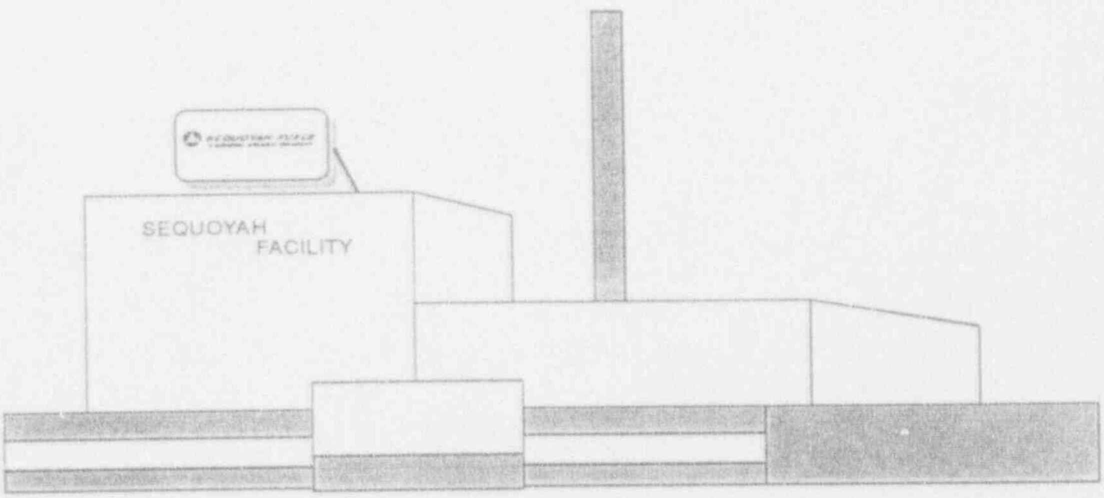
SEQUOYAH FUELS
A GENERAL ATOMICS COMPANY



SITE CHARACTERIZATION PLAN

JANUAR . 1994

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1.0 Introduction

1.1 Background

From 1970 to November, 1992, Sequoyah Fuels Corporation (SFC) operated a uranium conversion facility on its site located north of Interstate Highway I-40 and west of Oklahoma State Highway 10 about 2.5 miles southeast of Gore, Oklahoma. Production activity occurred on 85 acres located in the northern portion of the SFC property. In 1987, a second operation for the reduction of depleted UF_6 to UF_4 was begun at the site. The site holds five principal buildings used for manufacturing, warehousing and offices. In addition to uranium processing, the site has facilities that were used for production of fluorine, bulk storage of chemicals and fuels, storage of yellowcake, and a number of retention basins used for impoundment of calcium fluoride, untreated raffinates, and liquid fertilizer.

License SUB-1010, Docket No. 40-8027 was originally issued by the Atomic Energy Commission (now Nuclear Regulatory Commission) to Kerr-McGee Corporation on October 14, 1969, for storage only of uranium ore concentrate. The license was amended on February 20, 1970, authorizing Kerr-McGee to operate the Uranium Hexafluoride (UF_6) Conversion Plant. The license was amended on February 25, 1987, to authorize operation of the depleted UF_6 Reduction Plant. The license was last renewed on September 20, 1985, and would have expired on September 30, 1990. The license has remained in effect, pursuant to 10 CFR 40.43, based upon timely submittal of a renewal application dated August 29, 1990, and revised September 30, 1992. SFC formally discontinued UF_6 production operations in November, 1992, and depleted UF_6 reduction operations in July, 1993. On February 16, 1993, and July 7, 1993, pursuant to 10 CFR 40.42, SFC notified the Nuclear Regulatory Commission (NRC) of its intent to terminate licensed production activities at the SFC Facility and requested termination of License SUB-1010. On July 12, 1993, SFC filed a motion in the NRC license renewal hearing to withdraw its license renewal application. That motion was granted in an Order by the Presiding Officer; a request for Commission review of that Order is pending. The license will remain in effect pursuant to 10 CFR 40.42 (e) until decommissioning is completed and the NRC terminates SUB-1010.

On February 16, 1993, SFC submitted a Preliminary Plan for Completion of Decommissioning (PPCD) of the SFC Facility to the NRC. The PPCD included a commitment to develop a Site Characterization Plan to determine the extent and concentration of contamination from licensed material at the SFC Facility. Additionally, the PPCD projected a schedule and budget for completion of the decommissioning of the facility based upon the information available on site conditions, reasonable assumptions relative to decommissioning options, and NRC guidance concerning such work.

On August 3, 1993, the Environmental Protection Agency (EPA) and SFC signed a Resource Conservation and Recovery Act (RCRA) Administrative Order on Consent (AOC). The AOC included a requirement for SFC to perform a RCRA Facility Investigation (RFI). "The purpose of [the RFI] is to determine the nature and extent of releases of hazardous waste or constituents ... at the Facility and to gather all necessary data to support [a corrective measures study]".

Reports submitted to date as part of the AOC are the Draft Preliminary Report: Description of Current Conditions and Investigations (Current Conditions Report) dated November 1, 1993, and the final Groundwater Interim Measures (GWIM) Workplan dated November 19, 1993.

The next step in SFC's implementation of the AOC and 10 CFR 40.42 is to develop and submit a plan to collect the requisite data not yet obtained in previous studies. On January 28, 1994, SFC submitted to the EPA an RFI Workplan in accordance with the AOC. Concurrently, this submittal to the NRC, the Sequoyah Facility Site Characterization Plan, has been developed following the guidance provided in the NRC's Draft Branch Technical Position on Site Characterization for Decommissioning Sites, dated July 1992, (Draft BTP) and other technical documents referenced by the Draft BTP.

1.2 Regulatory Framework

The Sequoyah Facility was authorized to process uranium for ore concentrates to UF_6 by Source Material License SUB-1010 in 1970, was amended and renewed on several occasions to change or continue the authorized activities, and continues in effect under 10 CFR 40.42 (e). The NRC was established by the Energy Reorganization Act of 1974 and assumed the responsibility for licensing and related regulatory functions assigned to the Atomic Energy Commission by the Atomic Energy Act of 1954. The NRC will continue to regulate this facility until decommissioning is completed and termination monitoring indicates that the site is cleaned up in accordance with criteria approved by the NRC.

The RFI Workplan submitted to EPA focuses on identifying the release of hazardous waste or hazardous waste constituents as directed by the AOC. This Site Characterization Plan developed concurrently for submittal to the NRC focuses on the licensed materials that may be found at the facility. For purposes of completeness, it also contains information relating to non-radioactive materials (e.g., nitrates, fluorides), which are not within the scope of the AOC and will be addressed, if necessary, in accordance with pertinent requirements of the State of Oklahoma. It is expected that the activities required to satisfy the needs of the EPA, the NRC and the State of Oklahoma will overlap. The RFI will be conducted concurrently with the NRC site characterization effort to avoid inefficiencies and unnecessary duplication.

1.3 Objectives

The objectives of SFC's site characterization are consistent with those stated by the NRC in the Draft BTP and the EPA in the Corrective Action Plan (CAP) portion of the AOC issued to SFC. In summary, the main objectives of SFC's site characterization effort are:

- To quantify the physical and chemical characteristics of contamination and the extent of contaminant distribution, including the rate(s) and direction(s) of migration.
- To quantify environmental parameters that significantly affect residual environmental risks following final stabilization, decontamination and remediation activities.
- To provide the information necessary to support evaluation of alternative decommissioning and remediation actions, and to allow detailed planning of the preferred approach(es) for decommissioning and remediation.

This plan describes SFC's strategy, rationale, methods and schedule for completing a site characterization that accomplishes the objectives described above.

Prior to the AOC, several investigations were performed to determine the environmental conditions at the facility. These investigations provide information relevant to the current facility condition. Most notably, the Facility Environmental Investigation (FEI) and an addendum to the FEI were conducted to identify and investigate locations at the SFC Facility where past or present operations could have resulted in the release of licensed and other chemical materials to the environment. In addition, SFC assembled a substantial amount of information pertaining to the hydrogeology, geology, meteorology, climatology, demography and operation of the site in an effort to renew the NRC license for continued operation. The FEI and additional information were summarized, as appropriate, in the Current Conditions Report. Therefore, details on site history and currently available data are not presented here. Activities proposed in this SCP will be based in part upon the findings of these previous reports.

This site characterization plan is based on the review of previous studies and the compilation of information presented in the Current Conditions Report. Much of the data needed for the SCP has already been generated from previous investigations. References to existing data will be made throughout the discussion of the various tasks. The reader is referred to the previous investigations and reports for details in addition to the summaries provided herein. Areas where more information is needed are addressed in the SCP. A series of tasks will be undertaken, including the collection and analysis of water, soil, and air samples, compilation and evaluation of existing data and newly acquired data, and preparation of a Final Results Report. The Final Results Report developed from this investigation will then serve as the basis for the selection of decommissioning actions and development of the Final Plan for Completion of Decommissioning.

General information concerning the sampling and analysis requirements for each task are included in the narrative. However, many of these requirements overlap and data for several purposes will be obtained from a single sample, well installation, or borehole. Sampling under the SCP will be more extensive and extend to the media in each unit since licensed material (uranium) was present in most processing areas of the facility. Hazardous constituents, however, are expected to be limited to only a few areas. Sampling conducted during the initial phase of the RFI will focus on the potential sources rather than the media. The work effort required to complete the SCP, including quality assurance / quality control, are provided as appendices to this plan. Additional information on sampling and analysis methods, quality control, and other related issues are addressed in Section 3.0, "Data Collection Quality Assurance Plan".

1.4 Selection of Units

During the FEI, past and present operations which had the potential to contribute licensed material to the environment were identified and designated as operating units for investigation. Since much of the data available at the facility is associated with the unit designations in the FEI, those unit designations have been retained in this SCP. The balance of the site has been assigned unit designations to complete the investigation of the site. Table 1, "Site Characterization Unit Listing", lists the areas and their unit assignments.

For purposes of the SCP, SFC will investigate those units where past or present operations could have resulted in the release of licensed materials. In addition, for purposes of completeness, as mentioned above, the SCP also identifies units that SFC will investigate because they may contain chemical materials other than those containing hazardous constituents (which would be investigated under the RFI). The units where licensed materials or such chemical materials may be present are listed in Table 1.

1.5 Work Plan Organization

The SCP was written in the format of the RFI Workplan defined in the CAP. Much of the information suggested in the Draft BTP has been provided in the Current Conditions Report and will not be duplicated here. The SCP presented here addresses the five major areas outlined in the CAP as follows:

Section	Description
2.0	Project Management Plan
3.0	Data Collection Quality Assurance Plan
4.0	Data Management Plan

5.0	Health and Safety Plan
6.0	Community Relations Plan

Section 2.0 includes a description of the technical approach, schedules and estimated budgets. Elements of the tasks are discussed, and the general approach used to collect and evaluate the data is presented. Section 2 will also include the details of sample collection, such as the number of samples, location, parameters, etc.

Section 3.0 presents the quality assurance plans for sampling and analysis to be performed during the SCP. Information on the proposed sampling methods, field quality control, analytical methods, analytical quality control, etc. is presented in this plan. The general approach of the quality control plan is designed so that all data collected will be of acceptable quality and comparable with other data sets.

Section 4.0 presents the basic approach to handling data from previous studies and the data which will be generated during this investigation. A series of files, computer programs and a systematic approach to data management are the key elements to this plan.

Section 5.0 is the Health and Safety Plan to be used during field investigations. This plan is based upon the existing health and safety requirements currently in the NRC license, the collective experience of SFC, and experience gained in the previous investigations. This plan may be modified as the SCP progresses and actual field conditions warrant changes.

Section 6.0 outlines the basic approach to the community relations plans used by SFC. This plan outlines community relations activities to be conducted during the site characterization.

2.0 Project Management Plan

2.1 Environmental Setting

Sequoyah Fuels has historically conducted extensive monitoring, sampling and testing of its facility operations and the impacts it has had on the surrounding environment. While operating the facility, SFC routinely monitored approximately 350 environmental-related locations as required by its various federal and state licenses and permits.

Beyond the routine monitoring program, SFC was periodically required to gather and report additional environmental information, in response to requests from the various state and/or federal governing agencies. The environmental setting for SFC was well documented during the Facility Environmental Investigation (FEI) described in Section 1 of this report, and submitted to EPA with the Current Conditions Report, dated November 1, 1993. The FEI is an important study which supports this Site Characterization Plan and should be examined further for a more thorough investigation of the facility conditions.

The result of the data gathering described above, combined with a thorough understanding of the plant chemistry, operations and history, is a facility with an intimate knowledge of both the environmental conditions on-site as well as off-site. Therefore, the environmental setting is well established and the FEI investigation will need only supplemental data gathering for completing the RFI Report.

2.1.1 Geology

The SFC Site is immediately underlain by a thin layer of Quaternary-age terrace deposits which overlies approximately 390 feet of the Pennsylvanian-age Atoka Formation. The two (2) uppermost lithologic units of the Atoka are an upper shale with a sandstone unit immediately below the shale. The Atoka Formation is underlain by the Pennsylvanian-age Wapanoka Limestone Formation.

The Atoka Formation is characterized by irregularly bedded discontinuous units of sandstone, siltstone, and shale, with thin limestones in the lower part. Beneath the facility, the Atoka bedrock surface slopes toward the northwest, west, and south-southwest from its high point located in the MPB area (see Cross Section in Figure 1). The regional dip in the site area is 2-3 degrees southwest into the Arkoma Basin.

Terrace Deposits

The geology at SFC has been characterized and grouped into three (3) geological stratas. The first strata, the terrace deposits, are at or near the surface and are remnants of extensive terrace deposits laid down during historical high water stages of the local river systems. Downcutting by these rivers has left these deposits high above the present-day river valley. The terrace deposits consist primarily of silts, sandy clays, gravelly clays, and clays that overlie shale and sandstone units of the Atoka Formation. From their maximum thickness on the hilltops in the area (including the MPB and SX Building areas), the terrace deposits thin rapidly in all directions. The terrace deposits at SFC range in thickness from zero to approximately 16.4 feet (average about 6.7 feet). The thickest deposits are located near the southwest corner of the MPB and thin in all directions away from this area.

Shallow Shale Unit

The second strata, the Shallow Shale Unit consists of an upper shale unit which underlies the terrace deposits beneath the MPB and SX Building areas, the UF6 storage pad, the Yellowcake Storage Pad, the Emergency Basin, Sanitary Lagoon, the North Ditch, the DUF4 Building, and portions of the Fluoride Clarifier and Fluoride Settling Basins.

The thickness of this uppermost shale ranges from zero to 20.1 feet. The thickest areas of the shale are found in the Yellowcake Storage Pad area, the SX Building area, the MPB area, and the area north of the MPB. The shale thins to zero feet thickness to the west, north and south of the MPB area. This shale unit is typically dark grayish brown, fissile, silty and sandy near the contacts with adjacent sandstone units. This unit is laterally continuous beneath SFC until it is no longer present in the stratigraphic sequence due to erosion.

Deep Sandstone Unit

The third strata, the Deep Sandstone Unit, located beneath the uppermost shale, is a highly cemented, very fine to medium-grained, pale brown to dark gray, sandstone. This sandstone is laterally continuous across most areas of SFC. This sandstone is essentially impermeable (except for joints or fractures) due to its highly cemented nature. The formation ranges in thickness from zero to 12.5 feet and occurs at depths anywhere from 2 to 27.5 feet. The sandstone is thickest near the southeast and northeast corners of the MPB and gradually thins toward the west where it is eventually removed from the section through erosion.

Beneath the uppermost sandstone (in the MPB and SX Building area) is an alternating sequence of laterally continuous sandstone and shale units with lenses of sandstone and shale irregularly scattered throughout the formation. These individual units have been characterized to a depth of about 45 feet in the MPB area.

2.1.2 Hydrogeology

Groundwater at SFC occurs in limited quantities in the terrace deposits and within the deeper interbedded sandstones and shales of the Atoka Formation. The FEI identified two (2) zones with limited interconnection that support groundwater flow systems.

The uppermost groundwater system, the Shallow Shale/Terrace System, is in a shallow fractured weathered shale that is in hydraulic communication with groundwater contained in overlying terrace deposits. The average groundwater flow velocity, established during the FEI (See Vol. 1, Chapter 7, Section 7.4.2.2), in the shallow shale/terrace system was determined to be 0.016 feet/day (i.e. 5.8 feet/year). The groundwater potentiometric surface map for this unit is shown in Figure 2. Groundwater flow is radially away from the Site toward the northwest, west, and southwest.

Beneath this upper groundwater system, but separated by a dense, nearly impermeable, highly cemented, non-porous sandstone aquitard, is an interbedded shale and sandstone sequence referred to as the Deep Sandstone/Shale System. The Deep Sandstone/Shale System typically occurs between depths of 10 to 40 feet. The sandstone aquitard has a very low vertical permeability, and separates the overlying shallow shale/terrace groundwater from deeper bedrock groundwater systems. There appears to be no major communication with the groundwater contained within the overlying shale or terrace deposits. In fact, the uppermost sandstone unit may act in some areas as an impermeable barrier on which groundwater contained within the overlying shale and terrace deposits is perched. This sandstone is very highly cemented, very fine grained, and has very little primary porosity through which groundwater can move. The average groundwater flow velocity in the deep sandstone/shale system was determined to be 0.073 feet/day or about 27 feet/year (See Vol. 1, Chapter 7, Section 7.4.2.2). The groundwater potentiometric surface map for this unit is found in Figure 3. Groundwater flow is radially away from the east (MPB area) toward the northwest, west, and southwest.

Groundwater in the Site area is described in United States Geological Survey publications as being of poor to fair quality and considered least favorable for groundwater development (Marcher, 1969). The SFC Site does not overlie a bedrock or alluvial aquifer (Johnson, 1983).

2.1.3 Soils

According to the U.S.D.A. Soil Conservation Survey Map of Sequoyah County, Oklahoma (Abernathy, 1970), SFC's main plant is located over soils of the Pickwick Series. Other soils identified in the immediate process area include soils of the Hector Series, Linker Series, Stigler Series, Mason Series, Ender Series, and Vian Series. A detailed description of these soil series can be found in the FEI (Vol. 1, Section 7.4.1.1) as they will only be summarized here.

The Pickwick Series (PcB, PcC, PcC2) consists of deep, moderately permeable, well-drained soils on uplands that form in weathered material from sandstone. The Vian Series (VaB and VaC) soils consist of deep, moderately slowly permeable, moderately well drained soils on uplands that form in loamy alluvium or loess. The Stigler Series soils are deep, very slowly permeable, somewhat poorly drained soils on uplands. The Mason Series soils (Ma) consist of deep, moderately permeable, well drained soils in bottomlands. The Hector-Linker-Binder Complex (HCF), 5 to 40% slopes, range from stony and very shallow to deep. Hector and Linker soils make up 75% of the total area. The Hector Series soils consist of shallow, rapidly permeable, excessively drained soils on uplands that form in material weathered from sandstone. Soils of the Enders Series are deep, slowly permeable, moderately well drained and occur on sloping uplands. The Linker Series soils consist of moderately deep to deep, moderately permeable, well drained soils on uplands that formed in material weathered from sandstone.

2.1.4 Surface Water

SFC is located on the east bank of the headwaters of the Illinois River tributary of the Robert S. Kerr Reservoir. Downstream from the facility, approximately ½ mile, the Illinois River joins the Arkansas River tributary of the reservoir. The natural quality of the two river systems are quite severe in contrast. The much clearer Illinois River is fed by runoff from the steeper and rockier lands of eastern Oklahoma while the Arkansas River carries much more turbidity from it's course through the flatter farming areas of northern and western Oklahoma.

The east bank rises from the reservoir at a steady rate for several hundred feet before the slope lessens to a slight rise in the area of the facility processing area. The facility setting can generally be described as being located on a bluff above the reservoir headwaters with a floodplain located on the opposite or west side of the reservoir.

SFC has conducted analysis of the Illinois River upstream (U.S. Highway 64 bridge) and downstream (Robert S. Kerr Reservoir) of SFC's discharges on a monthly basis for several years as required by SFC's NRC license. In addition, quarterly samples are taken of the Arkansas River, both upstream and downstream of its confluence with the Illinois River. The analysis has included nitrate, fluoride, uranium, gross alpha and beta radiation and radium-226. The monitoring remains part of the SFC monitoring program and is anticipated to continue throughout the decommissioning process as a result of NRC license conditions. The State of Oklahoma (DEQ) has been a participant in the sampling program for several years.

SFC's NRC license requires monitoring of surface waters at three other locations in proximity to the facility to assist in determining if there have been operational impacts.

They include two farm ponds east of the facility and the Salt Fork River which is immediately north of SFC's property.

The Decorative Pond and the Storm Water Reservoir are the only non-process surface impoundments within or downgradient of the facility processing area located on SFC property. The Decorative Pond, located south of the MPB (see location on Figure 4), is fed by a pipeline from SFC's water supply line from Lake Tenkiller and therefore does not collect storm water runoff or process discharges and is used for aesthetic purposes only. The Storm Water Reservoir currently collects stormwater runoff from non-process areas. This impoundment is discussed in Section 2.1.6. The headwaters of the Robert S. Kerr Reservoir (the Illinois River Branch) is downgradient and, except for a narrow strip managed by the Corps of Engineers, borders the entire western boundary of SFC's property. All discharges and storm water runoff from the facility's processing area eventually enter the Robert S. Kerr Reservoir.

There are also eight small (less than 1/2 acre) man-made farm ponds located on SFC property as can be seen in aerial photos. None of the farm ponds receive storm water runoff or discharges from SFC process operation areas. Investigation of facility impacts will not be conducted on any of the eight farm ponds unless site studies indicate that impacts to off-site locations may have occurred.

2.1.5 Wetlands

SFC will contact the local office of the U.S. Fish and Wildlife Service to obtain a map(s) showing locations of wetlands within one mile of the facility. Wetlands which are identified as being within or at the facility property boundary or are within ½ mile downgradient from the processing area will be sampled and analyzed in a manner to characterize the physical and chemical nature of surface water and sediments.

2.1.6 Storm Water Runoff

Historically, storm water runoff from the outer perimeter of the process area, i.e., the northern and western sections, entered well defined ephemeral streams which flow westward and drain into the Robert S. Kerr Reservoir. In 1989, SFC constructed a drainage ditch around the perimeter of the northern and western SFC processing area that intercepts that storm water runoff and diverts it through Outfall 008. Storm water which falls on the interior sections of the processing area either flows directly into or is pumped from a catchment basin, i.e., the Emergency Basin, into the Combination Stream. The surface water routes, discharge points, and radiological impacts have been extensively investigated and are discussed in Volume I-Section 4 of the FEI.

Also, as part of the overall reconfiguration of storm water management, SFC constructed a sixteen acre (16) acre storm water retention pond in May 1991. This impoundment, known as the Storm Water Reservoir, was designed to collect storm water which discharges through Outfall 008 and facilitate a reduction of nutrient levels by biological processes prior to discharge. Permit modification requests to allow usage of the reservoir were made in September 1991, to both the OWRB (now DEQ) and the EPA Permits. The EPA has granted the necessary permit modification, however, the DEQ has not. Storm water from the outer portion of the process area continues to be discharged through Outfall 008 at its present location, which will continue until the permit modifications are granted by the DEQ. If DEQ grants the permit modification, Outfall 008 will move to a discharge point from the Storm Water Reservoir. Currently, the Storm Water Reservoir collects storm water from non-process areas.

