the Northwest CaF₂ Storage Area are chiefly composed of fine to medium grain sands. The sands vary in silt content, color, and percent of natural organic material. The clayey semiconfining unit that separates the surficial aquifer from the principle aquifer beneath most other areas of the GE property is thin or absent in the vicinity of the Northwest CaF₂ Storage Area. The deeper sands of the principle aquifer are typically greenish in color, increase in silt content with depth, and contain thin discontinuous layers of calcareous sandstone. These sediments are representative of the Peedee Formation.

The groundwater elevation in the immediate vicinity of the Northwest CaF₂ Storage Area (as measured in March 1995) occurs between elevation 16 and 18 ft, msl. The groundwater flow in this area of the site is interpreted to be toward the north-northwest. The approximate depth to groundwater beneath the ground surface in the vicinity of the Northwest CaF₂ Storage Area ranges from approximately 4 ft in southeast corner to 11 ft in the northwest corner (based on March 1995 measurements).

2.2 Physical Characteristics at Time of Final Survey

The anticipated physical characteristics of the Northwest CaF₂ Storage Area at the time of the final survey are as follows:

- vegetation in the potentially affected area has been removed;
- CaF₂ material and soil containing uranium above the release criteria have been removed;
- the excavated area has been prepared for sampling; and
- surface water drainage has been controlled by a trench surrounding the excavated area.

3.0 SURVEY INFORMATION

3.1 Identification of Contaminants

CaF₂ is a byproduct of the ammonium diuranate process and contains low concentrations of enriched uranium, the sole radiological contaminant anticipated in the Northwest CaF₂ Storage Area.

Based on site history and radiological survey data, the radionuclides of concern for this area are ²³⁴U, ²³⁵U, and ²³⁸U, existing (primarily) as physically bound constituents of CaF₂. Only small concentrations of short-lived daughter products are present due to the purification of the uranium. The average ²³⁵U enrichment is approximately two percent by weight. The average isotopic activity ratios are approximately:

U-234 75 %
U-238 22 %
U-235 3 %

A groundwater monitoring program is in effect at the Northwest CaF₂ Storage Area. The monitoring program consists of four wells (CAF-1A, CAF-2A, CAF-3A, and CAF-4A) which are sampled quarterly. Samples are analyzed for total uranium, gross alpha, and gross beta activity. The locations of the wells are presented in Figure 3-1.

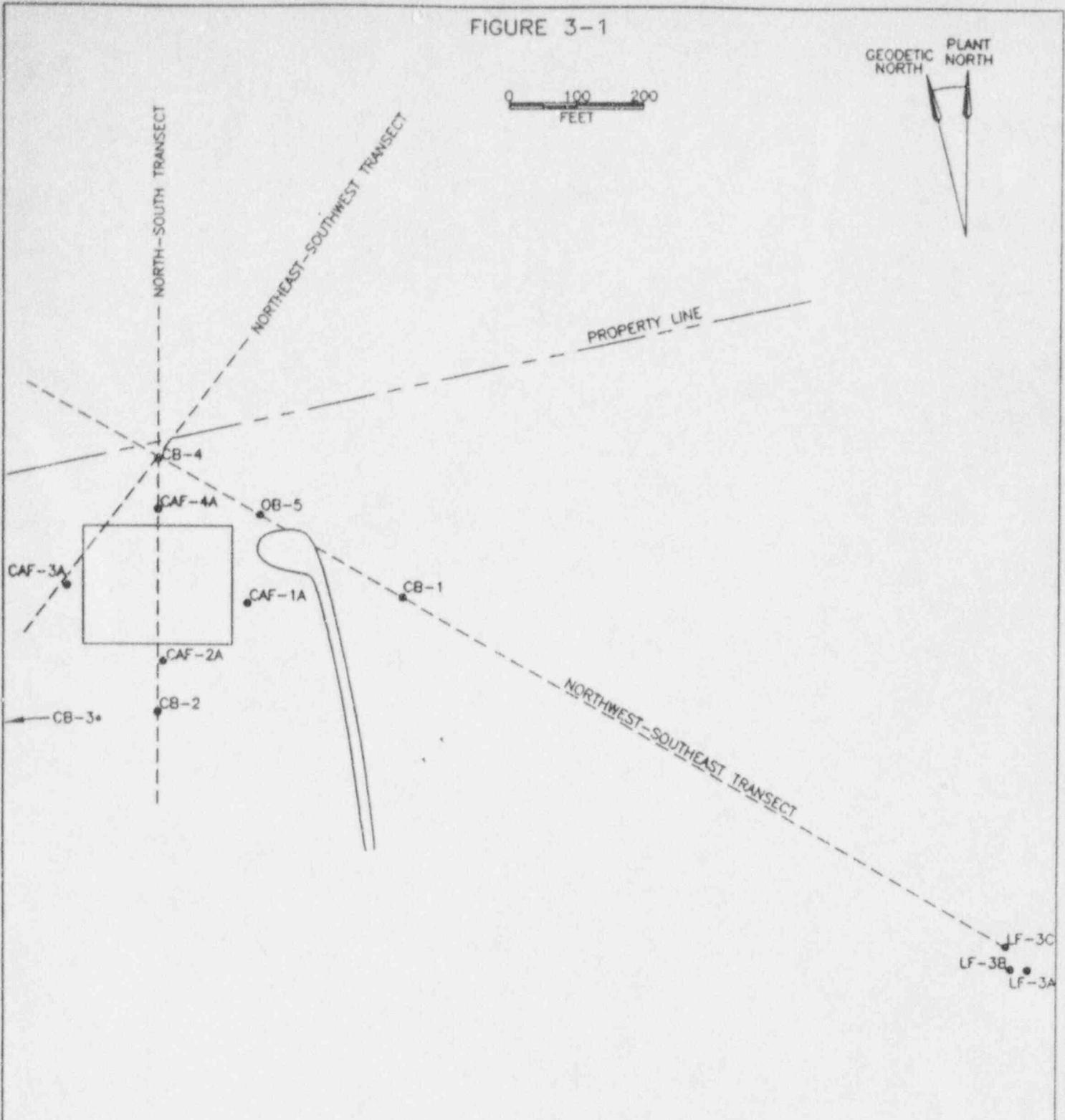
Based on data collected from 1983 to 1995, uranium is not present in groundwater at levels exceeding the proposed maximum contaminant limit (MCL) for drinking water (30 pCi/l).