Storm water runoff from the facility is monitored whenever runoff occurs as part of SFC's requirements under its EPA and DEQ permits. Results from monitoring under the two permits will be summarized in the Final Results Report.

2.1.7 Sediment

SFC has conducted extensive sampling of sediments in the Illinois River upstream and downstream of SFC at those locations described above for the surface water sampling. This monitoring remains part of the SFC monitoring program and is anticipated to continue throughout the decommissioning process as a requirement of SFC's NRC license conditions. The State of Oklahoma (DEQ) has been a participant in the sampling program for several years.

Sediments are also routinely sampled at two locations along the ephemeral stream which conveys discharges from SFC Outfalls 001 and 008 to the Robert S. Kerr Reservoir. These sediment sampling locations include a site at the Port Road Bridge and at the confluence of the effluent stream with the headwaters of the Robert S. Kerr Reservoir. Sediment samples within the Arkansas River are not required by the NRC license.

Additional studies have been conducted on sediments in the ephemeral stream which carried storm water from the facility to the Robert S. Kerr Reservoir. The results of these studies were reported in Section 4.4 of the Addendum to the FEI.

Results from all surface water sediment monitoring described above will be provided in the Final Results Report. Data will be limited to that collected since the UF6 facility shutdown in November of 1992, which is more representative of conditions existing today.

2.2 Characterization Plan

The purpose of the site characterization effort described in the SCP is to determine the extent and concentrations of licensed materials in the soil and other unconsolidated deposits. As noted in Section 1, the RFI will determine the nature and extent of releases of hazardous waste or hazardous constituents, and, for purposes of completeness, the SCP will also describe the investigation of areas where other chemical materials may be present. A significant number of soil, sediment and groundwater samples were collected and analyzed as part of the Facility Environmental Investigation (FEI) which was performed during 1990 and 1991. Data collected during the FEI meets the quality assurance and quality control requirements for site characterization. Appropriate sample collection, handling, preservation, chain-of-custody, and analytical protocols were used. Sampling results from the FEI area are therefore valid for site characterization. The results of this sampling effort have been evaluated and additional sampling locations selected as indicated. Subsurface contour plots and diagrams will be prepared as part of the characterization program.

A grid system was established for the Sequoyah Facility and was used for the assessment following the 1986 UF_6 release (see NUREG-1189, "Assessment of the Public Health Impact From Accidental Release of UF6 at the Sequoyah Fuels Corporation Facility at Gore, Oklahoma," Vol. 2, Appendix 5.2.7, Page 269, March 1986) and during the FEI performed by Roberts/Schornick and Associates, Inc. (see Facility Environmental Investigation, Vol. 1, July 31, 1991). The grid established is in feet with the southeast corner of Section 21 of T12N, R21E as the point on the grid system with coordinants N-10,000 and E-10,000. The N-10,000 line of the grid system lies along the section line (Highway 10). The plant process area and related facilities are within Section 21. This grid system will be used for reference purposes to designate the location of survey measurements and sample collection locations in all future sampling events or investigations. A third value may be used to designate depth from ground surface for subsurface soil samples.

SFC is in the process of conducting interviews with employees, both former and current, to help identify areas which may have been impacted by facility operations. Inquiries are being made regarding restricted area boundary changes, equipment and material storage locations, solid waste burial areas, and other structures or facility grounds and areas which may have become contaminated due to plant operations. The information obtained from the interviews will be reviewed and utilized for site characterization. For purposes of the SCP, the term "SCP Materials" is defined as licensed material and associated non-radiological constituents (i.e., nitrates or fluorides). Areas where SCP Materials may exist which have not been previously identified will be investigated, typically through collection of samples and performance of surveys.

Specific sampling locations will be selected through a combination of biased and random sampling. For example, a biased sample location may be selected after consideration of the process or operation which took place in the area and the likely location for SCP Materials to be present. This will be the primary type of sampling performed during the SCP effort. Random sampling will be utilized primarily when SFC believes that an area has been decontaminated or is not impacted. If SFC wishes to clear an area for unrestricted use, random sampling will be performed to demonstrate that the area does not contain licensed material above specified criteria.

Field Procedures

Characterization sampling and surveys are performed in order to identify potential residual radioactive materials, determine the general location and extent of activity, and estimate activity levels. General survey and sampling considerations are provided in this introduction. Specific information regarding the characterization surveys and sampling are included and will appear in approved site procedures. In order to select the appropriate media for sampling, the specific SCP Materials, the number of samples required and the sample locations, general guidance is provided for each unit.

Ponds/Basin Contents

The contents of each pond or basin will be sampled to determine the average concentration of the SCP Materials. The number of samples to be collected from each unit will be specified. Data from the FEI for two selected units indicates that the concentration of uranium is fairly uniform in each particular unit. Four (4) samples collected from the sanitary lagoon had uranium concentrations of 24,200; 10,700; 21,200; and 18,000 μg/g. For these four values the mean and standard deviation are 18,500 and 5800 μg/g, respectively. Three (3) samples collected from the emergency basin had uranium concentrations of 4700, 7900 and 6300 μg/g. For these three values the mean and standard deviation are 6300 and 1600 μg/g, respectively. As can be seen from these results the values are fairly consistent for each unit and indicate that an average of the values will be representative of the basin contents.

Another point to consider is how close the results are to a regulatory criteria or action level. The results for the two units provided above are above regulatory criteria or action levels which are currently approved by the NRC for unrestricted release of areas. Therefore, for characterization purposes, these materials may have to be controlled and disposed of in accordance with the approved plan for decommissioning of the facility. Only minimal, if any, additional sampling will be required for the contents of these units.

An evaluation will have to be performed for each pond/basin identified at the site to determine the appropriate sampling and analysis needs. If concentrations for sediments or sludges in a basin are at or near the regulatory criteria currently approved by NRC then statistical evaluations defined in NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination," or an equivalent methodology will be used to determine if enough samples have been collected and if the regulatory criteria have been satisfied.

The soils beneath each pond or basin will be sampled after the contents, sludge and sediments have been removed. Sampling locations will be selected on a random basis in accordance with the recommendations provided in NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination", or an equivalent methodology. This effort will not be completed until the ponds are empty. Therefore, as described in the Preliminary Plan for Completion of Decommissioning, SFC may issue a Preliminary Results Report, to be followed by an ac...ndum which will complete the Final Results Report.

Waste Burial Area Contents

Solid waste burial areas are difficult to characterize due to the physical nature of the materials which are contained in these areas. Samples often cannot be obtained using conventional subsurface soil sampling methods. A backhoe could be used to dig into the waste, however this exposes the waste to the environment and to workers performing the excavation. The most prudent form of sampling should involve the characterization of the media immediately surrounding the waste materials to evaluate the extent of migration from the cell. The boundaries of the burial areas should be defined and samples collected around the perimeter of the area. The primary focus of the initial characterization of these areas will be to determine if licensed material has migrated into the environmental media beyond the perimeter of the containment for the waste materials.

There are some burial areas, such as the CaF_2 sludge burials, where attempts could be made to evaluate the waste contents. Other materials such as drums mixed in with the sludge may make the sampling difficult to perform. Care will be taken not to drill or sample through the bottom of a basin, to preclude the potential creation of a pathway for a release to the environment. An investigation of these areas will also be made to determine if there are any physical indications of where excavations and burials may have been made. The findings of these investigations will be compared with the land survey information that defines the location of the excavation or burial.

Some information is available concerning solid waste burial area contents. Records were maintained describing the general types of wastes which were disposed of and the total activity of uranium which was disposed. Interviews were conducted with employees who have knowledge of the materials which were placed into the solid waste burial areas. Based on these interviews, the burial areas contain primarily scrap metal, old drums and miscellaneous equipment, with lesser quantities of lab samples and miscellaneous other items. There may be some asbestos in the solid waste burial areas since this material was used as insulation on piping and other equipment. Appropriate precautions for identification and handling asbestos will be taken.

Buildings, Structures, and Facilities

There have been routine surveys performed in buildings, structures and facilities for many years at the site. The results from these surveys were summarized and included in the Preliminary Plan for Completion of Decommissioning dated February 16, 1993, and in the Draft Preliminary Report - Description of Current Conditions and Investigations dated November 1, 1993. In general, the equipment in these facilities is contaminated with residual uranium and would require decontamination prior to release. The buildings will be dismantled as part of the decommissioning process and the materials generated disposed of in an on-site disposal cell, decontaminated for unrestricted release or shipped to an off-site licensed disposal facility.

The activity levels of licensed materials in structures and equipment will be characterized and reported in terms of maximum and average surface activities (fixed and removable) per 100 cm^2 and exposure rates. Radionuclide concentrations will also be determined on a mass basis (e.g. $\mu g/g$), activity basis (e.g. pCi/g) or volume basis (e.g. mg/l or pCi/l) where the radioactive material is present in gross quantities within equipment, such as tanks and conveyance systems. However, removal of bulk materials during deactivation of the facility should have reduced the amount of this material which will be present.

As part of the characterization process SFC will estimate the volume of the various types of material which will be generated when the facility is dismantled. This information will be used to provide estimates of the quantities of material which will be generated so that appropriate disposal alternatives are selected.

The main process building and other facilities may be subdivided into smaller areas for characterization purposes. There may also be areas or processes where unique situations exist which should be identified prior to the dismantlement activities. For example, if a pipe contained a significant amount of uranium - this must be considered during the demolition activity. Asbestos will be identified and appropriately handled during the decommissioning process. There may be other hazards, such as small amounts of UF_6 (UO_2F_2) left in a system, which may be a concern with respect to protection of workers. Oils containing PCB's have been noted to have leaked in some locations. Although cleanup was conducted, verification samples may be collected and analyzed in these areas.

Surface and Subsurface Soils

Surface and subsurface soil samples will be collected from areas which may have been impacted from facility operations. A preliminary review of data provided in the FEI indicates that the majority of the SCP Material exists in surface soils, rather than in subsurface soils. There is a significant quantity of data provided in the FEI. This data will be evaluated utilizing statistical methods provided in NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination" or an equivalent method. Judgement will be used when determining the number of samples required so that an excessive number of characterization samples are not collected. For example, if it is obvious that an area contains significant levels of licensed material, there is no need to collect additional samples. However, if an area is borderline with respect to the release criteria, an evaluation will be made of the number of samples that are required to provide the required degree of confidence that the area needs or does not need to be remediated.

Sampling results may also indicate the need to investigate an area further. Analysis of samples for additional parameters, collection of additional samples, or performance of a radiation survey may be indicated. A walkover survey using an appropriately sensitive system (e.g., NaI detector) to look for small areas where licensed material may be present may also be performed. This survey will be incorporated into the survey and sampling protocol for surface soil evaluations. Early identification of impacted areas will reduce the need to address these issues at the end of the decommissioning process. SFC's goal is to perform a comprehensive characterization of the site in order to minimize the number of surprises and findings during implementation of site remediation activities.

Borehole sampling will typically be performed to the water table or sample refusal at depth intervals specified for the location of interest. The depth of these borings will vary depending upon the extent of the licensed material, source of the licensed material and hydrogeologic conditions. Subsurface samples collected will be analyzed to determine the concentration of total uranium and in some cases, Ra-226 and/or Th-230.

Drainage Areas

The drainage areas west of the facility towards the headwaters of the Robert S. Kerr Reservoir contain some sediments with elevated concentrations of uranium, radium-226 and thorium-230. Previous sampling efforts have indicated sediment deposits are isolated and difficult to obtain, since the bed of these drainage areas is rough and irregular. Samples must be scraped up from in between cracks and crevices. The area is also very difficult to access due to the terrain, making it difficult to get any construction equipment or drilling rigs into the area. The deposits will be characterized to determine their solubility and potential to migrate into the water. These materials are likely very insoluble and will not migrate significantly. This information is required for characterization and evaluation of remediation options.

Estimation of the approximate volume of material which is deposited in stream beds will also be determined. A gamma survey utilizing a NaI(Tl) detector or other sensitive detector will be used to assist in the identification of the extent of contamination. Drainage areas will be carefully and systematically surveyed with a gamma detector. Locations of elevated readings will be documented for future sampling and characterization. Sampling locations will be referenced utilizing the facility grid system.

Background Samples and Survey

The criteria for acceptable levels of residual radioactivity at the SFC Facility following decommissioning will be presented in terms of radiation or activity levels above normal background. The survey will measure both direct radiation levels from soils and concentrations of the licensed material contaminants being characterized on site in soils, groundwaters, surface waters, and sediments. These background levels and concentrations will be determined by measurement and sampling at locations in the general vicinity of the site which are unaffected by site operations. The measurement and sample locations will be chosen such that the media sampled is the same as, or similar to, that found on site or downgradient of the site. The background survey will be performed using the same methodologies, techniques, and instrumentation as described for the on site characterization effort.

Analytical Testing

Samples will be analyzed for the constituents specified in accordance with standard laboratory procedures established for the facility. The analysis will be performed at SFC's laboratory or another laboratory capable of performing the analysis. Samples will be submitted to the laboratory using a standard chain-of-custody protocol. Samples will be stored in accordance with the guidance specified in approved procedures and will be analyzed for the constituents specified within the holding time specifications. Laboratory personnel performing the analysis will be trained and qualified to perform each analytical test specified. Samples will be disposed of in accordance with approved facility procedures.

QA/QC

Quality assurance and quality control practices are covered in detail in other sections and in the appendices to this document. The overall quality assurance objective is to ensure that sampling and analysis performed in association with the SCP is of acceptable quality. Sampling and analysis efforts will adhere to the QA/QC procedures outlined in the sampling plans and laboratory standard operating procedures. The QA/QC procedures cover most aspects of data collection including sample collection and preservation, custody of samples, data validation and recordkeeping and data management practices.

The laboratory performing the analyses will have a QA/QC program which specifies procedures and references to be used. As a minimum, the program will contain:

- Laboratory instrument calibration procedures and schedules,
- Specification of adherence to accepted test methods,
- Equipment inspection and servicing schedules,
- The regular use of standard or spiked sample analyses,
- Operator or analyst training procedures and schedules,

- A program of continuous review of results, procedures, and compliance with the QA/QC program, and

- Documentation of compliance with the program.

2.2.1 Unit Information and Sampling Requirements

The following information describes the sampling requirements for selected units. The unit designations and locations are shown in Figure 4 and are consistent with the unit assignments for the 28 units used in the FEI. The unit boundaries have been changed for some of the units and some new units have been added. Not all units will be sampled as part of the SCP. Some areas can be adequately characterized utilizing data obtained during the FEI and subsequent findings.

The primary radioactive constituents of interest at the Sequoyah Facility are uranium, thorium-230, and radium-226. Non-radioactive constituents of concern include nitrates and fluorides. Another factor which will be considered during the evaluation of the options available for disposition of soil is uranium solubility. A number of samples will be analyzed for uranium solubility. Other constituents, such as asbestos and PCBs will also be included for selected areas which may have been impacted.

The following notes are provided for clarification of certain sampling requirements specified in this section:

- The depth specified for hand auger sampling is five feet. The actual sampling depth will be five feet or to auger refusal if auger refusal occurs prior to reaching the five foot depth.

- The depth specified for bore hole sampling is twenty feet. The actual sampling depth will be twenty feet or to water, if the water table is less than 20 feet deep.

- Sample locations will be referenced using the facility grid system.

- Bore holes and other holes drilled for sample collection will be plugged using approved methods.

- Samples collected through concrete will be referenced to the base of the concrete slab. For example, collection of the 0-0.5 foot sample will begin at the surface of the material immediately beneath the concrete.

- Samples may not be collected from certain depths due to sample refusal during collection. Reasonable efforts will be made to obtain each sample specified, however if a sample cannot be obtained the reason will be documented and included with the written summary provided with the results.

- The unit number shown in parenthesis after the area description designates the unit within which the area falls

The following soils, sludges and sediment samples will be collected from the areas and units specified. This sampling effort will provide the results necessary to complete characterization of the soils, sludge and sediments. Additional sampling beyond that which is described here may be required to demonstrate that an area satisfies the requirements for release for unrestricted use.

2.2.1.1 Main Process Building Area (Unit 1)

Main Process Building Information

The Main Process Building (MPB), is located near the eastern edge of the industrial facility. The MPB is a four story metal building with approximately 95,000 sq.ft. on the ground floor. It is the largest building on the Site and contains the major UF_6 conversion processing operation, fluorine generation facilities, and utility and maintenance areas, administrative offices and a chemical process laboratory. Construction of the MPB began in 1968 and reached completion in 1969. The Plant began operation in 1970 and ceased in 1992. A thorough review of historical files, documents and interviews with past and present personnel provided a good understanding of processes and operating practices.

Main Process Building Sampling Requirements

For characterization purposes, the Main Process Building has been divided into several areas. Each of these areas is listed below, along with the number of samples required for that area. Several samples collected during the FEI will be reanalyzed.

Cell Room #1 - 1 location (1 FEI location)
Cell Room #2 - 2 locations
Maintenance Shop - 1 location (1 FEI location)
Warehouse - 2 locations
Sampling Plant - 2 locations
Process Lab - 0 locations (2 FEI locations)
Process Area (Main Plant) - 0 locations (11 FEI locations)

Hand auger samples will be collected from the surface to a depth of 5 feet. Cores must be drilled through the concrete floor prior to sample collection. Sample intervals will be 0 - 0.5, 0.5 - 1.0, 1.0 - 2.0, 2.0 - 3.0, 3.0 - 4.0 and 4.0 - 5.0 feet.

Samples from the 0 - 0.5, 1.0 - 2.0, and 4.0 - 5.0 intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(five samples with highest uranium concentration)
Ra-226	(five samples with highest uranium concentration)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, 2.0 -3.0, and 3.0 - 4.0 foot intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for the Main Process Building:

Total Number of Sample Locations:	8
Total Number of Samples Collected:	48
Total Number of Uranium Analyses:	41 (includes 17 reanalysis of FEI samples)
Total Number of Th-230 Analyses:	5
Total Number of Ra-226 Analyses:	5
Total Number of Nitrate Analyses:	24
Total Number of Fluoride Analyses:	24

Discussion:

Samples are needed from beneath the Main Process Building to evaluate the magnitude of SCP Material that may be present. Soil under the Cell Rooms, Maintenance Shop, Warehouse, and Process Lab should be minimally impacted. Soil under the Process Area probably would have been the most impacted area due to processing of uranium in this area and pathways which were present for contamination movement. The sand placed directly beneath the building during construction of the facility may provide a pathway for the movement of liquids which have seeped through the concrete.

The sampling prescribed will not be adequate to locate small areas that may have been impacted, such as seepage under a sump. These smaller impacted areas will be discovered and evaluated when the concrete floor is removed and excavation of impacted soils has begun. This sampling effort should provide a basis for evaluating the general impact to the area beneath the building.

Many of the samples collected under the FEI were analyzed for uranium using a method which had a detection capability of 400 ug/g. These samples have been secured since completion of the FEI. Some of the samples will be reanalyzed for uranium using a method with a much lower detection level, e.g. 5 ug/g. Several of these samples (five samples collected under the FEI from the process area) with higher uranium concentrations will be analyzed for Ra-226 and Th-230.

A review of samples collected during the FEI indicates that one sample location was between the cell rooms, one in the maintenance shop, two in the process lab and ten in the main process area.

Results from the FEI indicate the presence of licensed materials appears to be limited to the upper eight feet. However, since these samples were collected inside the building using a hand auger the depth was limited to 5 feet for most samples. In some areas auger refusal was encountered at a shallow depth. Samples greater than 5 feet were collected from the perimeter of building but not beneath the building.

Sanitary Sewer Line Information

Th Sanitary Sewer Line originates in the north part of the men's change room in the MPB and then runs west across the SX yard into the Sanitary Lagoon. The 6" clay pipe was laid during the original utilities construction before 1970. Some of the old clay sewer pipe was replaced with plastic pipe during excavation around the SX building's underground storage tanks.

Sanitary Sewer Line Sampling Requirements

Sample results from the Sanitary Lagoon should be representative of the presence of SCP Material in the Sanitary Sewer Line. A review of this data will be conducted for characterization of the Sanitary Sewer Line.

2.2.1.2 Solvent Extraction Building Area (Unit 2)

Solvent Extraction Building Area Information

The Solvent Extraction (SX) Building is a two story metal building approximately 80 feet by 50 feet. The building is located approximately 150 feet west of the MPB. Construction began in 1968 and was completed in 1969. Operations began in 1970 and ceased in 1992. The solvent extraction process involves the separation of uranium and impurities such as heavy metals using a hexane solvent and tributylphosphate to float the impurities for easier removal.

Solvent Extraction Building Area Sampling Requirements

The floor of the SX Building will be divided into quadrants for the purpose of sample collection. One sample will be taken from each quadrant. Sample locations will be evenly spaced, with allowances made for off-set due to obstructions.

Hand auger samples will be collected from the surface to a depth of 5 feet. Cores must be drilled through the concrete floor prior to sample collection. Sample intervals will be 0 - 0.5, 0.5 - 1.0, 1.0 - 2.0, 2.0 - 3.0, 3.0 - 4.0 and 4.0 - 5.0 feet.

Samples from the 0 - 0.5, 1.0 - 2.0, and 4.0 - 5.0 intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, 2.0 -3.0, and 3.0 - 4.0 foot intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for the Solvent Extraction Building:

Total Number of Sample Locations:	4
Total Number of Samples Collected:	24
Total Number of Uranium Analyses:	12
Total Number of Th-230 Analyses:	12
Total Number of Ra-226 Analyses:	12
Total Number of Nitrate Analyses:	12
Total Number of Fluoride Analyses:	12

Discussion:

Samples are needed from beneath the SX Building in order to evaluate the magnitude of SCP Material that may be present. Considering the size of this building, four samples should provide sufficient information to evaluate the general impact to this area. Small areas of impact may be missed in this effort. These areas, should they exist, will be discovered after removal of the concrete floor.

The SX Building area has a high probability of significant impact, based on previous samples collected from this area. Although samples were not collected from beneath the building during the FEI, many samples were collected from the yard area.

Contamination in the SX area appears to be limited to a depth of about ten feet. One sample exceeded 45 ug/g at a depth of 15 to 20 feet.

Cooling Tower Information

The Cooling Tower is located north of the SX Building and south of the North Ditch and was part of the original construction completed in 1969. The Cooling Tower is approximately 35 feet wide and 100 feet long and was designed to cool the process cooling water which was then recirculated to various heat exchangers throughout the facility. The equipment is made up of two basins, the hot side basin, and the equalization basin, used to keep a constant level in the process recirculation process.

Cooling Tower Sampling Requirements

Scale scrapings will be taken from two locations on the cooling tower and analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)

Summary of Sampling Requirements for the Cooling Tower:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	2
Total Number of Uranium Analyses:	2
Total Number of Th-230 Analyses:	2
Total Number of Ra-226 Analyses:	2

Discussion:

Cooling coils in the digest tanks or boildown tanks are believed to have developed leaks, allowing uranium to enter the cooling water and be taken to the Cooling Tower.