3.2 Area Release Criteria

The applicable radiological criteria for release of the Northwest CaF₂ Storage Area for unrestricted use is 30 pCi/g. This limit has been established by the Nuclear Regulatory Commission in Branch Technical Position, *Disposal or Onsite Storage of Residual Thorium or Uranium from Past Operations*, [Option 1] (Reference 9.2).

If during the final status survey elevated areas of radioactivity are encountered, such areas will be evaluated as described in Section 7.3.2 of this document.

FIGURE 3-1



 NEP		GENERAL ELECTRIC COMPANY NUCLEAR ENERGY PRODUCTION WILMINGTON, NC	
		GROUNDWATER MONITORING WELLS IN THE LOCATION OF NORTHWEST CaF ₂ STORAGE AREA	
ISSUE DATE	4-27-95	DWG. NO.	FIG. 3-1
DR. NO.	FILE NAME	SH. NO.	CONT. ON

3.3 Survey Report

A report will be prepared upon the completion of the final status survey. At a minimum, the report will contain the following information:

- survey findings and results;
- a description of the methods and techniques used to collect survey data;
- a description of the methods used to evaluate and interpret data.

Report format and content will follow the recommendations contained in Reference 9.1.

4.0 SURVEY METHODS

4.1 Survey Plan

A ten by ten meter grid system will be established over the Northwest CaF₂ Storage Area (i.e., the affected area). The grid system will consist of sixty-four 100 m² grids. Soil samples will be taken at a minimum of four locations in each grid. One surface sample and three subsurface samples will be retrieved at each location, resulting in sixteen samples (minimum) per grid. Thirty-six, ten-meter grids will also be established around the perimeter of the affected area. These grids will be designated as the unaffected area. One surface soil sample will be obtained from each grid in the unaffected area to determine the presence, or absence, of contamination potentially resulting from CaF₂ relocation operations. Soil samples will also be taken at a background location unaffected by manufacturing operations. A minimum of ten surface samples and ten subsurface samples will be retrieved at the background location. One groundwater sample will be obtained from each monitoring well at the Northwest CaF₂ Storage Area. All soil and groundwater samples will be analyzed for isotopic uranium using alpha spectroscopy.

4.2 Area Classification

4.2.1 Affected Areas

Affected areas are defined by the NRC as areas that potentially contain radioactive contamination based on plant operating history or known radioactive contamination. The affected area is depicted in Figure 4-1 and is based on the location of the CaF₂ storage pits.

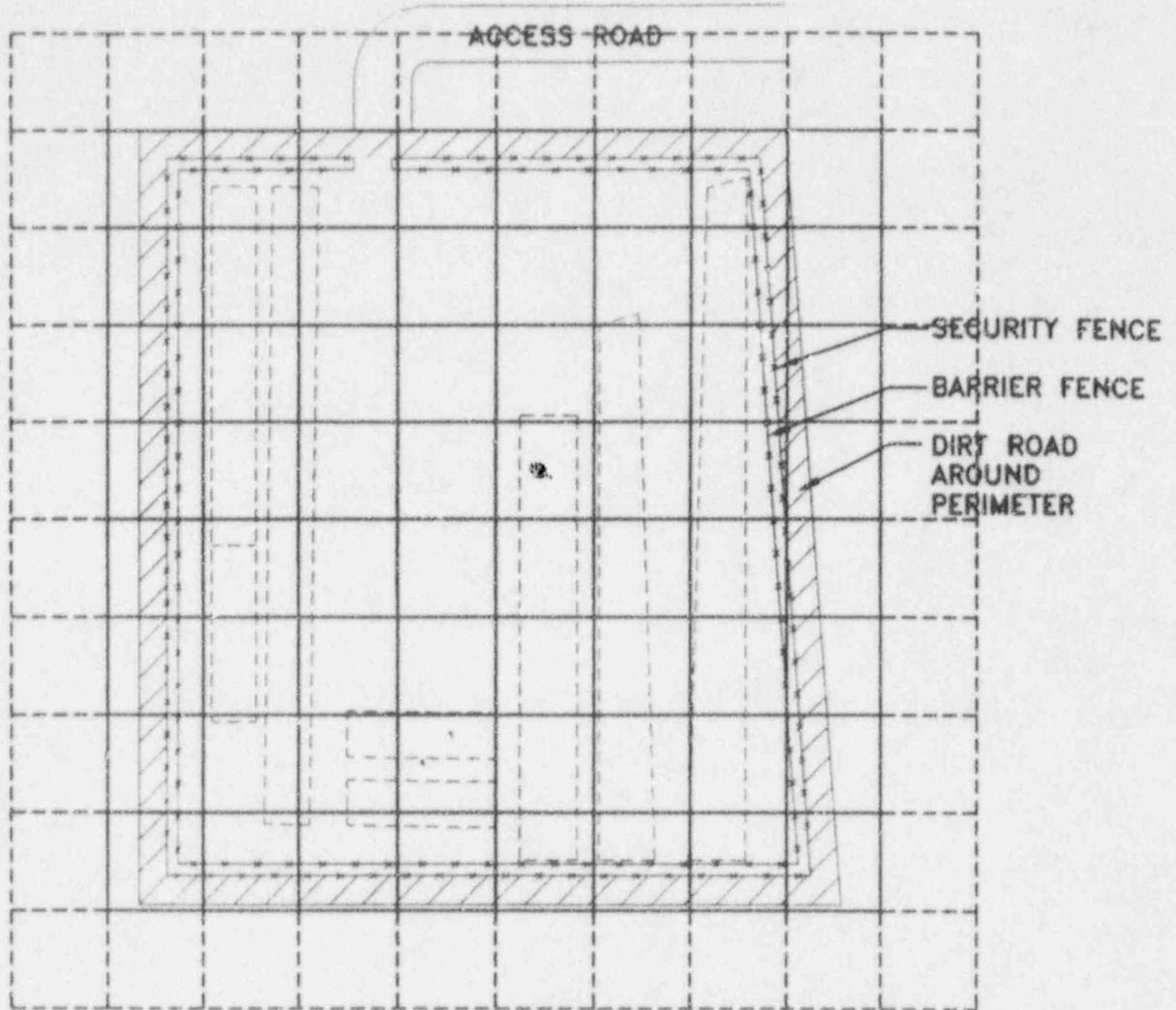
4.2.2 Unaffected Areas

Areas not expected to contain residual radioactivity are defined as unaffected areas. The final status survey includes unaffected areas in order to determine whether or not radioactive contamination has spread outside the confines of the assumed affected area. The unaffected area extends ten meters beyond the affected area and includes a portion of the site access road (Figure 4-1).

4.3 Exposure Rate (Walk-Over) Surveys

The initial phase of the final survey will consist of at least one walk-over survey (exposure rate survey) to detect gamma emitting radiological contaminants located on or near the surface. This survey will be conducted using technology which is

FIGURE 4-1



LEGEND:

- UNAFECTED AREA
(SYSTEMATIC SAMPLING GRID, ONE SAMPLE LOCATION PER GRID, NOT SHOWN)
- AFFECTED AREA
(SYSTEMATIC SAMPLING GRID, FOUR SAMPLE LOCATIONS PER GRID, NOT SHOWN)

GRIDS = 10m x 10m



NEP

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WILMINGTON, NC

**GRID LAYOUT FOR
NORTHWEST CaF2
STORAGE AREA**

ISSUE DATE 4-27-95	DWG. No. FIG4-1	
CR. NO.	FILE NAME FIG4-1	SH. NO. CONT. OR

both readily available and appropriate for the site and potential contaminants, as well as being consistent with the guidelines specified in NUREG/CR-5849 (Reference 9.1).

Gamma exposure rates will be measured at approximately one meter above the ground using a pressurized ionization chamber, gamma scintillation instrument, or other instrument with a sufficient sensitivity to detect low level gamma emissions. The primary purpose of the walk-over surveys will be to assess the potential radiological hazard to workers in the area and, to the extent practical, help identify the presence of contaminated areas. Information obtained from initial walk-over surveys will be used by the Project Health Physicist to establish work area radiological controls and re-direct, as necessary, survey activities. The Project Health Physicist will generate a survey map or other document used to plan and record survey points.

4.4 Soil Sampling

4.4.1 Sample Locations

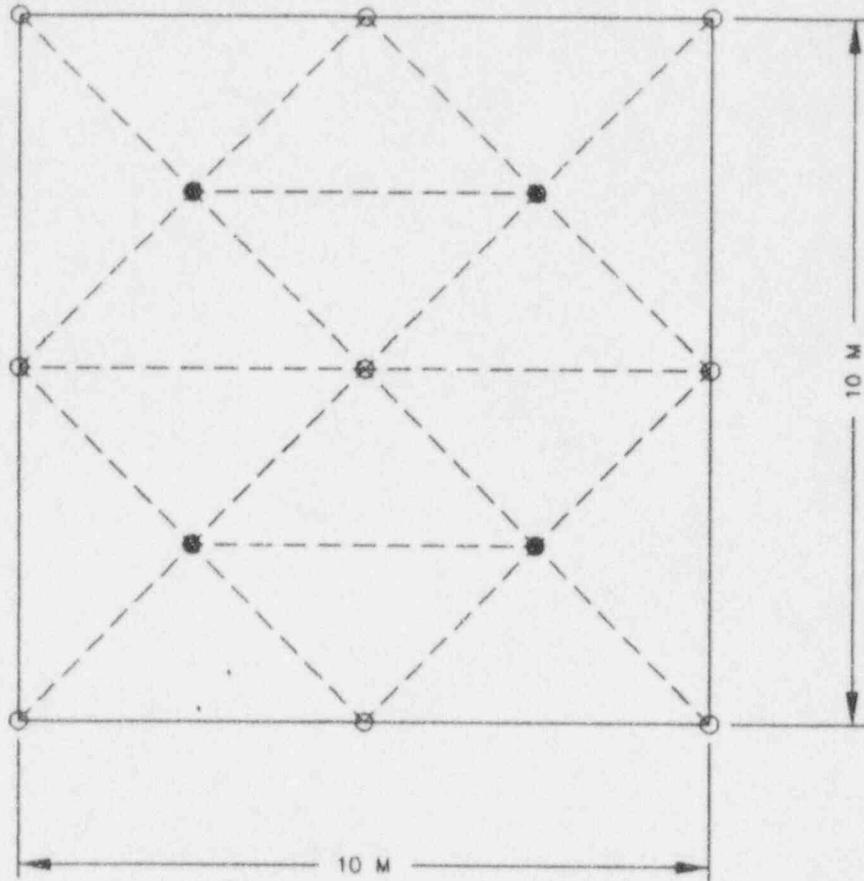
For the affected area, sampling locations will be determined using a systematic ten by ten meter sampling grid (Figure 4-1). Samples will be taken from four locations in each grid (Figure 4-2). Additional samples will be collected at grid corners and centers, and midway between corners of a grid (i.e., at five-meter intervals), if warranted by elevated walk-over survey data or sampling results.

For the unaffected area, a systematic sampling approach will be utilized (Figure 4-1). One surface sample will be taken from each ten by ten meter sampling grid. A judgmental approach will be used to determine the sample location within each grid. Sample locations will be determined by the Project Environmental Scientist. Additional samples will be collected if warranted by elevated walk-over survey data or sampling results.

4.4.2 Sampling Methods

Surface (0 to 6 inches) soil samples will be obtained with a hand auger appropriate to the soil type in the sampling area. If samples can not be collected in this manner, a scoop or shovel will be used. Samples will be homogenized. Aliquots will be removed and placed in appropriate containers for analyses.