RCC Evaporator Information

The RCC evaporator is located north of the SX Building and west of the Cooling Tower and was built in 1980. The RCC evaporator stands atop a concrete pad which measures approximately 35 feet by 30 feet. The mechanical recompression evaporator is approximately 40 feet tall.

RCC Evaporator Sampling Requirements

Hand auger samples will be collected from the surface to a depth of 5 feet. Cores must be drilled through the concrete pad prior to sample collection. Sample intervals will be 0 - 0.5, 0.5 - 1.0, 1.0 - 2.0, 2.0 - 3.0, 3.0 - 4.0 and 4.0 - 5.0 feet.

Samples from the 0 - 0.5, 1.0 -2.0, and 4.0 - 5.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for the RCC Evaporator:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	12
Total Number of Uranium Analyses:	6
Total Number of Th-230 Analyses:	6
Total Number of Ra-226 Analyses:	6

Discussion:

Liquid has spilled into the concrete sump area from leaks and malfunctions. Soil under the concrete will be characterized with the sampling described above.

2.2.1.3 Initial Lime Neutralization Area (Unit 3)

Initial Lime Neutralization Area Information

The Initial Lime Neutralization Area is located southwest of the MPB and southeast of the South Yellowcake Sump. Lime neutralization was conducted in this area for a brief time after plant start up in 1970 and consisted of approximately 50 tons of crushed limestone. The limestone pile functioned as the initial neutralization for hydrogen fluoride scrubber wash water was discharged on top of the limestone pile until construction of the Fluoride Settling Basins was completed in 1971. Limestone would be replaced as the limestone dissolved. Upon completion of the Fluoride Settling Basins, the scrubber wash water was re-routed for neutralization through these Settling Basins, and the limestone in Unit 3 was spread and abandoned. Subsequently, the limestone and surrounding soil were removed in 1992 and placed in the Interim Storage Cell.

Initial Lime Neutralization Area Sampling Requirements

The Initial Lime Neutralization area will be divided in half and a sample taken from each end, near the center of each half.

Bore hole samples will be collected from the surface to a depth of 20 feet. Sample Intervals will be 0 - 0.5, 0.5 - 1.0 feet, and thereafter at every one foot interval.

Samples from the 0 - 0.5, 1.0 - 2.0, 4.0 - 5.0, 9.0 - 10.0, and 19.0 - 20.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface samples only)

Ra-226	(surface samples only)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for the Initial Lime Neutralization Area:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	42
Total Number of Uranium Analyses:	10
Total Number of Th-230 Analyses:	2
Total Number of Ra-226 Analyses:	2
Total Number of Nitrate Analyses:	10
Total Number of Fluoride Analyses:	10

Discussion:

Samples must be collected from the Initial Lime Neutralization Area in order to evaluate the magnitude of SCP Materials that may be in the area. The sampling described here should provide sufficient information to evaluate the general impact to the area. Significant soil remediation work has already been completed in this area.

Most of the samples collected during the FEI were collected from near the ground surface. Samples were not collected at a depth greater than four feet. Approximately 20 percent of the samples collected from the upper two feet of ground surface were greater than 45 ug/g uranium. This area has been remediated since the FEI sampling. Samples collected after this remediation will also be used for site characterization.

2.2.1.4 Surface Water, Entire Facility (Unit 4)

This unit was defined under the FEI for the purpose of addressing "surface water from the 85-acre facility, as well as surface water runoff exit points and outfalls." Surface water is addressed in other sections of the SCP and RFI Workplan and will not be described here.

2.2.1.5 Solid Waste Burial Area No. 1 (South) (Unit 5)

Solid Waste Burial Area No. 1 Information

The Solid Waste Burial Area No. 1 (South), is located north of the Emergency Basin and was operated from September, 1970 to January, 1981. The 0.6 acre burial area was used for disposal of approximately 51,115 cubic feet of low level radioactive waste materials such as equipment, drums, laboratory sample containers and other solids. The burial activity complied with state and federal regulations (10 CFR 20.304).

Solid Waste Burial Area No. 1 Sampling Requirements

Sampling the contents of the solid waste burial area would be difficult, due to the physical characteristics of this material. Therefore the impact to the soil surrounding the waste material will be evaluated by sampling around the perimeter of the burial area.

An EM survey will be conducted to define the dimensions of the burial area.

Eight locations will be sampled, three on each side at even spacings, and one on each end.

Bore hole samples will be collected from the surface to a depth of 20 feet. Sample intervals will be 0 - 0.5, 0.5 - 1.0 feet, and thereafter at every one foot interval.

Samples from the 0 - 0.5, 1.0 - 2.0, 4.0 - 5.0, 9.0 - 10.0, and 19.0 - 20.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for Solid Waste Burial Area No. 1:

Total Number of Sample Locations:	8
Total Number of Samples Collected:	168
Total Number of Uranium Analyses:	40
Total Number of Th-230 Analyses:	40
Total Number of Ra-226 Analyses:	40
Total Number of Nitrate Analyses:	40
Total Number of Fluoride Analyses:	40

Discussion:

Records, photographs, and interviews with long term employees have shown that a variety of equipment and materials were disposed of in this area. An evaluation should be made of the impact of these materials on the soils surrounding the burial area. The sampling described here should allow such an evaluation. Samples collected during the FEI were collected from the upper four feet. Some uranium of significance was measured at the two to four foot depth - out of the five samples collected in this range, two exceeded 45 ug/g. The additional sampling described here is needed to adequately characterize this area. In order to characterize the impact to the soils adjoining the waste the sample depths should be greater than four feet, since at least four feet of cover is believed to have been placed over the waste.

As mentioned above, due the nature of the contents of the burial area, it is not practical to sample within the materials.

2.2.1.6 Emergency Basin (Unit 6)

Emergency Basin Information

The Emergency Basin is located within the restricted area boundary just west of the North Ditch and north of the SX Building. The unlined basin has an estimated capacity of approximately 133,300 cubic feet. Unit 6 was constructed in 1969 to provide temporary storage of storm water runoff from process areas and secondary containment for accidental spills and upsets. In 1986, the basin collected wash water from the UF_6 release incident.

Emergency Basin Sampling Requirements

Sludge/sediment samples will be collected from four locations in the basin. The sample interval will be the depth of the sludge. For purposes of volume determinations, ten locations will be probed to determine the depth of the sludge.

Location of the samples will probably be one in each quadrant, and will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for the Emergency Basin:

Total Number of Sample Locations:	4
Total Number of Samples Collected:	4
Total Number of Uranium Analyses:	4
Total Number of Th-230 Analyses:	4
Total Number of Ra-226 Analyses:	4

Total Number of Nitrate Analyses:	4
Total Number of Fluoride Analyses:	4
Total Number of Locations to be probed for depth:	10

Discussion:

A boat will be used to collect the samples and probe the depth of the sludge/sediment. There is no need to sample the sludge at intervals since the concentration of uranium in the sludge is fairly uniform. The sample interval will be the depth of the sludge.

Three samples were collected of the top six inches of sludge during performance of the FEI. These concentrations were 4700, 7900 and 6300 ug/g of uranium.

Volume estimates will be made in order to evaluate options available for disposition of the sludge.

Sampling Requirements for the Soils Beneath the Emergency Basin

After the sediment has been removed from the Emergency basin, the basin bottom will have to be sampled for characterization purposes. The basin bottom will be divided into six equal segment and samples collected from the center of each segment. Samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface sample for each location)
Ra-226	(surface sample for each location)
Nitrate	(all samples)
Fluoride	(all samples)

Hand auger samples will be collected from intervals of 0 - 0.5 ft., 0.5 - 1.0 ft., and at one foot intervals thereafter to a depth of five feet.

Samples from the 0 - 0.5 ft., 0.5 - 1.0 ft., 2.0 -3.0 ft., and 4.0 - 5.0 ft. interval will be analyzed for total uranium, thorium-230, radium-226, nitrates, and fluorides. The remaining samples collected will be secured and saved for later analysis if necessary.

Total Number of Sample Locations:	6
Total Number of Samples Collected:	36
Total Number of Uranium Analyses:	24
Total Number of Th-230 Analyses:	6
Total Number of Ra-226 Analyses:	6
Total Number of Nitrate Analyses:	24
Total Number of Fluoride Analyses:	24

2.2.1.7 Sanitary Lagoon (Unit 7)

Sanitary Lagoon Information

The Sanitary Lagoon, is located northwest of the SX Building and south of the Emergency Basin and was built in 1971. The lagoon is used for microbiological oxidation of sanitary waste water from lavatories, showers, and laundry facilities. The lagoon is approximately 230 feet by 150 feet and eight (8) feet deep, with a capacity of approximately 129,000 cubic feet. The water in the lagoon is treated and discharged via a permitted outfall into the Combination Stream Drain.

Sanitary Lagoon Sampling Requirements

Sludge/sediment samples will be collected from four locations in the lagoon. The sample interval will be the depth of the sludge.

For purposes of volume determinations, ten locations will be probed to determine the depth of the sludge.

Location of the samples will probably be one in each quadrant, and will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(two samples collected from the locations with the highest uranium concentration)
Ra-226	(two samples collected from the locations with the highest uranium concentration)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for the Sanitary Lagoon:

Total Number of Sample Locations:	4
Total Number of Samples Collected:	4
Total Number of Uranium Analyses:	4
Total Number of Th-230 Analyses:	2
Total Number of Ra-226 Analyses:	2
Total Number of Nitrate Analyses:	4
Total Number of Fluoride Analyses:	4
Total Number of Locations to be Probed for depth:	10

Discussion:

Uranium from the washing of contaminated clothing in the laundry has impacted the sanitary lagoon.

A boat will be used to collect the samples and probe the depth of the sludge/sediment. Concentrations of radionuclides in the sludge are fairly uniformly distributed throughout the sludge. The sample interval will be the depth of the sludge.

Four samples of sanitary sludge were collected during the FEI, with results of 24,200; 10,700; 21,200 and 18,000 ug/g uranium.

Volume estimates will be made in order to provide data for the evaluation of options available for disposition of the sludge.

Sampling Requirements for Soils Beneath the Sanitary Lagoon

After the sludge and sediment has been removed from the Sanitary Lagoon, the bottom of the lagoon will be sampled. The lagoon bottom will be divided into six equal segments and samples collected from the center of each segment. Samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface sample for each location)
Ra-226	(surface sample for each location)
Nitrate	(all samples)
Fluoride	(all samples)

Hand auger samples will be collected from intervals of 0 - 0.5 ft., 0.5 - 1.0 ft., and at one foot intervals thereafter to a depth of five feet.

Samples from the 0 - 0.5 ft., 0.5 - 1.0 ft., 2.0 -3.0 ft., and 4.0 - 5.0 ft. interval will be analyzed for total uranium, thorium-230, radium-226, nitrates, and fluorides. The remaining samples collected will be secured and saved for later analysis if necessary.

Total Number of Sample Locations:	6
Total Number of Samples Collected:	36
Total Number of Uranium Analyses:	24
Total Number of Th-230 Analyses:	6
Total Number of Ra-226 Analyses:	6
Total Number of Nitrate Analyses:	24
Total Number of Fluoride Analyses:	24

2.2.1.8 Pond 1 Spoils Pile (Unit 8)

Pond 1 Spoils Pile Information

The Pond 1 Spoils Pile is located west of the Emergency Basin and Sanitary Lagoon. This area consists of residual clays removed from the old raffinate Pond 1 during construction of Clarifier A in May 1980. The spoils pile area measures approximately 400 feet by 50 feet and approximately 15 foot deep, consisting of approximately 16,200 cubic yards of Pond 1 residual material and cover soil.

Pond 1 Spoils Pile Sampling Requirements

Samples will be collected from two (2) locations in the pond spoils pile. The sample locations will be at 100 foot spacings down the center of the area.

Bore hole samples will be collected from the surface to a depth of 20 feet. Sample intervals will be 0 - 0.5, 0.5 - 1.0 feet, and thereafter at every one foot interval.

Samples from the 0 - 0.5, 1.0 - 2.0, 4.0 - 5.0, 9.0 - 10.0, and 19.0 - 20.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored, for future analysis, if needed.

Summary of Sampling Requirements for the Pond 1 Spoils Pile:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	42
Total Number of Uranium Analyses:	10
Total Number of Th-230 Analyses:	10
Total Number of Ra-226 Analyses:	10
Total Number of Nitrate Analyses:	10
Total Number of Fluoride Analyses:	10

Discussion:

Samples collected during performance of the FEI were collected around the perimeter of the spoils pile and not collected from through the pile. However, fifty-nine samples were collected during 1987 from the pile at eight locations to a depth of four feet. These samples were analyzed for nitrates, radium-226, thorium-230 and uranium-238. Two locations with sample collection to a depth of 20 feet will provide information on the SCP Materials through and beneath the pile.

2.2.1.9 North Ditch (Unit 9)

North Ditch Information

The North Ditch is located immediately east of the Emergency Basin and west of the Incinerator. This retention basin was built in 1972 when an additional section was added to the east side of the Emergency Basin retaining dike to add a greater holding capacity for storm water. The North Ditch is triangular in shape with an estimated capacity of 12,500 cubic feet. Water that is collected in the North Ditch is managed and discharged via the Combination Stream Drain permitted outfall.

North Ditch Sampling Requirements

Sludge/sediment samples will be collected from four locations in the North Ditch. The sample interval will be the depth of the sludge.

For purposes of volume determinations, ten locations will be probed to determine the for depth of the sludge.

A sample will be collected from each quadrant and analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for the North Ditch:

Total Number of Sample Locations:	4
Total Number of Samples Collected:	4
Total Number of Uranium Analyses:	4
Total Number of Th-230 Analyses:	4
Total Number of Ra-226 Analyses:	4
Total Number of Nitrate Analyses:	4
Total Number of Fluoride Analyses:	4
Total Number of Locations to be Probed for depth:	10

Discussion:

Part of the North Ditch has been filled with silt, therefore the as-built configuration will have to be determined. A boat may be required to collect the samples and probe the depth of the sludge/sediment. The sample interval will be the depth of the sludge.

Samples were collected from 2 locations at intervals of 0 - 0.5 feet during the FEI. These samples are not adequate to characterize the sludge. Collection of an additional four samples through the depth of sludge should provide the necessary information.

Volume estimates will be made in order to provide data for the evaluation of options available for disposition of the sludge.

Sampling Requirements for Soils Beneath the North Ditch

After the sediment has been removed from the North Ditch, the bottom will be sampled. The ditch bottom will be divided into four segments and samples collected from the center of each segment. Samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface sample for each location)
Ra-226	(surface sample for each location)
Nitrate	(all samples)
Fluoride	(all samples)

Hand auger samples will be collected from intervals of 0 - 0.5 ft., 0.5 - 1.0 ft., and at one foot intervals thereafter to a depth of five feet.

Samples from the 0 - 0.5 ft., 0.5 - 1.0 ft., 2.0 -3.0 ft., and 4.0 - 5.0 ft. interval will be analyzed for total uranium, thorium-230, ra-226, nitrates, and fluorides. The remaining samples collected will be secured and saved for later analysis if necessary.

Total Number of Sample Locations:	4
Total Number of Samples Collected:	24
Total Number of Uranium Analyses:	16
Total Number of Th-230 Analyses:	4
Total Number of Ra-226 Analyses:	4
Total Number of Nitrate Analyses:	16
Total Number of Fluoride Analyses:	16

2.2.1.10 Contaminated Equipment Area (Unit 10)

Incinerator Area Information

The Incinerator is located to the east of the North Ditch and was built in 1970. The open-pit Incinerator is approximately 15 feet by 15 feet by 20 feet high and is a fully enclosed wire cage with a concrete sump, open on one end for ash removal. It has been used to burn non-radioactive combustibles such as boxes, crates, paper and rags. Rainwater that collects in the incinerator pit is pumped into the North Ditch. The ash was usually drummed and disposed of on-site.

Incinerator Sampling Requirements

Two sample locations have been selected for characterization of the soil around the incinerator, one on the northeast and one on the southwest corner.

Bore hole samples will be collected from the surface to a depth of 20 feet. Sample intervals will be 0 - 0.5, 0.5 - 1.0 feet, and thereafter at every one foot interval.

Samples from the 0 - 0.5, 1.0 - 2.0, 4.0 - 5.0, 9.0 - 10.0, and 19.0 - 20.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface samples only)
Ra-226	(surface samples only)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for the Incinerator:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	42
Total Number of Uranium Analyses:	10
Total Number of Th-230 Analyses:	2
Total Number of Ra-226 Analyses:	2
Total Number of Nitrate Analyses:	10
Total Number of Fluoride Analyses:	10

Discussion:

The ash in the incinerator will be evaluated when removed. For characterization at this point, evaluation of the impact of operation of the incinerator, if any, on the soil around the incinerator is needed. Another source of SCP Materials could be the handling of ash receivers in the area in the early 1970's. The sampling described here should accomplish the evaluation.

Solid Waste Building Information

The Solid Waste Building is located east of the North Ditch and south of the Incinerator. The metal building was built in 1989 and is approximately 30 feet by 50 feet. The building provides an enclosed area to sort trash and compact low level radioactive waste for shipment off-site.

Solid Waste Building Sampling Requirements

To aid in characterization of this area, two locations outside the building and as close to the building as possible, will be sampled. One will be on the west and the other on the south side.

Bore hole samples will be collected from the surface to a depth of 20 feet. Sample Intervals will be 0 - 0.5, 0.5 - 1.0 feet, and thereafter at every one foot interval.

Samples from the 0 - 0.5, 1.0 - 2.0, 4.0 - 5.0, 9.0 - 10.0, and 19.0 - 20.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface samples only)
Ra-226	(surface samples only)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for the Solid Waste Building:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	42
Total Number of Uranium Analyses:	10
Total Number of Th-230 Analyses:	2
Total Number of Ra-226 Analyses:	2
Total Number of Nitrate Analyses:	10

Total Number of Fluoride Analyses: 10

Discussion:

For characterization at this point, evaluation of amounts of SCP Material in soil around the solid waste building is needed. The sampling described here should accomplish the evaluation.

Uranium contamination in this area appears to be limited to near the ground surface. Samples collected during completion of the FEI indicate an average concentration in the top two feet of soil of 1190 ug/g, with 40 of 51 samples collected from this depth interval exceeding 45 ug/g uranium. Of the 45 samples collected below a depth of 4 feet, none exceeded 45 ug/g. The surface contamination identified in the area is consistent with reports that radioactive contaminated items were stored in this area.

2.2.1.11 Drainage Areas Around Emergency Basin and North Ditch (Unit 11)

Drainage Areas Around Emergency Basin and North Ditch Information

This unit includes the drainage areas around the emergency basin and north ditch.

Drainage Areas Around Emergency Basin and North Ditch Sampling Requirements

A significant number of samples were collected from this area during completion of the FEI. The results from the FEI are adequate to characterize this area. No additional sampling is required during site characterization.

2.2.1.12 Fluoride Holding Basin No. 2 (North) (Unit 12)

Fluoride Holding Basin No. 2 Information

Fluoride Sludge Holding Basin No. 2 is located in the northwest corner of the facility west of Solid Waste Burial Area No. 2 and north of the Pond 1 Spoils Pile. The 150 foot by 220 foot by nine (9) foot clay-lined basin was built in 1985 to store CaF_2 sludge from the lime neutralization process. The basin's estimated capacity is 201,000 cubic feet. After settling occurs the water is decanted and transferred to the Fluoride Clarifier. The basin was originally hypalon-lined and temporarily used upon completion for storing raffinate. The raffinate was transferred to the Clarifiers and the liner was removed and has been storing the fluoride sludge since.

Fluoride Holding Basin No. 2 Sampling Requirements

To aid in characterization of this area, sludge/sediment samples will be collected from two locations in the basin. A sample will be collected at each location over the depth interval of the sludge. For purposes of volume determinations, ten locations will be probed to determine the depth of the sludge.

Samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(one sample collected from the location with the highest uranium concentration)
Ra-226	(one sample collected from the location with the highest uranium concentration)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for Fluoride Holding Basin No.2:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	2
Total Number of Uranium Analyses:	2
Total Number of Th-230 Analyses:	1
Total Number of Ra-226 Analyses:	1
Total Number of Nitrate Analyses:	2
Total Number of Fluoride Analyses:	2
Total Number of Locations to be Probed for depth:	5

Discussion:

A boat will be used to collect the samples and probe the depth of t..e sludge/sediment.

No samples of sludge from this basin were collected during performance of the FEI. Sludge samples were collected in 1993 for TCLP and radionuclide analysis.

Volume estimates will be made in order to provide data for the evaluation of options available for disposition of the sludge.

Sampling Requirements for Soils Beneath Fluoride Basin No. 2

After the sludge has been removed from the basin, the basin bottom will be divided into four quadrants, and samples collected from the center of each quadrant and analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface sample for each location)
Ra-226	(surface sample for each location)

Nitrate	(all samples)
Fluoride	(all samples)

Hand auger samples will be collected from intervals of 0 - 0.5 ft., 0.5 - 1.0 ft., and at one foot intervals thereafter to a depth of five feet.

Samples from the 0 - 0.5 ft., 0.5 - 1.0 ft., 2.0 -3.0 ft., and 4.0 - 5.0 ft. interval will be analyzed for total uranium, thorium-230, radium-226, nitrates, and fluorides. The remaining samples collected will be secured and saved for later analysis if necessary.

Total Number of Sample Locations:	4
Total Number of Samples Collected:	24
Total Number of Uranium Analyses:	16
Total Number of Th-230 Analyses:	4
Total Number of Ra-226 Analyses:	4
Total Number of Nitrate Analyses:	16
Total Number of Fluoride Analyses:	16

2.2.1.13 Fluoride Holding Basin No. 1 (South) (Unit 13)

Fluoride Holding Basin No. 1 Information

Fluoride Sludge Holding Basin No.1 is located south of the Fluoride Settling Basins. The holding basin was constructed in 1981 to hold calcium fluoride (CaF_2) sludge generated from the Lime Neutralization Area. Prior to 1981, CaF_2 sludge had been buried in pits. Due to changes in regulations prohibiting the burial of process sludges, Holding Basin No.1 was built. The CaF_2 process stream originates at the lime treatment area where HF scrubber water and spent process laboratory chemicals are neutralized with lime (calcium oxide). This material flows to the Settling Basins (Unit 14). When these basins become full, the sludge is transferred to one of the two holding basins. Basin 1 measures 190 feet by 130 feet by 16 feet deep, with an estimated capacity of 186,800 cubic feet.

Fluoride Holding Basin No. 1 Sampling Requirements

To aid in the characterization of this area, sludge/sediment samples will be collected from two locations in the basin. The sample interval will be the depth of the sludge. For purposes of volume determinations, ten locations will be probed to determine the depth of the sludge.

The samples will be analyzed for the following constituents:

Uranium	(all samples)

Th-230	(one sample collected from the location with the highest uranium concentration)
Ra-226	(one sample collected from the location with the highest uranium concentration)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for Fluoride Basin No.1):

Total Number of Sample Locations:	2
Total Number of Samples Collected:	2
Total Number of Uranium Analyses:	2
Total Number of Th-230 Analyses:	1
Total Number of Ra-226 Analyses:	1
Total Number of Nitrate Analyses:	2
Total Number of Fluoride Analyses:	2
Total Number of Locations to be Probed for depth:	5

Discussion:

A boat will be used to collect the samples and probe the depth of the sludge/sediment.