FIGURE 4-2



LEGEND:

- SYSTEMATIC SAMPLING LOCATIONS
- ADDITIONAL SAMPLING LOCATIONS TO PROVIDE CLOSE-SPACED TRIANGULAR GRID PATTERNS

 NEP		GENERAL ELECTRIC COMPANY NUCLEAR ENERGY PRODUCTION WILMINGTON, N.C.	
		TYPE OF DRAWING SAMPLING LOCATIONS WITHIN EACH GRID	
ISSUE DATE 4-27-95		DWG. NO. FIG. 4-2	
OR NO.	FILE NAME FIG. 4-2	SH. NO.	CONT. ON

Subsurface (6 inches to approximately twelve feet) soil sampling will be accomplished using hollow stem augers with a split-spoon sampler (fitted with a sand retaining device, as necessary) appropriate to the soil type in the sampling area. Subsurface samples will be taken to a depth three feet below the maximum depth of the excavation.

The sampling device will be driven, retrieved and emptied to achieve depth intervals of three feet starting from six inches below the ground surface until the desired depth is achieved. Depth intervals will be individually mixed. Aliquots will be removed and placed in appropriate containers for analyses.

4.4.3 Number of Samples

Approximately 1,060 soil samples will be collected. Sampling in the affected area consists of 256 surface samples (64 sampling grids with 4 locations per grid) and 768 subsurface samples (64 sampling grids with 3 subsurface samples collected from each of the 4 boreholes). Unaffected area sampling includes 36 surface samples (36 sampling grids with 1 location per grid).

4.5 **Groundwater Sampling**

GE-Wilmington will maintain the routine groundwater monitoring program for the Northwest CaF₂ Storage Areas (Figure 3-1). Routine sampling will continue during CaF₂ relocation and results will be included in the final survey report. Additional groundwater samples will be collected and analyzed after completion of soil sampling.

Final survey groundwater sampling will be accomplished in accordance with Section 4.9, EPA Region IV Standard Operating Procedures (SOP) and Quality Assurance Manual (QAM) (Reference 9.3). Samples will be obtained using dedicated bladder pumps, or equivalent. Field and sampling parameters will be recorded and maintained in the project file.

Static water levels will be measured in each well prior to sample collection. Total well depth will be measured using a weighted reel tape. This information (difference between total well depth and depth to water), recorded to the 0.10 foot, will be used to calculate the volume of water in the well required for purging. The reference points for each well will be the surveyed top of the well casing.

Three casing volumes will be withdrawn from each well before field testing begins. The amount of water purged and discharge rates will be recorded. After initial purging, the water level recovery will also be noted to assist in determining the sampling rate. Dedicated bladder pumps, or equivalent, will be used to purge each well.

If the well is incapable of yielding three casing volumes, it will be evacuated to dryness once. When the well recovers sufficiently, the first sample will be tested for pH, temperature, and specific conductance. Samples will then be collected. The well will be retested for pH, temperature, and specific conductance after sampling as a measure of purging efficiency and as a check on the stability of the water samples over time. When full recovery exceeds two hours, a sample volume will be extracted as soon as sufficient volume is available for a sample. Measurement equipment will be decontaminated between sampling points.

4.6 Background Determination

Background samples will be collected at locations which are unaffected by effluent releases (upwind and upstream) and other site operations. Background measurements at an unaffected location will be taken for soil and exposure rate.

A background exposure rate will be established to provide a basis for identifying exposure rates in excess of natural radiation levels. A minimum of ten background exposure rate measurements will be made.

A minimum of twenty soil background samples will be taken. The information obtained from the background soil samples will be used to correct analytical results from samples taken in the affected area. A minimum of ten boreholes will be sampled. One surface sample and one subsurface sample will be collected from each borehole.

Background groundwater data collected from the routine monitoring program will be used to determine background concentrations.

4.7 Equipment Decontamination

Sampling and field measurement equipment will be decontaminated between each sampling point. The equipment will be surveyed for radioactive contamination as an indication of decontamination effectiveness. Decontamination will continue until contamination is below detectable limits.

4.8 Scope of Analyses/Analytical Methods

The scope of analysis for soil and groundwater samples consists of ²³⁴U, ²³⁵U, and ²³⁸U. Analyses will be performed by a contracted laboratory using alpha spectroscopy. Sensitivity (or Minimum Detectable Activity) requirements for the analyses of samples are specified in Section 6.2.1.1, Sensitivity.

The dissolution technique used to prepare samples for this analysis will be adequate to account for the uranium content of the samples.

5.0 HEALTH AND SAFETY

5.1 Identification of Potential Hazards

The following sections describe the physical and radiological hazards that may be encountered during the final status survey.

5.1.1 Physical Hazards

The use of mechanical equipment such as drill rigs and portable augers will be required to support soil sampling. If used, this type of equipment will be operated in accordance with OSHA recommendations, which include:

- equipment operation will be conducted by qualified or licensed personnel only;
- heavy equipment will be operated, maintained, and inspected before use, as directed by federal, state, or OSHA regulations.

5.1.2 Radiological Hazards

Since it is expected that residual radioactive material in the excavated area will be below release limit criteria, the need for radiological controls is not anticipated. However, radiological controls will be established for the work area in order to prevent unnecessary exposure to radioactive material if deemed necessary by the Project Health Physicist or as required by GE-Wilmington. Potential radiological controls are further discussed in Section 5.4.

5.2 General Worker Training

Workers involved in the final status survey will receive documented training relevant to the conduct of this survey and applicable GE-Wilmington site requirements.

5.3 Protective Equipment

Work area conditions are not expected to warrant the use of radiological and chemical protective equipment; however, protective equipment will be worn when required by GE-Wilmington site requirements, or prescribed by GE-Wilmington or project safety personnel.

The use of protective equipment including hard hats, safety glasses, hand protection, and appropriate footwear is anticipated. Protective equipment requirements will be documented in an applicable procedure, work permit, or other written instruction.