No samples of sludge were collected from this basin during performance of the FEI.

Volume estimates will be made in order to provide data for the evaluation of options available for disposition of the sludge.

Sampling Requirements for Soils Beneath Fluoride Basin No. 1

After the sludge has been removed from the basin, the basin bottom will be divided into four quadrants, and samples collected from the center of each quadrant and analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface sample for each location)
Ra-226	(surface sample for each location)
Nitrate	(all samples)
Fluoride	(all samples)

Hand auger samples will be collected from intervals of 0 - 0.5 ft., 0.5 - 1.0 ft., and at one foot intervals thereafter to a depth of five feet.

Samples from the 0 - 0.5 ft., 0.5 - 1.0 ft., 2.0 -3.0 ft., and 4.0 - 5.0 ft. interval will be analyzed for total uranium, thorium-230, ra-226, nitrates, and fluorides. The remaining samples collected will be secured and saved for later analysis if necessary.

Total Number of Sample Locations:	4
Total Number of Samples Collected:	24
Total Number of Uranium Analyses:	16
Total Number of Th-230 Analyses:	4
Total Number of Ra-226 Analyses:	4
Total Number of Nitrate Analyses:	16
Total Number of Fluoride Analyses:	16

2.2.1.14 Fluoride Clarifier and Settling Basins (South) (Unit 14)

Fluoride Clarifier and Settling Basin Information

The Fluoride Clarifier and Settling Basins, are located to the west of the Fluoride Sludge Burial Areas and to the south of the Clarifier Basins. This unit consists of three (3) separate basins built in 1971. Each basin is approximately fourteen (14) feet deep. The western-most basin, known as the clarifier, measures 220 feet long by 85 feet wide, and the two eastern basins, called the settling basins, measure 190 feet long by 75 feet wide. The estimated capacities are 102,100 cubic feet (clarifier) and 46,800 cubic feet (each settling basin). The settling basins were designed to allow CaF_2 solids from the lime neutralization process to settle. After the solids settle, the liquid was decanted and flowed to the Fluoride Clarifier. Liquid from this basin was then routed to the NPDES permitted outfall, the Combination Stream Drain. None of the these basins are lined.

Fluoride Clarifier Sampling Requirements

To aid in characterization of this area, sludge/sediment samples will be collected from two locations in the basin. The sample interval will be the depth of the sludge. For purposes of volume determinations, ten locations will be probed to determine the depth of the sludge.

The samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(one sample collected from the location with the highest uranium concentration)
Ra-226	(one sample collected from the location with the highest uranium concentration)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for the Fluoride Clarifier:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	2
Total Number of Uranium Analyses:	2
Total Number of Th-230 Analyses:	1
Total Number of Ra-226 Analyses:	1
Total Number of Nitrate Analyses:	2
Total Number of Fluoride Analyses:	2
Total Number of Locations to be Probed for depth:	5

Discussion:

A boat will be used to collect the samples and probe the depth of the sludge/sediment.

No samples of sludge were collected from this basin during performance of the FEI.

Volume estimates will be made in order to provide data for the evaluation of options available for disposition of the sludge.

Fluoride Settling Basin No. 1 (North) Sampling Requirements

To aid in characterization of the area, sludge/sediment samples will be collected from two locations in the basin. The sample interval will be the depth of the sludge. For purposes of volume determinations, ten locations will be probed to determine the depth of the sludge.

The samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(one sample with highest uranium concentration)
Ra-226	(one sample with highest uranium concentration)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for Fluoride Settling Basin No.1:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	2
Total Number of Uranium Analyses:	2
Total Number of Th-230 Analyses:	1
Total Number of Ra-226 Analyses:	1
Total Number of Nitrate Analyses:	2

Total Number of Fluoride Analyses:	2
Total Number of Locations to be Probed for depth:	10

Discussion:

A boat will be used to collect the samples and probe the depth of the sludge/sediment.

No samples of sludge were collected from this basin during performance of the FEI.

Volume estimates will be made in order to provide data for the evaluation of options available for disposition of the sludge.

Fluoride Settling Basin No. 2 (South) Sampling Requirements

To aid in characterization of the area, sludge/sediment samples will be collected from two locations in the basin. The sample interval will be the depth of the sludge. For purposes of volume determinations, ten locations will be probed for depth to sludge.

The samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(one sample collected from the location with the highest uranium concentration)
Ra-226	(one sample collected from the location with the highest uranium concentration)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for Fluoride Settling Basin No.2:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	2
Total Number of Uranium Analyses:	2
Total Number of Th-230 Analyses:	1
Total Number of Ra-226 Analyses:	1
Total Number of Nitrate Analyses:	2
Total Number of Fluoride Analyses:	2
Total Number of Locations to be Probed for depth:	5

Discussion:

A boat will be used to collect the samples and probe the depth of the sludge/sediment.

No samples of sludge were collected during performance of the FEI.

Volume estimates will be made in order to provide data for the evaluation of options available for disposition of the sludge.

Sampling Requirements for Soils Beneath Fluoride Clarifier Basin and Fluoride Settling Basins 1 and 2

After the sludge has been removed from these areas, the basin bottoms will be sampled. Based on the size and configuration of these basins, samples will be collected from three locations in each basin. The sample locations will be evenly spaced down the center of the basin. Samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface sample for each location)
Ra-226	(surface sample for each location)
Nitrate	(all samples)
Fluoride	(all samples)

Hand auger samples will be collected from intervals of 0 - 0.5 ft., 0.5 - 1.0 ft., and at one foot intervals thereafter to a depth of five feet.

Samples from the 0 - 0.5 ft., 0.5 - 1.0 ft., 2.0 -3.0 ft., and 4.0 - 5.0 ft. interval will be analyzed for total uranium, thorium-230, ra-226, nitrates, and fluorides. The remaining samples collected will be secured and saved for later analysis if necessary.

Total Number of Sample Locations:	9
Total Number of Samples Collected:	54
Total Number of Uranium Analyses:	36
Total Number of Th-230 Analyses:	9
Total Number of Ra-226 Analyses:	9
Total Number of Nitrate Analyses:	36
Total Number of Fluoride Analyses:	36

2.2.1.15 Fluoride Sludge Burial Areas (Unit 15)

Fluoride Sludge Burial Areas Information

The Fluoride Sludge Burial Areas, is located directly east and south of the Fluoride Settling Basins and was used prior to 1981 for the burial of CaF_2 sludge. These consist of three (3) distinct sections. The northern section measures approximately 100 feet by 200 feet and was filled in two phases, known as the West Pit and the East Pit. Burial occurred in the West Pit in September, 1978, and in the East Pit in December, 1979. The second section is located directly south of the East and West Pits and measures approximately 50 feet by 275 feet. It is divided into Pit 3 and Pit 4. Burial occurred in Pit 3 in December, 1980, and in Pit 4 in January, 1981. The third section is located at the southwest corner of the area and contains CaF_2 sludge that has not been buried and is currently used for the retention of sludge. None of these areas are lined. An analysis compiled by SFC in January 1985 of waste burials included the CaF_2 sludge. The calculated results indicated that approximately 96,830 cubic feet of CaF_2 sludge had been buried.

Fluoride Sludge Burial Area Sampling Requirements

Calcium fluoride sludge is buried in these three areas. The soil surrounding the area will be evaluated to determine if there are any impacts. To aid in characterization, a total of ten locations will be sampled in these three areas. The area around the burial pits will be characterized by sampling locations around the perimeter of the pits as follows:

- 2 - West side of Northern Area - East & West Pits
- 2 - East side of Northern Area - East & West Pits
- 2 - South side of Northern Area (also serves as 2 for North side of Southeast Area - Pit 3 and Southeast Area - Pit 4)
- 1 - East side of Southeast Area - Pit 3
- 3 - South side of Southeast Area - Pit 3 and Southeast Area - Pit 4

Bore hole samples will be collected from the surface to a depth of 20 feet. Sample Intervals will be 0 - 0.5, 0.5 - 1.0 feet, and thereafter at every one foot interval.

Samples from the 0 - 0.5, 1.0 - 2.0, 4.0 - 5.0, 9.0 - 10.0, and 19.0 - 20.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(5 samples with highest uranium concentration)
Ra-226	(5 samples with highest uranium concentration)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved, stored, and analyzed if needed for additional information.

Summary of Sampling Requirements for Fluoride Sludge Burial Areas:

Total Number of Sample Locations:	10
Total Number of Samples Collected:	210
Total Number of Uranium Analyses:	50
Total Number of Th-230 Analyses:	5

Total Number of Ra-226 Analyses:	5
Total Number of Nitrate Analyses:	50
Total Number of Fluoride Analyses:	50

Discussion:

Information from other calcium fluoride sludge sampling, historical records of the burial, and knowledge of the process will be used to characterize the buried sludge. The sampling describe above should allow an evaluation of the impact of SCP Material on the soil around the sludge burial pits.

Only a few samples were collected from this area during performance of the FEI. Additional samples are needed to complete the characterization of this area.

Two locations from the southwest fluoride sludge burial area will be sampled. Sludge/sediment samples will be collected. The sample interval will be the depth of the sludge. For purposes of volume determinations, ten locations will be probed for depth to sludge.

Samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(one sample collected from the location with the highest uranium concentration)
Ra-226	(one sample collected from the location with the highest uranium concentration)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for Fluoride Sludge (Southwest Area):

Total Number of Sample Locations:	2
Total Number of Samples Collected:	2
Total Number of Uranium Analyses:	2
Total Number of Th-230 Analyses:	1
Total Number of Ra-226 Analyses:	1
Total Number of Nitrate Analyses:	2
Total Number of Fluoride Analyses:	2
Total Number of Locations to be Probed for depth:	5

Discussion:

A boat will be used to collect the samples and probe the depth of the sludge/sediment.

No sludge samples were collected during completion of the FEI.

Volume estimates will be made in order to provide data for the evaluation of options available for disposition of the sludge.

Sampling Requirements for Soils Beneath Fluoride Sludge Basin

Based on the size of this basin, samples will be collected from three locations evenly spaced down the center of the basin, after the sludge has been removed. Samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface sample for each location)
Ra-226	(surface sample for each location)
Nitrate	(all samples)
Fluoride	(all samples)

Hand auger samples will be collected from intervals of 0 - 0.5 ft., 0.5 - 1.0 ft., and at one foot intervals thereafter to a depth of five feet.

Samples from the 0 - 0.5 ft., 0.5 - 1.0 ft., 2.0 -3.0 ft., and 4.0 - 5.0 ft. interval will be analyzed for total uranium, thorium-230, ra-226, nitrates, and fluorides. The remaining samples collected will be secured and saved for later analysis if necessary.

Total Number of Sample Locations:	3
Total Number of Samples Collected:	18
Total Number of Uranium Analyses:	12
Total Number of Th-230 Analyses:	3
Total Number of Ra-226 Analyses:	3
Total Number of Nitrate Analyses:	12
Total Number of Fluoride Analyses:	12

2.2.1.16 South Yellowcake Sump (Unit 16)

South Yellowcake Sump Information

The South Yellowcake Sump is located directly south of the southwest corner of the Yellowcake Storage Pad and was built in 1979. The unit is constructed of concrete and measures 75 feet by 75 feet by eight (8) feet deep. It receives surface water runoff from the Yellowcake Pad (Unit 21).

South Yellowcake Sump Sampling Requirements

The sediment in the South Yellowcake Sump will be sampled at two locations for purposes of characterization. The depth of the sediment will be probed at up to ten locations for purposes of volume determinations. The sample depth will be the depth of the sludge.

Samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(one sample collected from the location with the highest uranium concentration)
Ra-226	(one sample collected from the location with the highest uranium concentration)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for the South Yellowcake Sump:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	2
Total Number of Uranium Analyses:	2
Total Number of Th-230 Analyses:	1
Total Number of Ra-226 Analyses:	1
Total Number of Nitrate Analyses:	2
Total Number of Fluoride Analyses:	2
Total Number of Locations to be Probed for depth:	5

Discussion:

The sampling described here will allow evaluation of the amounts of SCP Material in the sediment in the South Yellowcake Sump. Probing the depth of the sludge will provide sufficient information, along with the dimensions of the sump, to calculate the volume of the sediment and the amount of uranium present.

2.2.1.17 Clarifier A Basin Area (Unit 17)

Clarifier A Basin Area Information

The Clarifier Basins are located directly north of the Fluoride Settling Basins and east of Pond 2. The unit consists of four (4) clay and hypalon-lined ponds, each measuring approximately 250 feet by 200 feet by thirteen (13) feet deep. The Clarifiers received raffinate from the solvent extraction process. The raffinate was treated within these ponds in series with ammonium and barium to precipitate metals and radionuclides. A raffinate sludge by-product accumulates in the bottom of these ponds. The treated ammonium nitrate solution, which has to meet stringent license conditions before it can be transferred, would be transferred by above ground pipeline south to the Ammonium Nitrate Lined Ponds. The Raffinate sludge by-product was sent to New Mexico for uranium recovery. Currently, the raffinate sludges from Pond 4 are being transferred back to the Clarifiers where sludge loadout and processing occurs.

Clarifier A Basin Area Sampling Requirements

Basin 1 is being filled with sludge from the other basins and from Pond 4. Basins 2 and 4 will be cleaned before this sampling plan is implemented, so it is not reasonable to establish sampling requirements. Basin 3 has been cleaned recently (no sludge), therefore sampling of sludge is not possible. Samples from Basin 1 will be representative of sludge which may accumulate in the basins in the future and the analyses used for the characterization of Basins 2, 3, and 4, as well as for Basin 1. For characterization purposes, sludge/sediment samples will be collected from two locations in the basin. The sample interval will be the depth of the sludge. For purposes of volume determinations, ten locations will be probed for depth to sludge.

Samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for Basin 4 of Clarifier A:

Total Number of Sample Locations:	4
Total Number of Samples Collected:	4
Total Number of Uranium Analyses:	4
Total Number of Th-230 Analyses:	4
Total Number of Ra-226 Analyses:	4
Total Number of Nitrate Analyses:	4
Total Number of Fluoride Analyses:	4
Total Number of Locations to be Probed for depth:	10

Discussion:

A boat will be used to collect the samples and probe the depth of the sludge/sediment.

Volume estimates will be made in order to provide data for the evaluation of options available for disposition of the sludge.

Sampling Requirements for Soils Beneath Clarifier A, Basins 1 - 4

After all sediment and sludge has been removed, each basin will be divided into four quadrants and samples collected from the center of each quadrant, and analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Hand auger samples will be collected from intervals of 0 - 0.5 ft., 0.5 - 1.0 ft., and at one foot intervals thereafter to a depth of five feet.

Samples from the 0 - 0.5 ft., 0.5 - 1.0 ft., 2.0 -3.0 ft., and 4.0 - 5.0 ft. interval will be analyzed for total uranium, thorium-230, radium-226, nitrates, and fluorides. The remaining samples collected will be secured and saved for later analysis if necessary.

Total Number of Sample Locations:	16
Total Number of Samples Collected:	96
Total Number of Uranium Analyses:	64
Total Number of Th-230 Analyses:	64
Total Number of Ra-226 Analyses:	64
Total Number of Nitrate Analyses:	64
Total Number of Fluoride Analyses:	64

This sampling would be best accomplished if the basin bottoms were dry. Accumulated rain water may have to be pumped to the basin to be sampled last in order to achieve this condition. Rain water from the last basin to be sampled will be pumped to a location determined at that time, based on facility status.

New BaCl Mixing Area (WPC Building) Information

The New BaCl Mixing Area (WPC Building) is located south of the Clarifiers and is approximately 21 feet by 26 feet in size and was built in 1982. The metal building was originally built to house a research project that attempted to solidify raffinate sludge in asphalt (WPC Project). The experiment lasted for less than 1 year and afterwards the building was used for storage until 1992. This building is now used for mixing BaCl for raffinate treatment.

New BaCl Mixing Area (WPC Building) Sampling Requirements

For characterization of this area, two locations will be sampled. Sampling will be done outside the building, at the back and at the front, as close to the building as possible. Bore hole samples will be collected from the surface to a depth of 20 feet. Sample intervals will be 0 - 0.5, 0.5 - 1.0 feet, and thereafter at every one foot interval.

Samples from the 0 - 0.5, 1.0 - 2.0, 4.0 - 5.0, 9.0 - 10.0, and 19.0 - 20.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for the New BaCl Mixing Area:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	42
Total Number of Uranium Analyses:	10
Total Number of Th-230 Analyses:	10
Total Number of Ra-226 Analyses:	10

Discussion:

This building was used for research of a method to solidify raffinate in asphalt (WPC project).

Centrifuge Building Information

The Centrifuge Building is located within the restricted area boundary and is approximately 25 feet by 35 feet in size and was built in 1989. The metal building housed four de-watering tanks. This process attempted to de-water the raffinate sludge by-product for economical shipping to a uranium mine in New Mexico for uranium recovery.

Centrifuge Building Sampling Requirements

Two locations will be sampled in this building.

Hand auger samples will be collected from the surface to a depth of 5 feet. Cores must be drilled through the concrete floor prior to sample collection. Sample intervals will be 0 - 0.5, 0.5 - 1.0, 1.0 - 2.0, 2.0 - 3.0, 3.0 - 4.0 and 4.0 - 5.0 feet.

Samples from the 0 - 0.5, 1.0 -2.0, and 4.0 - 5.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for the Centrifuge Building:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	12
Total Number of Uranium Analyses:	6
Total Number of Th-230 Analyses:	6
Total Number of Ra-226 Analyses:	6

Discussion:

This unit may have been impacted from the raffinate sludge processing that occurred in the Centrifuge Building.

2.2.1.18 Pond 2 (Unit 18)

Pond 2 Information

Pond 2 is located west of the Clarifier Basins and the Fluoride Settling Basins, spanning the length of both units. The pond was constructed in 1971 and measures approximately 300 feet by 700 feet by 18 feet deep, with an estimated total capacity of 2,963,000 cubic feet. Pond 2 contained raffinate and sludge by-products until it was taken out of service in the early 1980's because of historically documented leaks. A remediation plan was developed and implemented in 1991. The sludge and residual clays from Pond 2 were removed and transferred to the hypalon-lined, Pond 4. Pond 2 was covered with a synthetic liner and the southwest corner of the berm was breached to allow rainfall to drain. This action was intended to help eliminate the hydraulic head from rainwater potentially causing additional migration.

Pond 2 Sampling Requirements

There have already been a significant number of samples collected from this area for characterization purposes. Collection of additional samples for characterization is not required.

Sampling Requirements for Soils Beneath Pond 2

The soils beneath Pond 2 was sampled in July, 1991, prior to installation of the cover liner currently in place. The lower limit of detection for uranium for these samples was 400 μg/g, and many of the sample results for uranium were reported as <400 μg/g. The samples were also analyzed for Th-230, Ra-226, nitrate and fluoride.

These samples should be re-analyzed for uranium using a method with a lower limit of detection of less than 5 ug/g. If results average >40 μg/g, deeper sampling shall be conducted. At least four borehole samples to a depth of twenty feet or water should be attempted. The pond bottom will be divided into four quadrants and samples collected from the center of each quadrant.

The liner currently in place was installed to isolate rain water from the surface of the pond bottom. Sediment on this liner should be of no concern.

2.2.1.19 Area West of Pond No. 2 (Unit 19)

Area West of Pond No. 2 Information

This unit consists of a ditch located west of Pond 2 and lies outside the restricted area boundary. The ditch was used for stormwater drainage until the diversion ditch was built in 1989 and subsequently this area was filled in.

Area West of Pond No. 2 Sampling Requirements

A gamma walkover survey will be performed of this unit to determine areas which have elevated levels indicating surface radioactive contamination. Surface soil samples will be collected from a selected number of locations to determine the concentration of uranium present. The uranium concentration data will be used in conjunction with the gamma walkover survey results to determine the extent and degree of licensed material contamination. Some samples may also be analyzed for thorium-230, radium-226, nitrates and/or fluorides.

2.2.1.20 Solid Waste Burial Area No. 2 (North) (Unit 20)

Solid Waste Burial Area No. 2 Information

The Solid Waste Burial Area No. 2 (North) is located north of the Solid Waste Burial Area No. 1 and east of the Fluoride Holding Basin No. 2 and was operated for a brief time in the late 1979 to early 1980. The fenced in area measures approximately 350 feet by 200 feet. The historical review indicated that a trench was dug for equipment burial at or near the time the regulations changed that prohibited burial. Only a small area (75 feet by 75 feet) in the southeast corner is believed to contain buried material and the remainder of the empty trench was backfilled with soil. The fenced in area was then used, and is currently used, for storage of miscellaneous equipment.

Solid Waste Burial Area No. 2 Sampling Requirements

Impact on the surrounding area from uranium contaminated materials in this area will be evaluated by sampling around the perimeter of the burial area.

Five locations have been selected, three on the north side at even spacings, and one on each end. Sampling requirements for Solid Waste Burial Area No. 1 specify sampling between the two burial areas.

Bore hole samples will be collected from the surface to a depth of 20 feet. Sample Intervals will be 0 - 0.5, 0.5 - 1.0 feet, and thereafter at every one foot interval.

Samples from the 0 - 0.5, 1.0 - 2.0, 4.0 - 5.0, 9.0 - 10.0, and 19.0 - 20.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for Solid Waste Burial Area No.2):

Total Number of Sample Locations:	5
Total Number of Samples Collected:	105
Total Number of Uranium Analyses:	25
Total Number of Th-230 Analyses:	25
Total Number of Ra-226 Analyses:	25

Total Number of Nitrate Analyses: 25
Total Number of Fluoride Analyses: 25

Discussion:

The impact on the soils surrounding the burial area will be evaluated. Many different types of equipment and uranium contaminated materials are believed to have been placed into the burial area.

Due the physical nature of the possible contents of the burial area, it is not practical to sample in the burial area itself.

2.2.1.21 Yellowcake Storage Pad Area (Unit 21)

Yellowcake Storage Pad Area Information

The Yellowcake Storage Pad is located west of the MPB and east of the Clarifier Basins. The storage area has existed since plant start-up in 1970. The original gravel pad was concreted in 1979 and now measures 550 feet by 370 feet. The area is primarily used for unloading and storage of uranium yellowcake contained in 55-gallon drums. The hazardous waste storage area is also located at the southeast corner near the loading docks. The storage area is also used for the empty drum crushing operation and storage of miscellaneous equipment.

Yellowcake Storage Pad Sampling Requirements

For characterization purposes, samples will be taken from three locations - one in the northwest area, one in the southwest area, and one from south of the lime storage area. Holes will have to be drilled in the concrete prior to sampling to allow access to the soil beneath the pad. The west end of the pad is of special interest since uranium contaminated scrap and soil excavated from the SX yard has been stored in this area of the pad. Several samples collected during the FEI will be reanalyzed for Ra-226 and Th-230.

Bore hole samples will be collected from the surface to a depth of 20 feet. Sample intervals will be 0 - 0.5, 0.5 - 1.0 feet, and thereafter at every one foot interval.