5.4 Work Area Radiological Controls

Radiological controls will be established for the work area in order to prevent unnecessary exposure to radioactive material if deemed necessary by the Project Health Physicist or as required by GE-Wilmington.

5.4.1 Radiation Work Permit

A radiation work permit or other written instruction will be prepared prescribing the radiological precautions and controls in the work area.

5.4.2 Access Control

Access to the work area will be controlled to prevent the spread of loose surface contamination and to prohibit untrained or otherwise unqualified personnel from entering the area.

5.4.3 Work Area Radiological Monitoring

Routine radiological monitoring will be performed in radiologically controlled work areas in order to identify significant changes in radiological conditions. Monitoring frequencies will be determined by the Project Health Physicist. Exposure information will be periodically reviewed to ensure that radiation exposures are maintained ALARA.

5.4.4 Personnel Radiation Monitoring

5.4.4.1 Dosimetry

If required, personnel dosimetry will be issued and worn in accordance with GE-Wilmington site requirements.

5.4.4.2 Personnel Contamination Monitoring

Personnel working in radiologically controlled areas where loose surface contamination is present will be monitored for radiological contamination. Personnel contamination

monitoring requirements will be prescribed in a radiation work permit or other written instruction.

5.4.4.3 Bioassay Requirements

Bioassay requirements may be established for personnel working in the affected area. Bioassays will be carried out as required by GE-Wilmington site requirements or as prescribed by GE-Wilmington or project health physics personnel.

6.0 QUALITY ASSURANCE

The Quality Assurance (QA) Program that will be implemented as part of this survey is designed to assure that the survey results are accurate and that uncertainties are appropriately considered. Survey quality is assured through establishment of appropriate project staffing, data quality controls, document controls, preventative maintenance, audits and corrective actions.

6.1 Organization, Responsibilities, and Qualifications

The project organization will be staffed with the necessary skills to manage and implement the survey work scope (Figure 6-1). The organization will have experience in sampling, sample handling, packaging, decontamination, documentation, and in employee protection.

6.1.1 Project Manager

The Project Manager is responsible for implementing the survey work plan and ensuring that all survey activities are performed in accordance with applicable license, regulatory, quality assurance, safety, and work plan requirements. The Project Manager will also be responsible for personnel training, records management, and regulatory compliance.

The Project Manager should possess a Bachelor's degree in engineering, environmental, or physical sciences, and five or more years of nuclear facility experience.

6.1.2 Project Quality Assurance Manager

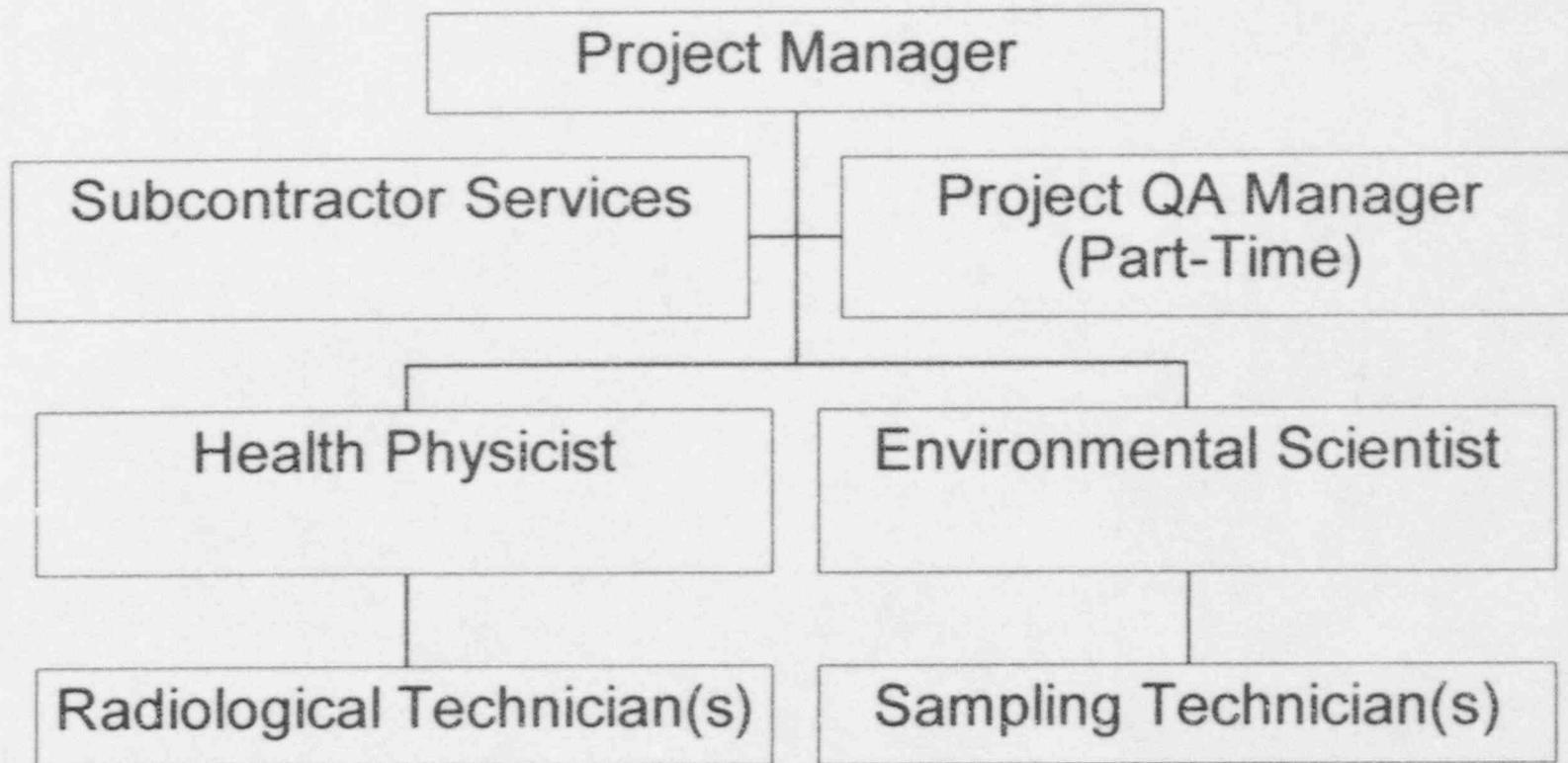
The Project QA Manager will be responsible for reviewing and initialing approved purchase requisitions for quality related supplies and services, performing periodic audits, and approving corrective actions taken to resolve audit findings.

The Project QA Manager should possess a Bachelor's degree in engineering, environmental or physical sciences, and at least three years of Quality Engineering experience.

6.1.3 Environmental Scientist

The Environmental Scientist will provide supervision and technical direction to staff responsible for executing data collection, processing, and management tasks. This position is responsible for identifying and resolving technical issues affecting data quality or validity, and ensuring

Project Organization Chart



results are properly interpreted and communicated. The Environmental Scientist will maintain sample documentation and sample inventory, and will provide supervision to the Sampling Technicians.

The Environmental Scientist should possess a Bachelor's degree in Environmental Science, Environmental Engineering (or a related discipline) and four years of professional experience.

6.1.4 Sampling Technicians

The Sampling Technicians are responsible for sample collection and packaging. Sampling Technicians will receive project specific training to ensure work is performed in accordance with established procedures for sampling, sampling documentation and chain-of-custody.

6.1.5 Project Health Physicist

The Project Health Physicist is responsible for oversight of all radiation and environmental monitoring and for assessment of all environmental and radiation protection data. The Health Physicist supervises the work of the Radiological Technicians.

The Project Health Physicist should possess a Bachelor's degree in health physics or a related area and four or more years of professional experience.

6.1.6 Radiological Technicians

The Radiological Technicians are responsible for project-related radiological health and safety tasks. Project-related instruction, as applicable, will be provided by the Project Health Physicist.

Qualified Radiological Technicians will have at least six months of radiation protection experience involving uranium or alpha emitting radionuclides, and have successfully completed the GE Radiation Protection Monitor training program.

6.1.7 Subcontractors

When assigned, subcontractors will be responsible to the Project Manager (or designee) for providing services which may include, but are not limited to, analytical services and core drilling.

6.2 Data Quality

6.2.1 Data Quality Objectives

The data quality objectives of the survey are to determine with adequate sensitivity, completeness, and representativeness, the level of residual radioactive contamination in the survey area.

6.2.1.1 Sensitivity

Section 3.2 specifies the release criteria that apply to the area being sampled. The target sample analysis sensitivity is 10 percent of the release criteria. In the event that this sensitivity can not be met, the closest sensitivity that can reasonably be achieved will be acceptable.

6.2.1.2 Completeness

Completeness will be assessed as the number of samples for which acceptable data are generated as compared to the total number of samples collected. The completeness objective for this project will be 90 percent.

6.2.1.3 Representativeness

Representativeness will be addressed through selection of appropriate sampling locations and methodology. The NRC has provided expert guidance on determining sampling locations and use of proper methods in NUREG/CR-5849, *Manual for Conducting Radiological Surveys in Support of License Termination, draft* (Reference 9.1). The sampling designs recommended in this guidance were incorporated in this plan to ensure representative results.

6.2.2 Project Data Control

The Project Manager will control and distribute quality-related survey data. All data generated during the survey effort will be routed to the appropriate personnel for prompt review. Expedient review will allow for resolution of potential problems prior to exceeding the sample holding times and prevent overlooking important developments requiring immediate action.

6.2.3 Instrument Calibration

Laboratory and field instruments will be calibrated before initial use and on a regular schedule thereafter. Standards used in the calibration of a system will be supported by certificates, reports, or data sheets attesting to the date, accuracy, and conditions under which the standard was manufactured.

6.2.3.1 Calibration

Equipment used during the survey may be calibrated on-site using approved procedures, as specified by manufacturer procedures, or calibrated off-site by the manufacturer.

Equipment calibration records will be maintained for each instrument and should include the following information: unique instrument identification (e.g., model and serial number), calibration standard(s) used, calibration results, date of calibration, names of individuals performing the calibration, and other pertinent information. Calibration information for field instruments will be recorded in the field data record. Pertinent calibration information, including the calibration expiration date, will be included on a label affixed to the instrument.

6.2.3.2 Operation Checks

All field survey instruments will be inspected and operation checked before use, or once per shift when the instrument is used repeatedly. Inspections will include a visual inspection for physical damage, current calibration, and a function/response check.

6.2.4 Field Sampling Quality Control

6.2.4.1 Chain-of-Custody

The chain-of-custody record will provide the means to individually identify, track, and monitor each sample from the point of collection through final data reporting. The chain-of-custody will be documented as specified in SW-846 (Reference 9.4). An original chain-of-custody form will accompany each shipment transmitted to the contract laboratory.

6.2.4.2 Field Quality Control Samples

6.2.4.2.1 Equipment Blanks

Equipment blanks will be obtained by running analyte-free water over, or through, a sample collection device (after cleaning) and then collecting the runoff in an appropriate sample container. The equipment blanks will be sent to the laboratory and analyzed for the same analytes as the samples which are collected that day. This serves as a check on sampling device cleanliness and decontamination procedures. Collection and analysis of equipment blanks will be at the discretion of the Project Manager.

6.2.4.2.2 Field Duplicates/Splits

Duplicate/split samples are two separate investigative samples taken from the same source (i.e., in separate containers and analyzed independently) and are used to assess precision. Collection and analysis of field duplicates will be at the discretion of the Project Manager.

6.2.5 Contract Analytical Laboratory Quality Control

6.2.5.1 Quality Assurance Program Requirements

Any laboratory contracted to provide sample analysis services will have a quality assurance program with systems that meet the intent of the NRC Regulatory Guide 4.15 Quality Assurance for Radiological Monitoring Programs (Reference 9.5) and ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities (Reference 9.6), where appropriate. The Project QA Manager will review laboratory programs prior to contracting services. The Project Manager will make no contract for laboratory services without prior written approval of the laboratory's QA program by the Project QA Manager.