Samples from the 0 - 0.5, 1.0 - 2.0, 4.0 - 5.0, 9.0 - 10.0, and 19.0 - 20.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(two locations, where the uranium concentration is the highest)
Ra-226	(two locations, where the uranium concentration is the highest)
Nitrate	(all samples)

Fluoride (all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for the Yellowcake Storage Pad:

Total Number of Sample Locations:	3
Total Number of Samples Collected:	63
Total Number of Uranium Analyses:	15
Total Number of Th-230 Analyses:	30
Total Number of Ra-226 Analyses:	30
Total Number of Nitrate Analyses:	15
Total Number of Fluoride Analyses:	15

Discussion:

Interviews with long term employees and known history indicate this area was not always covered with concrete. Also, seams, cracks, and anchor holes for various projects have allowed potential pathways for SCP Material to spread to the soil beneath the yellowcake pad.

Samples should be collected from beneath the Yellowcake Storage Pad in order to evaluate the magnitude of licensed material that may be present. The sampling described here, in addition to data already available, should provide sufficient information to evaluate the general impact to the area.

ADU / Misc. Digestion Building Information

The ADU Building is located south of the SX Building just north of the Yellowcake Storage Pad and was built in 1977. The original metal building was 50 feet by 30 feet designed to handle uranium slurry. After two (2) additions in 1978 and 1983, the building was expanded to measure approximately 30 feet wide by 100 feet long. The building modifications allowed room for drum handling equipment along with the uranium slurry unloading station and the miscellaneous digestion equipment. The building also houses a hydrated aluminum bin, used to neutralize fluorides.

ADU / Misc. Digestion Building Sampling Requirements

The soil beneath this building should be evaluated for presence of SCP Material. Two locations will be sampled in this building.

Hand auger samples will be collected from the surface to a depth of 5 feet. Cores must be drilled through the concrete floor prior to sample collection. Sample intervals will be 0 - 0.5, 0.5 - 1.0, 1.0 - 2.0, 2.0 - 3.0, 3.0 - 4.0 and 4.0 - 5.0 feet.

Samples from the 0 - 0.5, 1.0 -2.0, and 4.0 - 5.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved, stored, and analyzed if needed for additional information.

Summary of Sampling Requirements for the ADU / Misc. Digest Building:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	12
Total Number of Uranium Analyses:	6
Total Number of Th-230 Analyses:	6
Total Number of Ra-226 Analyses:	6
Total Number of Nitrate Analyses:	6
Total Number of Fluoride Analyses:	6

Discussion:

Interviews with long term employees indicated the concrete floor had been repaired several times.

2.2.1.22 East Perimeter Area (Northern Section) (Unit 22)

East Perimeter Area Information

This unit lies east of the industrial site and contains lawn areas, a substation, and the administration building/warehouse. The OG&E substation was installed when the original facility was constructed. The administration building/warehouse was constructed in 1992.

East Perimeter Area Sampling Requirements

A gamma walkover survey will be performed of this unit to determine areas which have elevated levels indicating surface radioactive contamination. Surface soil samples will be collected from a selected number of locations to determine the concentration of uranium present. The uranium concentration data will be used in conjunction with the gamma walkover survey results to determine the extent and degree of radioactive contamination. Some samples may also be analyzed for thorium-230, radium-226, nitrates and fluorides.

2.2.1.23 1986 Incident Soil Area Storage (Unit 23)

<u>1986 Incident Soil Area Storage Information</u>

The 1986 Incident Soil Storage Area is located north of Pond 2. Approximately 457 cubic yards of soil was removed from the facility front lawn as a remediation action after the UF_6 release in January 1986. The sod was placed in the 50 foot by 100 foot fenced-in area and totally encapsulated with a hypalon cover. Subsequently, the sod was removed and placed in the Interim Storage Cell in 1992.

<u>1986 Incident Soil Area Storage Sampling Requirements</u>

Samples will be collected at two locations to aid in characterization of this area. The samples will be evenly spaced over the area. The primary concern is surface contamination (0 - 0.5 ft) since the material has been removed.

Samples will be collected from the surface to a depth of 5 feet. Sample intervals will be 0 - 0.5, 0.5 - 1.0, 1.0 - 2.0, 2.0 - 3.0, 3.0 - 4.0 and 4.0 - 5.0 feet.

Samples from the 0 - 0.5 , 1.0 - 2.0, and 4.0 - 5.0 intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface samples only)
Ra-226	(surface samples only)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, 2.0 - 3.0, and 3.0 - 4.0 foot intervals will be preserved and stored for future analysis, if needed.

<u>Summary of Sampling Requirements for the 1986 Incident Soil Storage Area:</u>

Total Number of Sample Locations:	2
Total Number of Samples Collected:	12
Total Number of Uranium Analyses:	6
Total Number of Th-230 Analyses:	2 (surface samples only)

Total Number of Ra-226 Analyses:	2 (surface samples only)
Total Number of Nitrate Analyses:	6
Total Number of Fluoride Analyses:	6

Discussion:

Sod and soil contaminated with UO_2F_2 as a result of the 1986 UF6 release incident were stored in this area from 1986 until 1992, when the material was relocated to the interim storage cell. Residual SCP Material from this storage must be evaluated. Surface SCP Material levels will be looked at first, and if indicated, deeper samples collected can be analyzed at a later date.

2.2.1.24 Fertilizer Storage Pond Area (Unit 24)

Fertilizer Storage Pond Area Information

The Ammonium Nitrate Lined Ponds Area is located several hundred yards south of the MPB and began with the construction of Ponds 3E and 3W (built in 1978) followed by Pond 4 (built in 1980), Pond 5 (built in 1984) and Pond 6 (built in 1985). Each two (2) million cubic foot pond measures approximately 400 feet by 400 feet by 25 feet deep. Four ponds (Ponds 3E, 3W, 5 and 6) contain ammonium nitrate fertilizer transferred from the Clarifiers and one pond, Pond 4, contains raffinate sludge from Pond 2. A fertilizer loadout area is also located within this unit. All the ponds are clay and hypalon-lined with leak detection underdrains under the hypalon liner.

Ponds 3E, 3W, 5 and 6 Sampling Requirements

Two sediment samples will be taken from Pond 3E and analyzed for the following constituents:

Uranium
Th-230
Ra-226

A sample will be collected at each location over the depth interval of the sludge.

Summary of Sampling Requirements for Ponds 3E, 3W, 5 and 6:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	2
Total Number of Uranium Analyses:	2
Total Number of Th-230 Analyses:	2
Total Number of Ra-226 Analyses:	2

Discussion:

Ponds 3E, 3W, 5, and 6 are used to store ammonium nitrate fertilizer. Pond 3E is the first in the series to receive treated liquid from the clarification process (Clarifier A) and has had residual amounts of uranium collected on the pond bottom. Pond 6 is the last in the series and presumably would have the least accumulation of sediments with the lowest concentrations of radionuclides. Pond 3W and 5 are covered, and would be difficult to sample since it is not desirable to breech the covers at this time. It may be necessary to probe the sediment for depth measurements at the time of sampling. Sampling sediments with the highest concentrations (Pond 3E) should provide the necessary data for characterization.

Pond 4 Sampling Requirements

For characterization of this pond, samples will be collected in four locations, one from each quadrant. The sample depth will be the depth of the sludge. For purposes of volume determinations, ten locations will be probed for depth to sludge.

The samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for Pond 4:

Total Number of Sample Locations:	4
Total Number of Samples Collected:	4
Total Number of Uranium Analyses:	4
Total Number of Th-230 Analyses:	4
Total Number of Ra-226 Analyses:	4
Total Number of Nitrate Analyses:	4
Total Number of Fluoride Analyses:	4
Total Number of Locations to be Probed for depth:	10

Discussion:

Pond 4 is used for raffinate sludge storage. A boat will be used to collect the samples and probe the depth of the sediment.

Fertilizer Loadout Area Sampling Requirements

Sediment in the sump in the loadout area will be sampled to characterize this material. The sample depth will be the depth of the sediment. A composite of the sample over the depth will be analyzed for the following constituents:

Uranium
Th-230
Ra-226

Summary of Sampling Requirements for the Fertilizer Loadout Area:

Total Number of Sample Locations:	1
Total Number of Samples Collected:	1
Total Number of Uranium Analyses:	1
Total Number of Th-230 Analyses:	1
Total Number of Ra-226 Analyses:	1

Discussion:

Sediment carried into the sump by run-off from this area should present a good basis for the evaluation of contamination potential in this area.

Sampling Requirements for Soils Beneath 3E, 3W, 4, 5 and 6

After the sediment has been removed from Ponds 3E, 3W, 4, 5, and 6, the soil under the hypalon liners will be sampled. This sampling will have to done when the pond bottoms are relatively dry. To accomplish this, rain water that may accumulate will have to be pumped off (perhaps to one of these ponds, which would then be sampled last) and impounded, and the surface allowed to dry. Rain water from the last pond to be sampled will be pumped to a location to be determined at that time, based on facility status.

Hand auger samples will be collected from intervals of 0 - 0.5 ft., 0.5 - 1.0 ft., and at one foot intervals thereafter to a depth of five feet.

Samples from the 0 - 0.5 ft., 0.5 - 1.0 ft., 2.0 -3.0 ft., and 4.0 - 5.0 ft. interval will be analyzed for total uranium, thorium-230, radium-226, nitrates, and fluorides. The remaining samples collected will be secured and saved for later analysis if necessary.

Sampling Requirements for Soil Beneath Pond 3E

Pond 3E is known to have contained uranium in quantities large enough to be posted as a radioactive materials area, so it has a higher potential for SCP Material spread through possible liner leaks.

The pond bottom will be divided into six equal areas, and samples collected from the center of each area and analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface sample for each location)
Ra-226	(surface sample for each location)
Nitrate	(all samples)
Fluoride	(all samples)

Total Number of Sample Locations:	6
Total Number of Samples Collected:	36
Total Number of Uranium Analyses:	24
Total Number of Th-230 Analyses:	6
Total Number of Ra-226 Analyses:	6
Total Number of Nitrate Analyses:	24
Total Number of Fluoride Analyses:	24

Sampling Requirements for Soils Beneath Pond 3W

The pond bottom will be divided into four quadrants and samples collected from the center of each quadrant and analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface sample for each location)
Ra-226	(surface sample for each location)
Nitrate	(all samples)
Fluoride	(all samples)

Total Number of Sample Locations:	4
Total Number of Samples Collected:	24
Total Number of Uranium Analyses:	16
Total Number of Th-230 Analyses:	4
Total Number of Ra-226 Analyses:	4
Total Number of Nitrate Analyses:	16
Total Number of Fluoride Analyses:	16

Sampling Requirements for Soils Beneath Pond 4

The pond bottom will be divided into six equal segments and samples collected from the center of each segment and analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Total Number of Sample Locations:	6
Total Number of Samples Collected:	36
Total Number of Uranium Analyses:	24
Total Number of Th-230 Analyses:	24
Total Number of Ra-226 Analyses:	24
Total Number of Nitrate Analyses:	24
Total Number of Fluoride Analyses:	24

Sampling Requirements for Soils Beneath Pond 5

The pond bottom will be divided into four quadrants and samples collected from the center of each quadrant and analyzed for the following constituents:

Uranium	(all samples)
Th-230	(surface sample for each location)
Ra-226	(surface sample for each location)
Nitrate	(all samples)
Fluoride	(all samples)

Total Number of Sample Locations:	4
Total Number of Samples Collected:	24
Total Number of Uranium Analyses:	16
Total Number of Th-230 Analyses:	4
Total Number of Ra-226 Analyses:	4
Total Number of Nitrate Analyses:	16
Total Number of Fluoride Analyses:	16

Sampling Requirements for Soils Beneath Pond 6

The pond bottom will be divided into four equal quadrants and samples collected from the center of each quadrant and analyzed for the following constituents:

Uranium	(all samples)

Th-230	(surface sample for each location)
Ra-226	(surface sample for each location)
Nitrate	(all samples)
Fluoride	(all samples)

Total Number of Sample Locations:	4
Total Number of Samples Collected:	24
Total Number of Uranium Analyses:	16
Total Number of Th-230 Analyses:	4
Total Number of Ra-226 Analyses:	4
Total Number of Nitrate Analyses:	16
Total Number of Fluoride Analyses:	16

2.2.1.25 Former Raffinate Treatment Area (Unit 25)

Former Raffinate Treatment Area Information

The Former Raffinate Treatment Area is located between the Clarifier Pond Area and the Yellowcake Storage Pad. The raffinate treatment area operated from 1970 to the mid 1980's. The area consisted of several large tanks which were used for pilot studies and processing of various raffinate solutions and ammonium nitrate solutions. The testing area was abandoned, however, the empty tanks are still located in this area.

Former Raffinate Treatment Area Sampling Requirements

Two locations will be sampled in this area. Bore hole samples will be collected from the surface to a depth of 20 feet. Sample Intervals will be 0 - 0.5, 0.5 - 1.0 feet, and thereafter at every one foot interval.

Samples from the 0 - 0.5, 1.0 - 2.0, 4.0 - 5.0, 9.0 - 10.0, and 19.0 - 20.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for the Former Raffinate Treatment Area:

Total Number of Sample Locations:	2

Total Number of Samples Collected:	42
Total Number of Uranium Analyses:	10
Total Number of Th-230 Analyses:	10
Total Number of Ra-226 Analyses:	10
Total Number of Nitrate Analyses:	10
Total Number of Fluoride Analyses:	10

Discussion:

The former raffinate treatment area did not originally have a concrete pad. Leaks and spills of raffinate were reported to have occurred in this area. It will be necessary to drill a hole in the concrete pad prior to sampling.

The sampling described here should provide sufficient data to characterize the area.

Former BaCl Mixing Area Sampling Information

The Former BaCl (barium chloride) Mixing area is located within the restricted area boundaries northeast of the former raffinate treatment area and east of the Clarifiers. The building was constructed in July of 1988 to allow for weather protection of the mixing tank and storage of BaCl. In 1992, the BaCl mixing equipment and operation was moved and the metal building was expanded and converted into the facility laundry building, formerly located in the MPB.

Former BaCl Mixing Area Sampling Requirements

For characterization of this area, two locations will be sampled. Sampling will be done outside the building, at the back and at the front, as close to the building as possible. Bore hole samples will be collected from the surface to a depth of 20 feet. Sample intervals will be 0 - 0.5, 0.5 - 1.0 feet, and thereafter at every one foot interval.

Samples from the 0 - 0.5, 1.0 - 2.0, 4.0 - 5.0, 9.0 - 10.0, and 19.0 - 20.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrates	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for the Former BaCl Mixing Area:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	42
Total Number of Uranium Analyses:	10
Total Number of Th-230 Analyses:	10
Total Number of Ra-226 Analyses:	10
Total Number of Nitrate Analyses:	10

Discussion:

It may be possible that excess dirt from the Pond 1 Spoils Pile was used to construct the berm north of the old Barium Chloride Storage Building. This soil may have been contaminated with low concentrations of uranium, Ra-226, Th-230, and nitrates.

2.2.1.26 Decorative Pond Area (Unit 26)

Decorative Pond Area Information

This unit is located south of the MPB, outside the restricted area boundary, and includes a decorative pond, access roads, parking areas and lawn areas. The decorative pond was built around the time of plant start-up. The pond is used for decorative purposes only and has a capacity of 75,000 cubic feet.

Decorative Pond Sampling Requirements

Four (4) sediment samples will be collected from the decorative pond. These samples will be analyzed for the following constituents:

Uranium	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for the Decorative Pond:

Total Number of Sample Locations:	4
Total Number of Samples Collected:	4
Total Number of Uranium Analyses:	4
Total Number of Nitrate Analyses:	4
Total Number of Fluoride Analyses:	4

Lawn Area Sampling Requirements

A gamma walkover survey will be performed in this area to determine areas which have elevated levels indicating surface radioactive contamination. Surface soil samples will be collected from a selected number of locations to determine the concentration of uranium present. The uranium concentration data will be used in conjunction with the gamma walkover survey results to determine the extent and degree of radioactive contamination. Some samples may also be analyzed for thorium-230, radium-226, nitrates and/or fluorides.

Discussion:

Surface soils in this unit, primarily north of the decorative pond are known to be contaminated with uranium. Sediment samples should be collected from the pond at four locations which are spaced over the pond surface to determine if there are any significant SCP Material levels in the sediments.

2.2.1.27 Combination Stream (Unit 27)

Combination Stream Information

The Combination Stream Drain, originates immediately south of the Cooling Tower and runs southwesterly near the east side of the south Yellowcake Sump. The 15 inch concrete drain was installed 20 feet underground during initial construction activities and accepts once-through and excess cooling water. The FEI devoted an entire section (Vol. 1 Section 6) to the investigation of this drain and should be referenced for a detailed understanding of the many components of the process which discharge to this drain.

Combination Stream Sampling Requirements

The combination stream is routinely sampled for uranium, and radium-226, but not for thorium-230. Sample results from previous sampling will be utilized for the characterization of this unit.

2.2.1.28 Present Lime Neutralization Area (Unit 28)

Present Lime Neutralization Area Information

The Present Lime Neutralization Area is located in the far northeast corner of the Yellowcake Storage Pad, west of the MPB and was constructed in 1970. The curbed area is approximately 25 feet wide and 30 feet long with a lime storage tank and a mixing tank. The lime neutralization originally consisted of four (4) tanks used to neutralize both raffinate and hydrogen fluoride (HF) through the use of lime. The raffinate treatment equipment was removed circa 1973, and the current neutralization equipment was installed and designed to handle liquids from the Anhydrous HF (AHF) Vaporizer Sump, the HF Scrubber, and the Laboratory Sump Pump. The discharge can be valved to flow either to the CaF_2 Settling Basins (Unit 14B-C) or the Fluoride Holding Basin No.2.

Present Lime Neutralization Area Sampling Information

For characterization purposes, two locations in this area will be sampled. Bore hole samples will be collected from the surface to a depth of 20 feet. Sample intervals will be 0 - 0.5, 0.5 - 1.0 feet, and thereafter at every one foot interval.

Samples from the 0 - 0.5, 1.0 - 2.0, 4.0 - 5.0, 9.0 - 10.0, and 19.0 - 20.0 foot intervals will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)
Nitrate	(all samples)
Fluoride	(all samples)

Samples from the 0.5 - 1.0, and other remaining intervals will be preserved and stored for future analysis, if needed.

Summary of Sampling Requirements for the Present Lime Neutralization Area:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	42
Total Number of Uranium Analyses:	10
Total Number of Th-230 Analyses:	10
Total Number of Ra-226 Analyses:	10
Total Number of Nitrate Analyses:	10
Total Number of Fluoride Analyses:	10

Discussion:

The present lime neutralization area may have been subject to leaks and spills. The sampling described here should allow characterization of the impact from these spills.

2.2.1.29 DUF_4 Building Area (Unit 29)

DUF_4 Building Area Information

One of our five principal buildings on the 85 acre Sequoyah Facility. DUF_4 design and construction began in 1984, reached completion in 1986, and began operations at the end of 1986 (start-up was delayed from January because of incident of January 1986 at the UF_6 plant). The DUF_4 building is a steel frame metal building with approximately 7,000 square feet of ground floor area. There are four upper level working platforms in a 1,600 square foot chemical reactor bay area which is approximately 60 feet high. The DUF_4 building housed the process equipment to chemically react DUF_6 with hydrogen (H_2) to produce DUF_4 and anhydrous hydrofluoric acid (AHF). The product was packaged in 55 gallon drums and the recovered AHF was condensed to a liquid and sent to a holding tank south of the plant. The condensate from the DUF_4 plant discharged to the sanitary lagoon.

DUF4 Building Sampling Requirements

Existing data from the FEI for the area around the DUF4 building will be utilized for characterization of this area.

2.2.1.30 Tank Farm and Cylinder Storage Area (Unit 30)

Tank Farm and Cylinder Storage Area Information

The North Tank Farm is located north of the South Tank Farm and east of the Bechtel Building and was constructed as part of an expansion that began in 1975. The 48 foot by 46 foot curbed area consists of a sandblasting building, bulk chemical tanks, a diesel fuel tank and an emergency water supply tank. The curbed area where bulk chemicals are stored is lined with limestone rock bed for neutralization in case of a spill or upset. The bulk chemicals stored here are; two (2) 15,000 gallon 40% nitric acid tanks, one (1) 15,000 gallon anhydrous hydrogen fluoride, and one (1) 15,000 gallon aqueous hydrogen fluoride tank. Accumulated rainwater drains into the North Ditch. The diesel fuel tank has an earthen berm and rainfall is discharged to the North Ditch. The remainder of the area drains naturally to the North Ditch. Prior to 1975, the location of the present north tank farm was used as a storage area for drums of oil, equipment and trash.

The South Tank Farm is located immediately north of the MPB and was part of the original construction completed in 1969. The 47 foot by 62 foot curbed area is lined with a limestone rock bed for neutralization in case of a spill or upset. The rainfall collected in the curbed area is discharged to the North Ditch. The tank farm consists of seven tanks, two anhydrous hydrogen fluoride storage tanks, two ammonia storage tanks, and three nitric acid storage tanks. All of these tanks except for one had a capacity of 15,000 gallons. One of the nitric acid tanks had a capacity of 18,000 gallons. All of these tanks are currently empty.

Tank Farm and Cylinder Storage Area Sampling Requirements

Previous soil sampling collected during the FEI from this area will be utilized for characterization.

Bechtel Storage Building Sampling Information

The Bechtel Storage Building is located northwest of the MPB and east of the Cooling Tower and was originally built as a construction office and storage area during original plant construction in 1968. The metal building is 36 feet by 76 feet and was used for storage after the MPB was built and thereafter to sort trash until 1989. After the Solid Waste Sorting Building was built in 1989, the building provided dry storage for insulation materials, electric motors and bulk dry chemicals. A curbed area inside the east portion of the building served as a storage area for used oils, used solvents, freon, glycol and other miscellaneous chemicals.

Bechtel Storage Building Sampling Requirements

For characterization of soil under this building, samples will be take in two locations, one from each end, inside the building.

Hand auger samples will be collected from the surface to a depth of 5 feet. Cores must be drilled through the concrete floor prior to sample collection. Sample intervals will be 0 - 0.5, 0.5 - 1.0, 1.0 - 2.0, 2.0 - 3.0, 3.0 - 4.0 and 4.0 - 5.0 feet.

Samples from the 0 - 0.5, 1.0 -2.0, and 4.0 - 5.0 foot intervals will be analyzed for the following constituents:

Uranium (all samples)

Summary of Sampling Requirements for the Bechtel Storage Building:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	12
Total Number of Uranium Analyses:	6

Discussion:

The sampling described here will provide the information needed to complete characterization of this area.

Oil Storage Building Sampling Information

The Oil Storage Building, is located north of the MPB and east of the north Tank Farm and was built in 1990. The three (3) sided 20 foot by 20 foot wooden and metal shed, was built to isolate the storage of new solvents and lubricants as well as providing a satellite storage area for used oils and solvents.

Oil Storage Building Sampling Requirements

For characterization of this area, two surface soil samples will be collected. Along the edge of the concrete pad where any spills would have run off impacting the soil. Samples will be analyzed for the following:

Uranium (all samples)

Samples from the 0 - 0.5 foot interval will be collected.

Summary of Sampling Requirements for the Oil Storage Building:

Total Number of Sample Locations:	2
Total Number of Samples Collected:	2
Total Number of Uranium Analyses:	2

Discussion:

Potentially contaminated oil has been stored in this building. This sample should allow characterization of any spills or leaks of licensed material.

2.2.1.31 Front Lawn Area (Unit 31)

Front Lawn Area Information

This unit consists of lawn areas, access roads and a parking lot.

Front Lawn Area Sampling Requirements

A gamma walkover survey will be performed of this unit to determine areas which have elevated levels indicating surface contamination. Surface soil samples will be collected from a selected number of locations to determine the concentration of uranium present. The uranium concentration data will be used in conjunction with the gamma walkover survey results to determine the extent and degree of contamination. Some samples may also be analyzed for thorium-230, radium-226, nitrates and fluorides.

2.2.1.32 South Perimeter Area (Unit 32)

South Perimeter Area Information

The area includes a storm water reservoir which was constructed in May of 1991. The storm water reservoir has a capacity of 67,000,000 gallons and covers 16 acres. The normal water level is at an elevation of 510 feet and the flood stage at 520 feet.

The reservoir was constructed due to exceedances through the storm water outfalls. In 1990, SFC constructed a drainage ditch around the facility and diverted all surface water runoff from the northern and western portions of the facility through Outfall 008.

This impoundment was designed to collect storm water from the entire facility processing area and facilitate a reduction of nutrient levels by biological processes prior to discharge. However, the state has yet to approve permit modifications to include the storm water reservoir, therefore, the storm water reservoir collects only water from non-process areas. Efforts are being made to include the reservoir as a part of SFC's overall storm water management.

South Perimeter Area Sampling Requirements

A gamma walkover survey will be performed of this unit to determine areas which have elevated levels indicating surface radioactive contamination. Surface soil samples will be collected from a selected number of locations to determine the concentration of uranium present. The uranium concentration data will be used in conjunction with the gamma walkover survey results to determine the extent and degree of radioactive contamination. Some samples may also be analyzed for thorium-230, radium-226, nitrates and/or fluorides.

Three samples were taken from the storm water reservoir area in July, 1993. Results of these samples will be utilized for characterization of the area. This is a new impoundment and is not expected to have been impacted. However, the combination stream drainage did run through this area and may have resulted in the deposition of licensed material. Sediment samples from this area will therefore be included in the SCP.

2.2.1.33 Northeast Perimeter Area (Unit 33)

Northeast Perimeter Area Information

This unit lies north of the industrial site and consists of field and timbered areas. A gravel access road runs through the area.

Northeast Perimeter Area Sampling Requirements

A gamma walkover survey will be performed of this unit to determine areas which have elevated levels indicating surface radioactive contamination. Surface soil samples will be collected from a selected number of locations to determine the concentration of uranium present. The uranium concentration data will be used in conjunction with the gamma walkover survey results to determine the extent and degree of radioactive contamination. Some samples may also be analyzed for thorium-230, radium-226, nitrates and/or fluorides.

2.2.1.34 Drainage / Runoff Areas (Unit 34)

Drainage / Runoff Areas Information

There are several drainage areas which originate in or near the restricted area and flow towards the Illinois and Arkansas Rivers.

Drainage / Runoff Areas Sampling Requirements

Samples have been collected from the drainage areas and sediments identified with elevated concentrations of uranium, radium-226 and thorium-230. These results were included in the Facility Environmental Investigation. A gamma survey of the drainage areas will be performed and the need for additional sampling evaluated.

2.2.1.35 Scrap Metal Storage Area / Interim Storage Cell Area (Unit 35)

Scrap Metal Storage Area Information

The Scrap Metal Storage Area, is located north of the DUF_4 Plant and east of the Interim Storage Cell and was built in 1975. The graveled, fenced area is approximately 50 feet by 120 feet. The area was used to store leftover construction materials such as pipe, beams, and siding that were previously stored near the North Tank Farm. The area was also used as a staging area, for storage of decontaminated equipment prior to release as clean scrap. Some radioactive contaminated equipment, primarily equipment identified during the unrestricted area survey program, was moved into this area for storage.

Scrap Metal Storage Area Sampling Requirements

Characterization of this area will be accomplished by performing a gamma walkover survey and collecting surface samples from six locations. The sample locations will be evenly spaced over the area unless areas are identified with elevated gamma results.

Hand auger samples will be collected from 0 - 0.5 and 0.5 to 1.0 feet, and will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(three locations, with the highest uranium concentration)
Ra-226	(three locations, with the highest uranium concentration)
Nitrate	(all samples)
Fluoride	(all samples)

Summary of Sampling Requirements for the Scrap Metal Storage Area:

Total Number of Sample Locations:	6
Total Number of Samples Collected:	12
Total Number of Uranium Analyses:	12
Total Number of Th-230 Analyses:	6
Total Number of Ra-226 Analyses:	6
Total Number of Nitrate Analyses:	12
Total Number of Fluoride Analyses:	12

Discussion:

Radioactive contaminated scrap metal may has stored in this area. Transport to the soil will be evaluated with the sampling described here.

Interim Storage Cell Information

The Interim Storage Cell is located east of the Solid Waste Burial Area No.2 and north of the Incinerator and was constructed in 1992. The 100 feet by 160 feet temporary structure was erected on an existing concrete pad using portable inverted concrete tee sections. Each section is approximately four feet high, ten feet long, and three feet wide at the base. A synthetic protective liner was used over the entire bottom and another synthetic liner was used to cover the soil after it was placed into the cell. There were three areas of soils that were placed in the cell. Approximately 450 cubic yards of soil from the 1986 Incident Soil Storage Area, approximately 2,200 cubic yards from the Initial Lime Neutralization Area, and approximately 1,650 cubic yards of soil from the 1990 UST excavation temporarily stored on the Yellowcake Storage Pad.

Interim Storage Cell Sampling Requirements

Two composite samples will be collected from the soil in the cell. These samples will be composited over the depth of the soil in the cell where the sample is taken. the samples will be analyzed for the following constituents:

Uranium	(all samples)
Th-230	(all samples)
Ra-226	(all samples)

The volume of soil will also be estimated and provided with the characterization information.

Summary of Sampling Requirements for the Interim Storage Cell:

Total Number of Sample Locations:	2

Total Number of Samples Collected: 2
Total Number of Uranium Analyses: 2
Total Number of Th-230 Analyses: 2
Total Number of Ra-226 Analyses: 2

Discussion:

Soil from several locations and sources was placed into this cell during 1992. A significant number of samples were collected and analyzed as soil was put into the cell, and will be a source of information for characterization. The sampling described here combined with data from other sampling events should allow characterization of the cell contents.

2.2.2 Radiological Characterization of Buildings and Equipment

2.2.2.1 Introduction

The purpose of the radiological characterization of the buildings and equipment is to provide information concerning the degree of radioactive contamination, radiation levels, physical and chemical properties of the material or equipment, and volume information. This information will be needed to evaluate the options available for decontamination and decommissioning of the facility. Equipment and materials associated with the facility's restricted areas are considered to be radiologically contaminated above the release criteria for the facility. Therefore, general scoping surveys will be performed for characterization. Detailed surveys which would typically be performed to demonstrate that the facility could be released for unrestricted release will not be performed at this time. However, a good understanding of the radiological conditions is required in order to perform the work activities related to decommissioning in a safe manner. Industrial and chemical safety concerns will also be considered and appropriate controls and procedures implemented.

The general layout and arrangement of the facility is included as Figure 1. Included on this drawing are the boundaries of each area or unit which has been identified at the facility.

Samples and survey results should be referenced to the facility grid system. This may be more difficult to do for indoor survey results of equipment or building surfaces. However, where practical, results will be referenced to the facility grid system. The grid established for the facility is in feet with the southeast corner of Section 21 of T12N, R21E as the point on the grid system with coordinates N-10,000 and E-10,000. The N-10,000 line of the grid system lies along the section line (Highway 10). The plant process area and related facilities are within Section 21. This grid system will be used for reference purposes to designate the location of survey measurements and sample collection locations. A third value may be used with the grid system coordinates to designate the depth from ground surface for subsurface soil samples, or the height above ground level for survey points.

2.2.2.2 Historical Information and Sampling Results

General survey information for the UF_6 Plant and DUF_4 Plant is provided in the Preliminary Plan for Completion of Decommissioning dated February 16, 1993 and in the Draft Preliminary Report - Description of Current Conditions and Investigations dated November 1, 1993. Results for outlying facilities and some areas within the plants previously surveyed are not adequate surveys for a scoping or characterization survey. Survey information will be required for each building, process area and system located at the facility. The survey and sampling protocols which will be utilized in the facility are described below under the section titled "Survey and Sampling Program". Adequacy of the data will be evaluated for each area or unit and a determination made if additional information is required. This will be done as a survey protocol is written for each area or unit.

Sources of information which will be utilized to assist in the characterization process include a review of the license, license amendment requests, contamination incident reports, inspection findings, and other such documents. These documents will be reviewed and significant findings documented so that the information can be utilized during site characterization. Areas which may have been impacted will be investigated through biased surveys and sampling which focus on each area of interest. This activity was completed during the FEI and will be supplemented for site characterization.

Information obtained during interviews held with long term employees of the company who are familiar with the site history and could provide information about the site will be used to help identify areas which may have been impacted by facility operations. In some cases the restricted area boundaries have changed, locations for storage of materials have changed and materials have been buried on-site. These locations may not be apparent today from an inspection of the facility. There may also have been releases of radioactive material which may have impacted the environment. Examples of the types of information which should be identified includes old yellowcake storage areas, cylinder clean out areas, ash receiver clean out areas, sump locations, scrap storage areas, areas of process impacts due to spills and old burial areas. Information obtained during interviews will be documented for future review and utilization for facility characterization.

Old photographs, prints, drawings and surveys have been reviewed for inclusion in the characterization process. The decommissioning files have also been reviewed and appropriate information included. Extensive surveys were conducted of surfaces, equipment and materials located in the unrestricted areas of the facility during 1991 and 1992. Results of these surveys will be valuable to site characterization and will be included in the site characterization effort.

2.2.2.3 Potential Radionuclides and Locations

The material handling and operational processes utilized at the facility will be considered as survey plans are developed for each specific area or unit being evaluated. Specific radionuclides may exist in greater concentrations in certain areas depending upon the properties of the material and process applied. For example, thorium-230 and radium-226 concentrate in the raffinate stream which was a byproduct of the solvent extraction operation. These radionuclides are removed as impurities.

Each unit will be evaluated to determine the radionuclide composition and the chemical and physical form of the material. Other concerns which may be present in an area will also be described. For example, there may be asbestos insulation on pipes or other equipment. Some equipment contained PCB's which leaked and resulted in releases to concrete surfaces and soil in some areas. Although remediation of these areas has been conducted, further investigation may be necessary to confirm that concentrations of the material are below acceptable levels.

2.2.2.4 Identification of Specific Radionuclides

There are areas at the site where the radionuclide composition can vary somewhat depending upon the process and behavior of each element. The primary radionuclides of interest from a site remediation standpoint include uranium, thorium-230 and radium-226. Uranium may be present as either depleted (DUF_4 Plant) or natural (UF_6 Conversion Plant). Radium-226 and thorium-230 are present in the raffinate stream which is generated from the processing of the uranium.

In order to characterize the various by-product or waste streams which are present, samples must be collected and analyzed for the radionuclides of interest. Sample analysis results will be reviewed by a qualified individual to determine the significance of the results.

Information concerning the radionuclides which are present and their chemical and physical form is important for several reasons. This information is necessary in order to perform the pathway analysis and dose assessment necessary for development of site specific criteria. Evaluation of the remedial options will also require knowledge of the chemical and physical form of the materials.

2.2.2.5 Site Guidelines and Criteria

Building surfaces, equipment, and other items must be surveyed to quantify radioactive contamination levels and in some instances to demonstrate that surface radioactive contamination criteria have been met prior to release for unrestricted use. With respect to this characterization effort, the detail required for a survey of a particular area will be evaluated and the appropriate level of survey performed. If an area is known to be radiologically contaminated, such as a process area, a general survey will be performed to evaluate the radiation and contamination levels in the area. However, if an area is believed to be releasable, such as an administrative office area, a more detailed survey will be required to demonstrate that decommissioning of the area is not required. Minor radioactive contamination identified will be included in the results report and will be decontaminated prior to the termination survey. Survey plans will be developed for each unit or area to be surveyed.

The NRC acceptable surface radioactive contamination guidelines for decontamination of facilities and equipment prior to release for unrestricted use or termination of licenses in contained in Table 1. Information concerning implementation of the criteria is included as footnotes in the table.

Criteria for acceptable radioactive contamination levels in soil and sediments will be developed for the facility based on guidance provided by the NRC and other circumstances involving similar elements (such as uranium mill tailings under 10 CFR Part 40, Appendix A). Section 2.5 includes a discussion of the pathway evaluation and dose assessment which will be performed in the process of developing site specific soil and sediment criteria.

2.2.2.6 Survey and Sampling Program

Instrumentation used for surveys performed will be appropriate for the type of radiation the survey is seeking to identify and/or quantify. Detailed instructions regarding instrument selection, calibration, use, and control will be provided in written Surveys will be performed using one or more of the following instruments:

- Scaler/count rate meter type instruments can be used with a variety of different detectors including scintillation, Geiger-Meuller, and proportional, giving this type of instrument the capability to be used to measure alpha, beta and/or gamma radiations. The instrument can be operated in either the ratemeter or scaler mode.

- NaI(Tl) or CsI detector based instruments such as microR meters can be useful for making low level gamma measurements. A scintillation detector (probe) and count rate meter may also be used to scan surfaces in the area which is being surveyed. A pressurized ion chamber may be used at selected locations to provide results for calibration of the scintillation instruments.

- Radiation monitors consisting of compact, alarming, count rate meters can be used with a variety of detectors for both alpha and beta/gamma monitoring.

- Gas flow proportional detectors may be set up to detect alpha particles only, beta/gamma radiations only, or a combination of alpha and beta/gamma.

- Alpha scintillation detectors, e.g. zinc sulfide, can be used for personnel and equipment surveys.

- Geiger-Meuller detectors with thin windows can be used for detecting beta and gamma radiation.

A radiation survey will be performed of buildings and structures at the facility in order to characterize the respective radiological conditions for that area or unit. Large buildings will be subdivided for survey purposes. Smooth surfaces such as floors, walls and ceilings will be systematically surveyed utilizing a grid system. Irregular surfaces such as equipment and tanks will be surveyed in accordance with the survey plan developed for the area being surveyed. Floor and wall surfaces will typically be surveyed on a 10 foot grid pattern. However, a location may be not be surveyed if equipment or another obstruction happens to be at that same location. Also, in some areas there are no walls present and this fact will be documented as the reason for the lack of results. The facility is complex and will require flexibility in the design and performance of surveys for each area. The location of survey results will be documented using a standard grid system.

The radiation and contamination survey results obtained during this characterization effort are not intended to be utilized to release areas for unrestricted release. Measurements obtained during characterization of the facility will be utilized for the purpose of reporting the radiological conditions at the site. This information will be used in planning the decontamination and decommissioning actions which will be taken. When these decontamination and decommissioning actions have been completed termination surveys will be performed to demonstrate that the criteria established for the site have been satisfied.

Characterization surveys will be performed in outdoor areas to identify radioactive contamination and to describe the radiation levels in these areas. Surveys will also be performed in areas outside the restricted area suspected of containing some level of radioactive contamination. This would include drainage areas which receive surface water runoff originating in the restricted area and locations in the immediate vicinity of the facility which were potentially impacted by company operations.

Results from surveys will be documented utilizing standard forms in accordance with approved procedures. Records shall be prepared in indelible ink, signed, and dated. These records shall be adequate to enable an independent evaluation of the site status. Changes may be made by striking through the item to be changed with a single line, entering the corrected information and initialing and dating the change. All data and supporting information, necessary to substantiate the survey findings, are considered permanent records and will be retained in accordance with the site records retention policy.

Survey and sampling methods; instrumentation capabilities and requirements; calculation of results; and reporting of results will be addressed in approved site procedures. Radiation survey instrumentation will also be calibrated in accordance with the requirements contained in the approved site procedures. Survey and sampling at the site will also be conducted in accordance with the information contained in the Health and Safety Plan.

2.2.3 Soil Characterization

2.2.3.1 Introduction

Sections 2.2.1 and 2.2.2 of this document contain information relating to the survey and sampling efforts associated with the characterization of buildings, facilities and equipment; contents of ponds and basins; solid waste burial areas; surface and subsurface soils; surface water drainage areas and background sampling and measurements. This section will discuss how the results obtained from the effort described in Section 2.2.1 will be utilized to characterize the nature and extent of SCF Material impacts to the soil and rock units above the water table associated with the designated characterization areas.

Chemical and physical properties of soils present at the Site will be determined in order to complete the pathway analysis and dose assessment. Soil property information will be included in the Final Results Report.

2.2.3.2 Soil Sample Collection

Boreholes at depths down to the water table will be constructed to provide samples representing subsurface deposits. The depth of these boreholes will vary depending on extent of impacts, sources, and hydrogeologic conditions. Soil samples will be analyzed to determine the concentration and for a representative number of samples, the physical / chemical state of the radiological and associated constituents.

<u>Soil Boring Number, Location, and Depth</u>

Each sample collected during the completion of the RFI Workplan and Site Characterization Plan shall be assigned a unique number. In addition, the location will be documented in accordance with the grid system which has been established. North and East coordinates will be assigned to the sample location. The depth interval from which the sample was collected will also be documented, to the nearest 0.1 foot. For example, if a sample were collected from the top 6 inches of soil, the depth interval for that sample would be documented as "0 - 0.5 feet."

Soil Sample Depth Intervals

Soil sampling intervals will typically be six inches between the ground surface and one foot below ground surfaces, and one foot at depths greater than the surface or one foot below ground surface. Soil samples will typically be collected continuously using borehole sampling to the depth of interest. However, not all samples will be analyzed for the parameters of interest. Depth intervals of interest will be specified for the specific conditions and data needs for the area or units being characterized.

2.2.4 Procedures for Establishing Background Quality

The background survey will establish the background exposure rate and concentration of total uranium, thorium-230, and radium-226 in the local environment. Average background levels for each of these parameters except exposure rate will be determined for soils, groundwaters, surface waters, and sediments. The background exposure rate will be determined at soil sample locations.

In the case of soils, ten locations will be chosen to sample surface and subsurface soils. The sample locations will be greater than five miles from the perimeter of the SFC Facility. The soil types and geologic formations sampled will be the same as, or at least similar to, those found on site. Sample locations will be chosen such that anthropogenic influences are minimized; examples of locations that will be avoided are drainage ways, paved surfaces, railroads, and agricultural areas. An exposure rate measurement will be made at each sample location prior to collecting any samples.

For groundwater, the background survey will be developed from the sampling efforts described in the final Groundwater Interim Measures Workplan. Specifically, existing and future data collected from monitoring wells upgradient of the site will be used to derive average background concentrations.

Regarding surface waters and sediments, the background survey will be derived from the existing respective monitoring efforts conducted in accordance with SFC's Source Materials License SUB-1010. Specifically, existing and future data collected from monitoring locations upgradient of the site will be used to derive average background concentrations.

2.3 Air Quality Monitoring

The primary air contaminant of concern at the Sequoyah Fuels Facility is uranium. A program for uranium monitoring is well established at the Sequoyah Fuels Facility, and should be satisfactory to ensure air quality is being monitored. Airborne fluorides were monitored during operation of the facility and will be monitored during a limited number of decommissioning activities.

There are a number of stacks and vents which are airborne effluent sources from the facility. These sources include the main plant stack, main plant dust collection system, sampling plant dust collector, roof ventilation exhaust fans, laboratory hood exhausts, DUF_4 Plant dust collection system and the miscellaneous digestion dust collector.

Each airborne effluent which has a potential to release significant quantities of uranium is monitored using a sampling system which will obtain a representative sample. Typically an appropriately sized and shaped sampling probe is inserted into the stack. A sample collection system consisting of tubing, filters, pump, flow measuring device, etc. is provided. The specific components and configuration will depend upon the parameters being tested for and the effluent characteristics.

Sample filters are normally exchanged every 24 hours and analyzed for gross alpha activity. The analysis is performed after allowing for the decay of short lived radon decay products. Results are reviewed by Health and Safety department personnel daily and compiled into a monthly status report for review by facility management. Health and Safety personnel evaluate concentrations exceeding established action levels and report the findings of this investigation to facility management and the radiation protection officer.

Airborne effluent results will be evaluated by the Facility ALARA Committee on an annual basis and will be included in the Committee's annual meeting report. Trends will be evaluated with respect to ongoing site work and, if indicated, methods considered to reduce emissions.

Effluent results must be reported to the Nuclear Regulatory Commission on a semi-annual basis in accordance with the requirements specified in 10CFR40.65. These reports must be submitted within 60 days after January 1 and July 1 of each year and specify the quantity of each of the principal radionuclides released to unrestricted areas in liquid and gaseous effluents during the previous six months.

Environmental air monitoring stations are provided around the perimeter of the facility at various locations. Each station is equipped with air sampling equipment including a pump, flow measuring device, filter media, associated tubing and an enclosure for the equipment. Samples are collected and analyzed in accordance with the facility environmental program, typically for uranium, radium-226 and thorium-230.

Results from environmental air sampling are distributed to facility management personnel. Included in the evaluation is a comparison of the results with the regulatory requirements. Results which are significantly elevated above the normal values shall be evaluated and the findings documented in a report to facility management.

Air samples are collected continuously, at the Restricted Area Fenceline, from each of the cardinal points of the compass. These samples are counted for gross alpha and the results reported to facility management.

Air samples are collected weekly, for uranium and fluoride analyses, from five off-site stations located in relatively high population density areas and also at the point of maximum downwind concentrations as determined by Dames and Moore dispersion calculations.

Samples obtained from the sampler located at the nearest residence are composited quarterly and analyzed for uranium, thorium-230, and radium-226. The nearest residence sample is also analyzed for uranium solubility quarterly and particle size analysis annually.

The Sequoyah Fuels Facility also has an in-plant sampling system consisting of fixed sample locations and portable high volume samplers. Areas are sampled as needed to evaluate the exposure to workers. The primary constituent of interest is uranium. Samples are collected daily, or more often if necessary, analyzed, and results reported to management.

All fixed location samples are calibrated for proper air flow in accordance with approved procedures. Samplers found out of tolerance for air flow are reported to health and safety supervision, and the impact evaluated.

Breathing zone samples are also collected as needed. The device used for this purpose is commonly called a lapel sampler. Lapel samplers are also checked for calibration and battery maintenance on a routine basis. Exposure assignments resulting from the lapel samplers are tracked on an individual basis.

In addition to the routine air sampling for uranium, the Sequoyah Fuels facility has the capability to perform the required industrial hygiene monitoring. Draeger tube kits with appropriate tubes for the chemical compounds of interest are also available. Instruments for evaluating explosive atmospheres, oxygen content, and carbon dioxide levels are available on site, and will be used as indicated.