Contract laboratories must be able to provide services that meet the following quality control requirements:

- the data quality objectives specified in Section 6.2.1;
- the reporting format specified in Sections 6.2.5.2, 7.1 and 7.2.

6.2.5.2 Data Reduction, Validation, and Reporting

6.2.5.2.1 Data Reduction

Data resulting from the analysis of samples will be reduced and summarized into data tables. All information used in calculations will be recorded to enable reconstruction of the final result at a later date.

Data will be reviewed by a second qualified project member to ensure that calculations are correct and to detect transcription errors. Any corrections to data sheets will be made by drawing a single line through the incorrect data, initialing and dating the line-out, and adding the revised information next to the line-out. Errors detected in the

review process will be referred to the originator(s) for corrective action. The supporting documentation to be provided with the laboratory report will include at a minimum:

- chain-of-custody record with sample information (including unique sample identification number, sample collection date and time, date of sample receipt, and date(s) of sample preparation and analysis);
- analytical results reported with appropriate significant figures;
- detection limits that reflect dilutions, interferences, or correction for equivalent dry weight; method reference;
- appropriate QC results; and
- data qualifiers with appropriate references and narrative on the quality of the results.

6.2.5.2.2 Data Validation

Data validation is a systematic review of data resulting from the analysis of field samples and QC samples. The purpose of the review is to make determinations concerning data quality and data limitations. Data generated in the survey study will be validated using an approved procedure.

6.2.5.2.3 Data Reporting

Each analytical report will include all sample data and associated QC documentation. QC samples will be clearly labeled with the laboratory sample number and associated field sample number.

In addition to the analytical results and QC data, the laboratory will provide a case narrative describing procedure modifications, interferences, deviations, and other observations applicable to sample analyses. The final data package submitted by the analytical laboratory will include a summary of the analytical results for each sample and the appropriate QC documentation.

6.3 Document Control

6.3.1 Distribution and Review

The Project Manager will control and distribute quality-related survey documents. Documents generated during the survey effort will be routed to the appropriate personnel for prompt review. Expedient review will allow for prompt resolution of potential problems, as well as identify important developments requiring immediate action. Records which fall under this quality document control program will include:

- draft and final reports and work plans;
- logbooks, maps, graphs, drawings, photos, etc.;
- instructions and regulations affecting project operations;
- health and safety records, including OSHA recordable injury log.

6.3.2 Storage and Disposition

Data and documents from the survey will be managed using a file classification system determined by the Project Manager. The system will specify tracking numbers and a filing system for organization of documents generated by the project activities.

A project file will be maintained for temporary storage of data and documents pertaining to site survey activities. The project file will include analytical results, quality assurance records, computer files, training and qualification records, sampling records, logbooks, all official correspondence, reports and other relevant documents. At the conclusion of the project, pertinent documents will be transferred to GE-Wilmington. These documents include:

- reports, procedures and work plans;
- logbooks, maps, graphs, drawings, photos;
- chain-of-custody records; and
- analytical result reports.

6.3.3 Operating Procedures, Instructions, Forms, Field Logbooks

Procedures and instructions will be developed and implemented for performance of the survey activities affecting quality. Procedures and instructions will be approved by both the Project Manager and the GE-Wilmington Project Manager prior to implementation. Each procedure or instruction will bear an effective date. Modifications will not be implemented, unless specifically allowed by the approved document, until the modifications have been approved and a new effective date assigned.

Forms, such as chain-of-custody records, calibration/maintenance logs, and sample data records will be developed as part of standard procedures and instructions. Each form will be assigned a unique tracking number, referenced in the procedure, and a revision date. Requirements for modification of forms will be specified in the relevant procedure.

A bound logbook will be maintained to provide a record of sample collection and adherence to sampling protocol. The logbook will typically list sampling personnel and include a sample log, sampling times and locations, conditions during sampling, methods, pertinent observations, and a brief description of any difficulties encountered. The completed logbook will be placed in the project file. All sample identification labels, field records, and chain-of-custody records will be recorded in waterproof, indelible ink. Transcription errors will be corrected by crossing a single line through the error and entering the correct information. Corrections will be initialed and dated. Photographs will be taken to document sampling activities and site conditions.

6.3.4 Procurement Control

The procurement of supplies and services will be controlled by the Project Manager or designee to assure quality. The extent of control will be a function of the importance and complexity of the supplies or services procured. Controls for quality-related supplies and services will include all or part of: preparation, review, and approval of Purchase Requests; vendor evaluations and/or audits; and examination of supplies or services upon receipt.

6.4 **Preventive Maintenance**

The following preventive maintenance measures are intended to ensure a maximum amount of active time for analytical instrumentation and field devices over the course of the survey.

6.4.1 Field Equipment Program

All field equipment should be maintained following the procedures outlined by the manufacturer. Field equipment should be inspected daily during periods of use and calibrated regularly to ensure it is working properly.

6.4.2 Field Laboratory Program

The field analytical laboratory will follow standard protocols for major, preventive, and day-to-day maintenance. All maintenance activities will be documented along with the name of the individual performing the maintenance. At a minimum, the laboratory instrumentation will be maintained following the procedures outlined by the instrument manufacturer. Instrument logbooks should be kept with each instrument and will be updated by the operator whenever maintenance is performed. Laboratory protocols for preventive maintenance should include routine tasks to minimize downtime of the measurement systems.

6.5 **Audits and Corrective Actions**

6.5.1 Quality Assurance Audits

The Project Quality Assurance Manager or designee will conduct periodic audits of such items as, field activities, analytical, and data management activities. These audits may include a review of selected records,

documents, procedures, and practices. The results of the findings will be reported to the Project Manager.