The Sequoyah Fuels Facility uses the quality assurance guidance outlined in Nuclear Regulatory Commission Regulatory Guide 4.16, "Monitoring and Reporting Radioactive Materials In Releases of Radioactive Materials Of Liquid and Gaseous Effluents from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants", and those sections of Regulatory Guide 4.15. "Quality Assurance for Radiological Monitoring Programs (Normal Operations), - Effluent Streams and the Environment", which apply to a uranium conversion facility.

The Sequoyah Fuels facility has an established comprehensive air monitoring program in place, supported by procedures, equipment, and experienced personnel. It has proven to be effective in times of plant operation, and should serve just as well during site characterization and decontamination and decommissioning activities to protect the workers and the environment.

2.4 Monitoring Wastewater Discharge

SFC currently conducts and will continue to conduct monitoring of facility wastewater and storm water under permits issued by the EPA (NPDES Permit OK0000191) and Oklahoma's Department of Environmental Quality (ODEQ) (Waste Disposal Permit WD-75-074). In addition, SFC's operating license issued by the NRC requires monitoring of the facility's Combination Stream for contamination control purposes. All permits and licenses will be maintained as required throughout the decommissioning / remediation process.

Both the EPA and ODEQ permits are currently undergoing renewal. SFC's applications for renewal of those permits recognized that the facility is no longer operating and is undergoing decommissioning. Any required adjustments to the currently required monitoring due to this status will be addressed during the permit renewal process.

The NPDES permit renewal process required SFC to conduct a more extensive characterization of the two permitted outfalls which are described below. The characterization included all non-organic hazardous constituents identified with SFC's process operations and several other constituents which have not been identified with the process. The characterization information will be included in the RFI Report along with all monitoring information described below since the shutdown of the UF_6 facility.

2.4.1 Combination Stream (Outfall 001)

Facility wastewater is discharged via buried pipeline called the "Combination Stream" into an unnamed tributary of the Robert S. Kerr Reservoir at the facility property line west of the facility. The Combination Stream also receives storm water runoff from some of the interior sections of the processing area.

The Combination Stream is referred to as "Outfall 001" on the EPA and ODEQ discharge permits and is required to be continually sampled by the NRC license and monitored three times per week by a 24-hour composite sample by the EPA and ODEQ. Sampling of the discharge is conducted at a sampling station on the south side of the facility where the Combination Stream exits the Controlled Access Area. Samples are collected by automatic sampler and transported to the SFC laboratory by facility employees for required analyses.

Monitoring parameters for Outfall 001 on one or both permits or the license currently include the following:

- Flow (MGD)
- Total Suspended Solids
- Nitrate (as N)
- Ammonia (as N)
- Fluoride
- Uranium
- Radium 226
- Thorium 230
- Temperature
- pH

2.4.2 Storm Water Reservoir (Outfall 008)

Storm water from the outer perimeter of the facility is collected in a man-made trench and diverted to the facility's storm water reservoir located south of the processing area. The reservoir serves as a biological reactor for denitrification to reduce nitrate and ammonia levels which seep to the surface from groundwater in the western areas of the facility.

Discharges from the Storm Water Reservoir are manually controlled by sluice gates located on a tower near the dam. Both the EPA and ODEQ permits require monitoring of storm water on a daily basis when discharges are occurring for the following parameters:

- Flow (MGD)
- Nitrate (as N)
- Ammonia (as N)
- Fluoride

- Radium 226
- pH

2.4.3 Sanitary Wastewater (Outfall 01A)

Sanitary wastes from the facility restrooms and showers discharge by pipeline into the facility's Sanitary Lagoon, a facultative lagoon utilized also as an equalization reservoir prior to treatment in a package treatment plant. The package plant provides biological treatment and filtration prior to release into the Combination Stream where it is discharged with other facility wastewater discharges through Outfall 001.

EPA requires monitoring of the treated sanitary wastewater once per week as it is discharged into the Combination Stream for the parameters shown below. The DEQ permit does not require monitoring of this internal outfall. The parameters monitored include:

- Flow (MGD)
- Biochemical Oxygen Demand (BOD)
- Total Suspended Solids

2.5 Potential Receptors

Information describing the human populations and environmental systems that may be susceptible to constituent releases from the facility is important to assessment of remediation strategies. Such information includes demography, land use, threatened and endangered species, biota, floodplains and wetlands, and water usage. This information is described in sections 3.6 through 3.10 of SFC's "Preliminary Report: Descriptions of Current Conditions and Investigations".

2.6 Dose Assessment

2.6.1 Purpose

The purpose of site characterization is to accumulate site information sufficient either to support a decision that the site, in its existing state, is ready for termination of the NRC license or to support selection of some remediation strategy that can make the site suitable for license termination. Dose assessment is the estimation of the radiation dose that might be received by persons that might use the site or lands in the site environs after termination of the license. Dose assessment will probably not be required for release of substantial portions of the SFC site for unrestricted use, if, as expected, radioactive contaminant concentrations in soils fall below levels specified as Option 1 limits in the NRC Branch Technical Position. However, for certain other portions of the site, dose assessment, primarily for the development of acceptance criteria, will be an integral part of the development of the Plan for Completion of Decommissioning (PCD). This section describes the design and implementation plan for the dose assessment process to be conducted as part of the PCD based on information obtained during the SCP.

Acceptance criteria for the license termination decision are usually expressed directly in terms of radiation dose, but, in practice, must be translated into terms of radioactive concentrations of contaminants in site media. Acceptance criteria expressed in terms of dose are usually obtained from regulations and guidance of government agencies or from recommendations of organizations chartered to provide guidance for radiation protection regulations to government agencies. Concentration criteria are quantitatively related to potential radiation dose that could be received by persons using the site or its environs after termination of the license. The dose assessment process is used to derive these concentration from criteria expressed in terms of dose, taking site characteristics into account, and will be used in that way for the PCD.

The primary role of dose assessment in the PCD will be the development of appropriate acceptance criteria expressed in terms other than dose, for materials that might be left in place. These criteria can be used to classify site zones into groups that either will or will not require remediation. In addition, the dose assessment process will be used to evaluate potential radiation doses that might result from reasonably expected future uses of the site after license termination.

If, as expected, remediation turns out to be necessary for certain portions of the site, the demonstration of conformance of site conditions to acceptance criteria expressed in terms of dose will be left to the PCD. The PCD will include an evaluation of expected effectiveness of candidate remediation options and the basis for selection of certain options. However, certain candidate remediation options will be considered in the design of the site characterization to assure that data collected and dose assessment methods developed in the site characterization effort will be sufficient to support evaluation and selection of remediation options in the development of the decommissioning plan. One such option to be specifically included will be an onsite isolation facility for disposal of materials that, in their existing states, may contain levels of radioactive contaminant too high to permit termination of the license.

The dose assessment process relies to a considerable extent on site characterization data, and can also serve to help guide the site characterization effort. For example, the dose assessment process can reveal significant gaps in available site characterization data and can be used to develop appropriate quality objectives (lower limits of detection, etc.) for site characterization data. However, for reasons discussed below, it is expected that the kind and quality of site characterization data required for the SFC site can be specified adequately without a preliminary dose assessment.

2.6.2 Scope of the Dose Assessment Process

In general, the dose assessment process can be described as four discrete steps. The first two steps develop a conceptual model that describes the initial physical conditions of the site and the important characteristics of the potentially exposed population. Important characteristics are those likely to affect radiation doses that might be received by groups of people within the exposed population. The conceptual model must incorporate exposure pathways, which may be considered links between the potentially exposed population and the radioactive materials that constitute potential sources of exposure. The conceptual model must also accommodate the ways in which activities of the potentially exposed population can modify the physical conditions of the site, which can in turn, affect potential exposures and doses.

The third step expresses the conceptual model in mathematical form and the fourth step uses the mathematical model and available data from the technical literature or from the site characterization process to estimate future exposures and radiation doses as a function of time. Some iteration might be expected as data developed in site characterization force changes in the conceptual model or in data used in the mathematical representation of the model, but an aim of the site characterization plan is to minimize iteration to the extent practical. The four steps outlined above are discussed in more detail in the following sections.

2.6.2.1 Characterization of Exposure Setting and Potentially Exposed Population

Information known about the site will be evaluated to form a conceptual model of the site and the population that might be exposed to radioactive materials on the site after termination of the license. This conceptual model will accommodate projected uses of site lands, surface waters, and groundwaters based on the present and anticipated uses of physically similar sites in the area and the capabilities of the site to support various uses. This conceptual model will be sufficiently detailed to permit identification of exposure pathways, as described below.

The information to be evaluated will include descriptions of site physical characteristics, data indicating the types and spatial distributions of radioactive contaminants, and land use and demography data from the site and its environs. A substantial body of this kind of information exists for the SFC site in the form of studies performed for a variety of purposes in years past. These include studies of site physical characteristics and land use and demography conducted in the preparation of environmental reports and other reports supporting license applications and the recent Facility Environmental Investigation (FEI), an extensive study of radioactive material contamination of site soils and groundwaters. This type of information is presented in the Current Conditions Report.

2.6.2.2 Identification of Potential Exposure Pathways

This section discusses the primary aspects associated with evaluation, including quantification, of exposure pathways. Applicable information may also be found in Section 2.4 of this report.

2.6.2.2.1 Sources and Receiving Media

Reviews of the site operational history (including waste disposal practices) and studies of the distribution of radioactive contaminants on the site will be conducted to identify and classify areas of the site potentially affected by radioactive contaminants and to identify, within those areas, the types and spatial distributions of radioactive contaminants that might constitute potential exposure sources. These distributions may include radioactive contaminants contained in structures, equipment and piping, waste disposal trenches, lagoons, soils, surface waters, and groundwaters.

It is likely that a requirement for the decontamination or disposition of some plant structures, equipment, piping, and materials can be identified prior to site characterization. Those potential sources will not be included in their existing forms in the dose assessment process. However, residual radioactive materials expected to remain after decontamination or disposition will be considered as potential sources in the dose assessment process. Furthermore, items for which onsite disposal is a candidate disposition option will be considered potential sources in the forms that might be expected to exist in the onsite disposal setting.

Although some potential exposure sources can be expected to remain static over the time period of interest, natural processes and the activities of man and other organisms can combine to redistribute radioactive materials in the environment over the 1,000-year time period of interest. This necessitates evaluation of potential migration mechanisms (such as erosion by water or wind, intrusive excavation, and leaching in water) and identification of receiving media (such as surface water, groundwater, soil, sediments, and biota) to assure that the list of potentially important exposure pathways is complete.

An important part of this step is to define, in spatial terms, source and receiving units within which radioactive contaminant distributions and/or physical characteristics can be considered reasonably uniform and, at the same time, reasonably representative of site conditions. Such a simplified representation of the site is necessary to permit description of the site conditions in a mathematical form.

2.6.2.2.2 Fate and Transport of Contaminants

The time frame of interest for projection of radiation doses is 1,000 years. Therefore, projections of the transport and fate of radioactive contaminants far into the future will be developed. The starting point will be an identification of media currently contaminated with radioactive materials. Media likely to become contaminated by radioactive materials in the time frame of interest will be identified by examining the actual and anticipated rates of transport of contaminants through site media and the actual and potential effects of attenuative processes and radioactive decay and daughter ingrowth on projected concentrations in radioactive contaminated media.

Dilution is likely to be an important attenuative process for pathways involving release of radioactive material to air, surface water, and groundwater. Sorption on soil is likely to be an important attenuative process for pathways related to transport of radioactive contamination in groundwater.

Because of the long half-lives of the uranium isotopes of interest and associated nuclides that may be present, such as thorium-230 and radium-226, radioactive decay over the period of interest will not significantly reduce doses. However, contributions to radiation doses from the slow ingrowth of thorium-230 and radium-226 and daughters of radium-226 could be important in some circumstances, and will be included in the assessment of transport and fate and the projection of doses.

2.6.2.2.3 Identification of Exposure Points and Exposure Routes

Potential uses of the site and anticipated site radiological conditions will be evaluated to identify where and how groups of people in the potentially exposed population are likely to become exposed to radioactive contaminants. This evaluation will take into account reasonably expected public use of portions of the site likely to be released for unrestricted use (all but a small portion of the site), and reasonably expected intrusion scenarios for the small portions of the site likely to remain restricted after termination of the SFC license.

Definition of multiple exposure scenarios may be necessary to identify the critical population group (a hypothetical small group of people likely to receive the highest radiation doses) and to permit calculation of the aggregate population dose (to be performed in preparation of the plan for completion of decommissioning). Each scenario would calculate dose to a hypothetical receptor intended to represent a group of people exposed through a particular set of pathways appropriate for the receptor location and conditions of the site in the vicinity of the receptor location. To identify the critical population group, receptor locations would be selected to maximize the calculated dose from the source units being evaluated. In the calculation of aggregate population dose, receptor locations would be selected to represent the range of calculated doses from the source units being evaluated.

2.6.2.3 Quantification of Exposure Hazard in Terms of Radionuclide Concentrations or Exposure Rates

Potential future media concentrations and associated potential future radioactive contaminant intake rates or exposure rates for receptors representing groups in the potentially exposed population will be computed as a function of time after license termination for each exposure pathway. Direct measurements of media concentrations will be used as a starting point, but reasonable estimates of expected future concentrations, based on expected migration patterns and rates, will be included. Computer models selected for computation of radioactive contaminant transport will be capable of modeling transport associated with candidate remediation scenarios.

2.6.2.4 Estimation of Radiation Dose

Potential future radiation doses based on potential intake rates and exposure rates will be computed. Radiation doses from internal exposure (inhalation or ingestion) will be computed using dose factors developed from ICRP 30 methodology, such as those in Federal Guidance Report 11. Annual total effective dose equivalents, totaled over all applicable exposure pathways, will be computed as a function of time after license termination (over a period up to 1,000 years in duration) for each receptor. This value can be compared to acceptance criteria expressed in terms of dose to evaluate a remediation strategy. The value can also be used in conjunction with acceptance criteria expressed in terms of dose to derive acceptance criteria in terms of concentration using the principle that radiation dose is directly proportional to the source unit concentration.

The computation of radioactive contaminant concentrations in media and radiation doses associated with exposure to those media are complex, and are usually performed using computer codes designed for the purpose. Some widely-used computer codes calculate both contaminant concentrations in media, as discussed in Section 2.5.2.3, and radiation dose to receptors. It is anticipated that two of these codes, RESRAD and GENII, would be suitable for evaluation of almost all pathways in the SFC site characterization.

A possible exception could be pathways involving radioactive contaminant transport in groundwater. The GENII code has no capability for calculation of contaminant transport in groundwater, and the RESRAD transport model may be too simplistic for application to the SFC situation. However, it is likely that other available codes, such as PRESTO-CPG and PATHRAE-EPA, would be suitable as complements to either the RESRAD or GENII codes for evaluation of groundwater pathways. The PRESTO-CPG code includes a module that calculates infiltration through a low-permeability cover, which could be particularly helpful in the evaluation of acceptance criteria for material to be disposed of in an onsite isolation cell.

2.7 The Dose Assessment Plan for the SFC Site Characterization

The plan for the application of dose assessment in the SFC site characterization is discussed in this section.

2.7.1 Preliminary Dose Assessment

For site characterization in the general case, a preliminary dose assessment, conducted in the initial stages of the planning of the site characterization, may be useful. For example, a preliminary dose assessment may be necessary to develop required analytical sensitivities for radioactive contaminants not addressed in NRC positions stating maximum concentrations in soils and other materials for release for unrestricted use. A preliminary dose assessment may also be useful in identifying parameters that are both highly important to dose and highly variable from site to site.

However, in the particular case of the SFC site, a preliminary site-specific dose assessment is not necessary. Appropriate sensitivities can be derived as suitably small fractions of the Branch Technical Position Option 1 values, which include values for all nuclides potentially present at the SFC site. In addition, the pathways of greatest potential importance and those parameters that are most important and that vary significantly from site to site can be accurately identified without a preliminary dose assessment. It may, however, be desirable to include in the site characterization plan reasonable efforts to quantify these parameters for the SFC site. Plans regarding pathways to be evaluated and site-specific measurements of parameters potentially important in the SFC dose assessment are discussed in the following two sections.

2.7.2 Potentially Important Exposure Pathways

A summary description of exposure pathways potentially significant enough that they may warrant evaluation in the PCD include:

- Direct radiation from material in soil
- Resuspension of surface particulate material--air--inhalation
- Release of radon gas from radioactive material in near-surface soils--ingrowth of airborne particulate radon daughter products--inhalation
- Resuspension of surface particulate material--air--deposition or uptake in edible plant tissue--ingestion
- Uptake of material in soil through roots of edible plants--ingestion

- Resuspension of surface particulate material--air--deposition or uptake in edible plant tissue--ingestion by animal--ingestion of animal product

- Uptake of material in soil through roots of edible plants--ingestion by animal--ingestion of animal product

- Release of materials in soil to water flowing through the site--runoff to surface water--ingestion

- Release of materials in soil to water flowing through the site--runoff to surface water--uptake in water life--ingestion

- Release of materials in soil to infiltrating water--groundwater--ingestion

- Release of materials in soil to infiltrating water--groundwater--transport to surface water--ingestion

- Release of materials in soil to infiltrating water--groundwater--transport to surface water--uptake in water life--ingestion

- Release of materials in soil to infiltrating water--groundwater--transport to surface as irrigation water--deposition or uptake in edible plant tissue--ingestion

- Release of materials in soil to infiltrating water--groundwater--transport to surface as irrigation water--deposition or uptake in edible plant tissue--ingestion by animal--ingestion of animal product

The groundwater ingestion pathway could be of particular importance for source units containing soils or groundwaters contaminated with uranium, thorium or radium. Crop ingestion would be a significant pathway for these units, and could be most important in the absence of a groundwater pathway. Radon inhalation and direct exposure pathways would be important for units contaminated primarily by thorium-230 or radium-226, which, as uranium daughter product impurities present in incoming uranium yellowcake, could be present in some site soils.

Some of these pathways may be eliminated through appropriate restrictions in use.

2.7.3 Site-specific Measurements Desirable for Dose Assessment

As stated above, radiation dose assessments will be used to develop criteria for evaluating remediation strategies including material to be left in place and material to be deposited in an on-site isolation cell. The most important site-specific data required for the radiological assessments necessary to develop criteria for material to be left in place are data related to characterization of the source term and data important for the groundwater pathway. The most important parameters are:

- lateral and vertical extent of impacted soil zones, and distribution of concentrations of radioactive materials in site soils within these zones,

- characterization of site hydrogeology, including characterization of water-bearing zones (composition, thickness, total and effective porosity, gradients, hydraulic conductivities, extent of communication between zones, etc.)

- distribution of radioactive contaminants in water-bearing formations,

- rate of water infiltration,

- leach rate fraction, distribution coefficient (K_d), and/or solubility for radioactive contaminants of interest in the zone,

- distribution coefficient (K_d) for radioactive contaminants of interest in the uncontaminated zones between the contaminated zone and groundwater, and in water-bearing zones.

Many of these parameters are related to the groundwater pathway. It will be necessary to determine the potential use of water-bearing formations based on consideration of capacity limitations, water quality limitations, and other physical characteristics. It will also be necessary to collect data sufficient to determine the extent to which radioactive contamination of lower water-bearing zones that might be suitable for use can be expected. If groundwater in a potentially impacted zone is usable, then data necessary to compute future contaminant concentrations in the groundwater will be required.

Some of the data listed above have been collected during the FEI. However, the FEI was not intended to be an investigation in support of decommissioning. For example, the primary FEI focus was distribution of uranium contamination in the present and in the near future, i.e., the next few decades. The evaluations for purposes of decommissioning will be broader in scope, and the time duration of interest will extend to as long as 1,000 years. Because of these differences, additional site characterization will be required. For example, the potential for radioactive contaminant migration in groundwater beneath the upper-most water-bearing zones, which were characterized in the FEI, needs to be explored. In addition, contaminant sorption and retardation characteristics (leach rate constants, distribution coefficients, etc.) within the water-bearing zones and in soils above the water-bearing zones need to be determined. Additional assessment of the lateral and vertical distribution in soil of thorium-230 and radium-226 will also be required.

Many of the parameters described above will also be required for radiological assessments to develop criteria for material to be deposited in an on-site isolation cell, should such a cell be necessary. For these analyses, however, the spatial area of interest will be more concentrated in the candidate locations for the isolation cell. Some of these parameters, such as hydraulic conductivity of the cover and liner, will depend to an extent upon cell design, but values achieved in typical cases can be used in evaluating the expected effectiveness of remediation options. Additional site characterization may be necessary to support the detailed design of an engineered isolation cell. However, a complete definition of additional data needs for this purpose must await preliminary design work.

2.8 Schedule

The current plan for completing this SCP is described in the schedule in Figure 5. Each major task is shown along with the estimated duration and relationship between tasks. SFC will utilize the plant staff where possible to complete the characterization work. SFC's staff will be augmented with consultants and contract personnel to make up for any resource shortfalls or gaps in expertise.

2.9 Budget

The budget shown in Table 3 is the best estimate currently available for the overall work defined in both the RFI Workplan and the SCP. Actual sampling requirements in some areas will be defined during implementation of the SCP after preliminary surveys have been performed. SFC has attempted to estimate the sampling analysis requirements for these areas and Table 3 includes those costs.

3.0 Data Collection Quality Assurance Plan

3.1 Data Collection Strategy

This section presents the rationale for investigation of the SFC Facility to characterize source and SCP Material conditions. It describes the associated procedures for sampling, field measurements, and sample analyses to be performed during the investigation. The investigation will be conducted in such a fashion to ensure that all information, data, and resulting decisions are technically sound, statistically valid, and properly documented.

3.1.1 Data Usage

Data collected during the investigation will be used to determine if, and to what extent, SCP Materials are present in the units and if so, if releases have occurred from the units. Data will also be collected and used to evaluate receptor locations and potential impacts upon identified receptors.

3.1.2 Data Assessment

The quality of the data will be controlled and monitored throughout the investigation effort. The degree of control and monitoring will be a function of the parameter and end use of the data. The control and monitoring efforts will occur during sample collection, sample handling, sample analysis, and data management. In general, precision, accuracy, and completeness will be controlled and monitored in accordance with quality assurance/quality control plans and procedures specific to either sample collection, sample handling, sample analysis, or data management. Such plans, except data management, are discussed in the following subsections. Data management is discussed in Section 4.0.

3.2 Quality Assurance Plan

3.2.1 Introduction

This section of the Data Collection Quality Assurance Plan provides rationale and guidance for field sampling and field measurements.

Procedures for field sampling of specific media types are described in separate quality assurance plans.

3.2.2 Field Sampling Procedures

Specific guidance for field sampling procedures are detailed in the following plans:

- Soil Sampling Quality Assurance Plan, Appendix A.
- Surface Water Sampling Quality Assurance Plan, Appendix B.
- Sediment/Sludge Sampling Quality Assurance Plan, Appendix C.
- Monitor Well Installation and Field Sampling Quality Assurance Plan, Appendix D.
- Groundwater Sampling Quality Assurance Plan, Appendix E.

In addition, examples of all forms to be used in the field, as appropriate, to document activities and sample chain-of-custody control are presented in Appendix F, "Example Forms".