6.5.2 Corrective Action

Corrective actions are measures taken to rectify conditions adverse to data quality. These adverse conditions may be identified at any stage of the survey process, including field sampling, laboratory analysis, and data management. Identification of these problems may be the result of routine QA/QC activities, routine quality assurance audits, or project team knowledge. Corrective actions will be conducted and documented. Follow-up reviews of corrective action will be accomplished during subsequent routine audits and surveillance. The Project QA Manager will receive a copy of all corrective action reports to assess performance.

7.0 INTERPRETATION OF SURVEY RESULTS

7.1 Result Reporting Units and Format

Radiological survey data will be reported in the following standard units:

- soil radionuclide concentration in pCi/g;
- water radionuclide concentration in pCi/l; and
- exposure rate in μ R/h.

For radionuclide concentration data, the report format will include the following:

- values of the individual uranium isotopes ²³⁴U, ²³⁵U and ²³⁸U, as well as the sum of these results (total uranium);
- the counting uncertainty in each result;
- the estimated Minimum Detectable Activity (MDA) for each result;
- total uranium activity for each sample result corrected for background.

7.2 Measurement Uncertainty

Uncertainty (counting error) of each analysis result will be determined at the 95 percent confidence level and reported in the final report. Uncertainty information will be provided by the contract laboratory with the sample analysis results.

7.3 Comparison of Soil Survey Results to Release Criteria

The release criteria, identified in Section 3.2, apply to the concentration of total uranium activity in the soil only. Therefore, this section is limited to addressing the interpretation of the soil survey results for the purpose of comparison with the release criteria.

7.3.1 Use of Background Results and Minimum Detectable Activities

The average background soil concentration determined to be representative of the survey area will be subtracted from each survey result to generate data to be evaluated against the release criteria. Calculation of background subtracted data will be made using the actual analytical result provided by the contract laboratory, even in instances when this result is lower than the estimated Minimum Detectable Activity.

7.3.2 Elevated Areas of Radioactivity

The limit for soil activity at any sampling location is 90 pCi/g of total uranium. Residual activity exceeding this limit will be remediated as directed by GE-Wilmington after which follow-up samples will be taken to confirm that no location exceeds 90 pCi/g.

Contiguous areas, or individual sample locations, with elevated activity in the range of 30 to 90 pCi/g will be evaluated to assure that the average concentration is less than $(100/A)^{1/2}$ times 30 pCi/g, where A is the area of the elevated activity in m². Areas exceeding this limit will be remediated as directed by GE-Wilmington after which follow-up samples will be taken to confirm that no area exceeds the limit.

Finally, upon satisfaction of the above criteria, a weighted mean will be generated for the 100 m² contiguous area of the elevation. If this mean is less than 30 pCi/g, the release criteria will be considered to be satisfied for this area.

7.3.3 Averaging Results

Soil survey results (above background) will be averaged over the 100 m² area associated with each systematic sampling grid. In instances where additional sampling within a grid or the loss or invalidation of a sample result has resulted in a lack of uniformity in the sample spacing within a grid, a weighted mean will be calculated.

7.3.4 Comparison of Averages

Average uranium activity in each 100 m² will be compared to the 30 pCi/g limit. Areas exceeding this limit will be remediated as directed by GE-Wilmington after which follow-up samples will be taken to confirm that no grid average exceeds 30 pCi/g.

After average uranium activities in each grid have been shown to be less than 30 pCi/g, the results will be further evaluated by determining the 95 percent (upper) confidence level for both the affected and unaffected area. The 95 percent (upper) confidence level will be determined using appropriate statistical methods chosen after evaluation of the data distribution. If the 95 percent (upper) confidence level for the affected and unaffected areas are less than 30 pCi/g, no further remediation investigation is required.

7.4 Use of Exposure Rate Measurements

The exposure rate survey (described in Section 4.3) will generate data that may be useful in the early determination of elevated areas of radioactivity. This data may be used to specify additional sampling which will better define the radioactivity concentrations and the areal extent of the elevated areas.

The exact application of the exposure rate data for use in specifying additional samples is judgmental. However, it is anticipated that any area exhibiting a exposure rate which is greater than 10 $\mu\text{R/h}$ above background will be considered for additional sampling.

7.5 Groundwater Results

The results of the analysis of groundwater from each well will be compared to the proposed EPA drinking water MCL of 30 pCi/l total uranium. Results exceeding the proposed MCL will be noted in the survey report. No further interpretation of groundwater results is anticipated.

8.0 TENTATIVE SCHEDULE

The tentative milestones for performing the final status survey are shown below. The start date for the survey is dependent on CaF₂ and contaminated soil relocation. The survey schedule is based on completing CaF₂ and soil relocation by the end of 1995. Contingencies (i.e., "reserves") are provided in the schedule for follow-up sampling and analyzes to define areas of elevated activity, if necessary.

Begin Sampling and Survey	February 1996
Complete Soil Sampling	May 1996
Complete Laboratory Analysis	July 1996
Complete Follow-up Sampling and Analysis	September 1996
Complete Final Survey Report	December 1996
Submit Report to NRC	January 1997

9.0 REFERENCES

- 9.1 U.S. Nuclear Regulatory Commission (NRC). 1993. NUREG/CR-5849. Manual for Conducting Radiological Surveys in Support of License Termination.
- 9.2 U.S. Nuclear Regulatory Commission (NRC). 1981. Branch Technical Position. Disposal or Onsite Storage of Residual Thorium or Uranium from Past Operations. 46FR2061.
- 9.3 U.S. Environmental Protection Agency (EPA), Region IV. 1991. Environmental Compliance Branch. Standard Operating Procedures and Quality Assurance Manual.
- 9.4 U.S. Environmental Protection Agency (EPA), Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods. Office of Solid Waste and Emergency Response, Washington, D.C., SW-846, Final Update I. July 1992.
- 9.5 U.S. Nuclear Regulatory Commission (NRC). 1979. Regulatory Guide 4.15. Quality Assurance for Radiological Monitoring Program - Effluent Streams and the Environment.
- 9.6 ANSI/ASME NQA-1. 1989. Quality Assurance Program Requirements for Nuclear Facilities. 1989.