3.2.3 Laboratory Quality Assurance Plan

3.2.3.1 Introduction

The purpose of the Laboratory Quality Assurance Plan is to ensure that information, data, and interpretations resulting from the analytical data are technically sound and provide accurate and precise data. The following sections discuss sample handling, preservation, analytical procedures and chain of custody. A copy of the Laboratory QA/QC Plan from SFC's Laboratory is provided in Appendix G, "Laboratory QA/QC Plan".

3.2.3.2 Quality Assurance Objectives

The overall quality assurance (QA) objective is to develop and implement procedures for laboratory analysis to attain acceptable levels of quality for the Site Characterization Plan (SCP).

<u>Project Management Objectives</u>

The project management objectives are established to ensure:

- the quality of data generated by the study meets the objectives of the SCP and RFI;
- the validity and integrity of laboratory analysis; and
- the quality of work performed by laboratory subcontractors meets performance quality standards.

The QA procedures adopted for this project provide assurance that all investigations will yield comprehensive and valid results.

Field Quality Assurance Objectives and Procedures

Equipment blanks, trip blanks, and/or duplicate samples will be collected and submitted to the analytical laboratory to assess the quality of the analytical data from the field sampling program. One equipment blank sample per day during water sampling will be submitted for analysis of the same analytical parameters as unit samples. One duplicate sample per day will be collected and submitted for analysis of the same analytical parameters as the unit samples.

Borehole locations will be surveyed to position and elevation. Horizontal position will be surveyed to within one (1) foot. Vertical groundwater elevations will be surveyed to within 0.1 foot. All elevations will be referenced to mean sea level elevations.

3.2.3.3 Sample Handling

Sample handling requirements, such as preservation and holding times, for hazardous constituent analysis are generally different than those for radiological constituents. Therefore, it may be necessary to split samples for each respective analysis.

Appropriate containers and handling to provide sample integrity and prevent cross contamination of samples will be used for samples collected in association with the Site Characterization Plan. Specific sample handling requirements are provided in written procedures.

3.2.3.4 Sample Analytical Parameters and Methods

SCP related samples will be analyzed for uranium, radium-226, thorium-230, nitrates and fluorides in accordance with written procedures and NRC license requirements. SFC routinely analyzes samples for these parameters in association with licensed activities performed at the site. The rationale for selection of these parameters was based on process knowledge, a review of results of samples collected from process and waste streams during operation of the facility, and a review of the Facility Environmental Investigation (FEI).

3.2.3.5 Laboratory Analytical Procedures and Analytical Reporting Limits

Uranium analysis will be performed by laser fluorimetry in accordance with a written procedure. This procedure has been prepared in accordance with the manufacturers recommendations.

Thorium-230 analyses will be performed in accordance with a modification to Los Alamos National Laboratory Method ER-200, "Thorium-230 in Soils, Rocks, Sediments and Ores". This method utilizes separation by wet chemistry, followed by alpha spectral analysis.

Radium-226 analysis will be performed using differential analysis by gross alpha and gross beta counting after $BaSO_4$ precipitation. This method measures ingrowth of Ra-226 progeny.

Fluoride analyses will be performed for soil, sediment and sludge samples using EML Method F-01 from the HASL manual. Water samples will be analyzed for fluoride using EPA Method 340.2.

Nitrate analyses will be performed using Method 4500-NO3-D from Standard Methods of Analysis, 17th Edition. This method includes analysis of soils, sediments, sludges and water samples.

4.0 Data Management and Reporting

4.1 Data Management

Site characterization activities at SFC will result in the generation of a significant amount of data. The data will consist predominantly of physical and chemical analyses of different environmental media. Data will be collected representing a variety of constituents, locations, and time, among other potential parameters. Data management procedures will be established to ensure that the data is readily accessible and accurately maintained in a timely manner. The data management procedures will ensure that data is verified, reduced, interpreted, and presented in appropriate formats for decision-making purposes. The data will be managed primarily in terms of records and files.

4.1.1 Data Record

A data record(s) will be established to document field observations, collection of samples, field measurements, analytical results, and data evaluation. The data record(s) will include the following information:

- Unique identification for each sample or measurement;
- Field data sheets;
- Chain-of-custody forms;
- Field log books;
- Maps and drawings;
- Analytical results; and
- Calculation work sheets.

4.1.2 Files

Data collected during site characterization activities will be maintained in two file formats; hardcopy and electronic. The two formats will not necessarily be completely redundant, but will serve to make the data accessible and preservable.

4.1.2.1 Hardcopy

Each area of investigation (unit) will be assigned a unique project number. The number will be used as a cross-reference on data records and also as a filing system number.

Index numbers will be assigned to each major task conducted in a unit. Hardcopy files will be filed by unit number and subsequently by index number.

4.1.2.2 Electronic

All numerical data collected during an investigation (e.g. raw data, field measurements, analytical results) will be evaluated for reduction and entry into an electronic database format. The evaluation will consider the amount of data, the duration of the investigation, current and future use of the data, and data presentation. Typical formats will be spreadsheets and relational databases. The data will be stored on disk with a unique file name consistent with the file structure established for hardcopy files.

4.3 Data Presentation

Data collected during site characterization activities will be presented in two primary formats; tabular and graphic. A combination of formats may be used depending on the data evaluation or presentation requirements.

4.3.1 Tables

In many cases, tables will be used to present the raw data or simple evaluations in an organized manner. Types of data most likely presented in this fashion are field measurements, analytical data, and statistical summaries.

4.3.2 Graphics

Data interpretation, and evaluation of such, will often rely on graphs, charts, maps, diagrams, drawings, or plots. Typical uses of this format include line graphs, bar charts, area maps, cross-sections diagrams, construction drawings, and location plots.

4.4 Data Reduction

Data shall be reported in accordance with quality assurance and validation practices as described in approved facility procedures. All data will be reported.

4.4.1 Duplicates

Duplicate measurements will be averaged prior to further data reduction.

4.4.2 Outliers

Outlier values will be included and identified with presentations of raw data. However, these values will not be included in summary data presentations or data evaluations.

4.4.3 Values Below Detection Limits

Analytical values determined at or below the detection limit will be reported numerically (e.g. <0.5 pCi/g). The numeric value of the detection limit will be used for data evaluation and the corresponding result reported as a "less than" value.

4.5 Reporting

Reporting will be done in accordance with applicable regulations and SFC license conditions.

5.0 Health and Safety Plan

5.1 Introduction

Sequoyah Fuels Corporation has an established health and safety program which will be maintained during RFI activities, site characterization, and site decommissioning. The program is contained in several program documents, corporate policies, and site procedures. In order to serve as a health and safety plan for the Site Characterization Plan, a facility description, description of roads and utilities, and description of known hazards is presented here. Other health and safety plan elements are contained in program documents, corporate policies, and site procedures which are included as appendices.

5.1.1 Facility Description

A description of the facility is provided in Section 1 of this plan. A more complete description may be found in SFC's NRC license.

5.1.2 Roads and Utilities

Roads and utilities (e.g., water, electricity, communications) are essential components of the emergency response capabilities at the Sequoyah Facility. Access to the facility is provided by Oklahoma Highway 10 adjacent to the eastern boundary of the site. Arterial roads include U.S. Highway 64 and Interstate 40.

The plant make-up water is supplied from Tenkiller Reservoir at approximately 1,600 gpm and is piped to a storage sump having a design capacity of 30,000 gallons from which it is distributed to the following systems:

- Emergency cooling water, which can be redirected to the suction of the fire pumps.
- Cooling water system, overflow from the storage sump to the cooling tower equalizing pit.
- Domestic water sedimentation sump.

There is no flow control of the make-up water to the storage sump. At periods of low demand, the sump overflows into the cooling tower equalizing pit where, at a high water level, it overflows to the Combination Stream. During periods of low flow from Tenkiller Reservoir, emergency water will be introduced into the storage sump from the 100,000 gallon emergency cooling water storage. Flow is activated by a level transmitter signaling a control valve to open.

Preliminary water treatment, when necessary, takes place in the sedimentation sump prior to distribution of the water to the domestic water system, and consists of chemical addition and flocculation and/or a coagulant aid injection. The sedimentation basin has a design capacity which provides a design flow rate of approximately 340 gpm.

The fire protection system is designed to supply a minimum of 150,000 gallons of fire water stored in the water storage tank and piped to the fire pumps. Water is plumbed to major areas of the facility and may be extended to additional zones on an as needed basis.

Primary electrical power is supplied to the facility at 69KV from Oklahoma Gas and Electric Company's Warner Substation and Roland Road Substation. OG&E's substations are tied together in their substation located on SFC property.

The 69KV lines feed two 10,000 KVA 69KV/12.47 KV transformers in the substation. Either of these transformers have the capacity to supply the facility's electrical requirement. Power at 12.47 KV is fed to the plant's load centers and rectifiers through static reclosers. The static reclosers are equipped with protective relays and are electrically operated from the control room.

The double-ended load centers each have two 1000 KVA 12.47KV/480V transformers, fused primary load break switch, 480V main breakers and a tie breaker. The load centers are loop tied from the reclosers. A transformer in each load center is supplied from a recloser and the other transformer supplied from a different recloser. The load centers distribute power to designated motor control centers, as needed. A separate load center is supplied for the UF_6 Reduction Plant. One transformer is supplied from one vacuum switch in the main distribution system.

Control switches for operating the load center main breakers are located in the control room along with voltmeters and ammeters to monitor transformer electrical loading. Each load center transformer is equipped with a ground fault sensing relay and indication provided in the control room for a ground fault.

With the redundancy designed into this electrical system, the plant power supply could remain operational if one of the 10,000 KVA substation transformers failed or if one of the 1000 KVA transformers in each load center should fail.

Power will be routed to field locations on an as needed basis for routine work activities. Portable generation equipment may be necessary for activities performed at remote locations at the facility.

The Sequoyah Facility is equipped with a diesel powered electrical generator to provide power to certain critical equipment in the event of a total loss of offsite electrical power. All emergency loads are connected to a motor control center which is fed through an automatic transfer switch. This switch senses the loss of 480V power and automatically starts the emergency generator. After a time delay of approximately 30 seconds, to allow the generator to reach operation speed, the switch transfers the emergency loads to the generator. Upon restoration of normal power, the load is transferred back to normal power. The emergency generator is tested bi-monthly. The generator is a diesel driven 480 VAC unit rated at 300 KW at a 0.8 power factor, continuous duty. A bank of 24 VDC batteries with 120 VAC electrical charging is maintained to assure that the engine will start when required. The diesel oil supply tank has 2000 gallon capacity and also supplies fuel to a diesel engine driven fire pump.

Normal communications at the facility are provided by a private automatic telephone system. The facility also utilizes an FM radio communications system consisting of a base station in the Control Room and portable, two-way sets carried by personnel. An ample supply of portable units is available onsite.

A facility public address system is used in conjunction with an air horn to alert employees and direct them away from hazardous conditions. These two systems comprise the Onsite Emergency Notification System. The air horn signal alerts personnel to an emergency condition. Then information is passed over the public address system concerning protective actions and evacuation routes. Both the air horn and the public address signal systems can be activated from the Control Room or the South Guard House.

5.1.3 Known Hazards

Known hazards present at the Sequoyah Facility are well defined. These hazards have been identified during operation of the plant, and there is no reason to believe they would not be indicative of hazards that will be encountered during characterization or remediation activities. Bulk chemicals which were stored at the facility for production purposes have been removed from the facility and most of the process lines have been flushed to remove contents.

Hazards

A description of hazards is presented in Section III of the Hazardous Work Permit Guidance Document, a facility aid used in the preparation of Hazardous Work Permits. Section III of this document is included as Appendix H. Facility personnel are trained and equipped to control and handle these hazards. This document was prepared while the facility was still in operation and therefore is a conservative representation of the current conditions at the site. The information provided should be included in the evaluation of precautions to be taken when beginning work in an area in which residual materials may be present.

Postulated Accidents

Emergency procedures (EP's) and Contingency Plan Implementing Procedures (CPIP's) are in place to address accidents and emergencies. A list of the procedures in included in Appendix M. Postulated accidents include:

- Ammonia valve leak or line breakage.
- Acid spill.
- Spill of dry uranium compounds.
- Chlorine

Natural uranium, although radioactive, is of low specific activity, and radiation emitted has low penetrating power. Therefore, the primary health and safety consideration with regard to natural uranium is its chemical toxicity as a heavy metal. Thus, the immediate environmental considerations of accidents that could occur are related almost exclusively to the toxic effects of chemicals, including uranium, which might be released to the environment in the event of an accident.

The analysis of probable events and their appropriate emergency classification has been developed to conform with the NRC guidance concerning emergency plan requirements in NUREG 0762, Standard Format & Content for Radiological Contingency Plans for Fuel Cycle and Materials Facilities. This document also reflects the technical assessments contained in the following documents:

- NUREG 1140, A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and other Radiological Material Licenses, S.A. McGuire,USNRC Draft Report for Comment, June, 1985.
- NUREG 1157, Environmental Assessment for Renewal of Special Nuclear Material License No. SUB-1010, Docked No. 40-8027, Sequoyah Fuels Corporation.

5.1.3.1 Ammonia (NH_3) Valve Leak or Line Breakage

Ammonia is stored onsite in a portable, 1000 gallon tank that is charged to 800 pounds. A catastrophic failure of this tank is not probable, therefore a leaking valve or transfer line failure is postulated to be the maximum credible accident (NUREG-1157). Should a release occur at an ambient temperature of 80°F, about 20% of the NH_3 would flash to vapor resulting in a release of approximately 34 kg/min.

NUREG-1157 presents an independent conservative analysis which concludes that noticeable irritation for a brief exposure would not extend beyond about one-half mile. The potential risks were therefore judged to involve discomfort without any permanent damage.

This incident would be classified and responded to in accordance with facility emergency procedures.

5.1.3.2 Acid Spill

Although systems have been purged of material and the tanks have been drained, it is a possibility that some residual material could remain in the system. Aqueous HF and Nitric Acid are corrosive acids that, if spilled, could cause impacts on site until neutralized and cleaned up. Some sulfuric acid (less than 500 lbs.) is stored onsite for pH adjustment of effluent streams. Storage tanks are located in containments which would prevent uncontrolled spills in the event of a tank failure. Containments are located in proximity to retention basins.

Spills would be visually detected by shift operators. The spill would be neutralized and cleaned up.

5.1.3.3 Spill of Dry Uranium Compound

The majority of uranium concentrate (normally U_3O_8) stored at the facility is contained in fifty-five gallon drums. Inventories are being reduced and will ultimately be eliminated. There is a potential for spillage of low specific activity solids during sampling and transporting activities.

The spill would be visually detected by shift operators, and would be promptly contained and affected areas decontaminated. Spills would not be expected to have off-site consequences.

5.1.3.4 Chlorine

Chlorine is used on site for water treatment. Online cylinders are stored in containment areas to minimize the risk of exposure to personnel. These are 90 lb. cylinders, and only one is in use at any one time. Detailed procedures exist for emergency exposure control and evacuation.

In summary, hazards at the Sequoyah Fuels Facility are identified, and appropriate response measures are well established. There is a procedure to accomplish required training for emergency responders; see the listing of procedures in Appendix M.

5.1.4 Worker Protection from Weather Related Problems

The Sequoyah Fuels Facility has a response plan for dealing with weather related problems. The information is included in the Emergency Procedures series. See Appendix M for a listing of Emergency Procedures.

5.2 Radiation Protection Program

The Radiation Protection Program, included as Appendix I, describes:

- Organization responsible for safety, including responsibilities for protecting workers, public, and environment
- Work areas
- Personnel Protective Equipment
- Site Access
- Decontamination
- Site Emergency Procedures
- Medical Care for Injuries and Toxicological Problems
- Environmental Surveillance

Many other health and safety topics are covered in the Radiation Protection Program. Those listed above are of special interest to the Health and Safety Plan developed in support of the Site Characterization Plan.

5.2.1 ALARA Policy

The philosophy of maintaining exposures As Low As Reasonably Achievable is practiced at the Sequoyah Facility. The ALARA Policy is included as Appendix J. The ALARA Policy is implemented in accordance with a written procedure.

5.2.2 Respiratory Protection Program Policy

A Respiratory Protection Policy Statement is required by the Sequoyah Fuels Corporation respiratory protection program. This statement is included as Appendix K. The respiratory protection program is implemented in accordance with a written procedure.

5.3 Employee Safety Handbook

The Employee Safety Handbook, issued to all employees, provides the basic safety requirements for all personnel working at the Sequoyah Facility. This handbook is included as Appendix L.

5.4 Listing of Procedures

Procedures are established to guide work activities so that they are performed safely. These procedures reflect guidance from 29CFR1910, Occupational Safety and Health Administration Occupational Safety and Health Standards; 10CFR20, Nuclear Regulatory Commission Standards for Radiation Protection; and other pertinent regulations, guidance and standards of good practice. A listing of applicable procedures is included as Appendix M.

5.4.1 General Procedures

General procedures are applicable to all facility employees and include general safety information.

5.4.2 Health and Safety Procedures

Health and Safety procedures are specifically applicable to health and safety issues, such are radiation survey requirements, posting requirements, etc.

5.4.3 Emergency Procedures

Emergency Procedures and Contingency Plan Implementing Procedures provide information to employees relative to emergency response.

5.5 Non-Routine Work

Work activities which are not covered by a procedure will be addressed under hazardous work permits (HWP's). An HWP specifies safety precautions and health & safety measures necessary to ensure the safe completion of required work. Prior to starting work, all parties involved will review and sign an HWP. All confined space work will require a Confined Space/Vessel Entry Permit. Major excavation or drilling (more than four feet) will require a Digging Permit.

6.0 Community Relations Plan

6.1 Overview of Community Relations Plan

The community relations plan outlines community relations activities to be conducted during the Site Characterization Plan (SCP) activities at the SFC Site. There is a possibility that activities at the Site may cause some questions or concerns among members of the communities near the Site. An effective community relations program for this Facility should prepare for any community interest and attempt to educate, without alarming residents, so that they can better understand both the site characterization and decommissioning process.

This community relations plan has been prepared to aid SFC in developing a community relations program for communities located near the Site. An outline of the community relations plan is presented below:

- Capsule Site Description
- Community Background
- Highlights of Community Relations Program
- Community Relations Activities

6.2 Capsule Site Description

The Site is owned by Sequoyah Fuels Corporation. It is located on State Highway 10, just north of Interstate 40 near Gore, Oklahoma. SFC began operation of the facility in 1970 under license by the Nuclear Regulatory Commission. The SFC Facility is currently undergoing decommissioning and no longer is in commercial operation. When in operation, the Facility operated 24 hours a day, seven days a week, and provided, at times, jobs for more than 300 people.

When in operation, the Facility processed uranium ore concentrates to produce uranium hexafluoride. The uranium hexafluoride was subsequently shipped to other facilities around the country for further processing. The Sequoyah Facility was one of only two such facilities in the United States which produced uranium hexafluoride. The Facility also processed depleted uranium for the U. S. defense industry.

The processing of the uranium ore concentrates involved several complex steps. The uranium ore concentrate, or yellowcake, was weighed and sampled upon arrival from various sources around the world. The yellowcake was then dissolved in acid and the uranium was extracted. This uranium, in a nitrate solution was then converted to an oxide and finally was reacted with hydrogen fluoride and fluorine to produce the uranium hexafluoride product. The nitrate materials were reacted with ammonia to produce an ammonium nitrate fertilizer solution used on agricultural lands.

On February 16, 1993, SFC submitted a Preliminary Plan for Completion of Decommissioning (PPCD) of the SFC Facility to the Nuclear Regulatory Commission (NRC). The PPCD included a commitment to develop a Site Characterization Plan (SCP) to determine the extent and concentration of licensed material at the SFC Facility. Additionally, the PPCD projected a schedule and budget for completion of the decommissioning of the facility based upon the information available on site conditions, reasonable assumptions relative to decommissioning options, and NRC guidance concerning such work.

On August 3, 1993, SFC and the U.S. Environmental Protection Agency (EPA) signed a Resource Conservation and Recovery Act (RCRA) Administrative Order on Consent (AOC). The AOC includes a requirement for SFC to perform a RCRA Facility Investigation (RFI). "The purpose of [the RFI] is to determine the nature and extent of releases of hazardous waste or constituents... at the Facility and to gather all necessary data to support [a corrective measures study]."

6.3 Community Background

The Sequoyah Facility is located approximately 2.5 miles southeast of the town of Gore, 3 miles east of the town of Webbers Falls and 6.3 miles west of the town of Vian. The area around the Facility can be described as sparsely-populated and rural.

The approximate populations of these towns, as recorded in the 1990 census, are Gore 690 persons; Webbers Falls 722 persons; and Vian 1414 persons. The towns of Gore and Vian are located within Sequoyah County in eastern Oklahoma. The town of Webbers Falls is within Muskogee County. Agriculture is a mainstay of the county's economy, with grain and cattle being major products. The 1988 to 1989 average daily attendance at the school districts of Webbers Falls, Gore, and Vian were 336 students, 454 students, and 879 students, respectively.

The local community has expressed various questions and concerns regarding the Facility. These include the economic impact on the community now that operations have ceased and decommissioning and remediation activities, and health hazards or potential health hazards are all questions that have been asked. Other questions regarding long term health effects and groundwater quality have also been discussed.

The start of the RFI and site characterization activity may increase public interest because the activities may be noticeable, particularly when using drilling rigs or teams of sampling personnel. It is important to recognize this potential for increased community interest.

6.4 Highlights of Community Relations Program

The goal of the community relations program is to build trust and confidence that the investigations and decommissioning and remediation activities do not present any significant risks to the community. The community relations program will be administered according to the local community's need for information and their interest and willingness to participate in the process.

The program establishes guidelines for informing the local community of the processes required for site characterization, SCP activity progress, and opportunities for local input into the SCP. To accomplish these objectives, the following approaches will be considered:

6.4.1 Maintain frequent contact with adjacent neighbors.

The community relations program will initially include contact with those adjacent neighbors that would likely notice the investigation activities such as drilling and sampling. It is SFC's goal that they be regularly and fully informed of site activities, plans, findings and developments.

6.4.2 Provide the community with periodic updates.

A local public information/community relations coordinator has been appointed. This individual is familiar with the investigative process and the community relations program and is available to explain both. Fact sheets and information addressing the investigation will include the name and telephone number of the community relations coordinator. The coordinator will work with SFC management to develop fact sheets and other materials, plan strategies for dissemination of information to the public, and represent the company at public meetings and briefings, if such meetings are necessary. Additionally, the community relations coordinator will ensure that all public information is available and up to date.

6.4.3 Document program activities.

Records will be maintained documenting all activities and efforts undertaken as part of the community relations program. The community relations coordinator will be responsible for recording all major contacts and activities, the date of such contact or activity, and its result or outcome. This documentation will be a helpful tool in assessing and updating the program.

6.5 Community Relations Activities

Based on past local interest about the Facility, care will be taken to provide sufficient information to keep the community informed without causing alarm through an overzealous community relations program. Information will be supplied as needed by the community and will not be forced upon local community members. It is possible, therefore, that some of the activities listed below may be revised or deleted altogether, depending on community needs.

The following activities may be undertaken to ensure that the community is well informed about the site activities and has the opportunity to express concerns:

6.5.1 Establish an information contact.

The community relations coordinator for SFC is responsible to respond directly to public inquiries regarding site activities. The coordinator's name, telephone number and mailing address will be listed on information material so that residents know where to seek information about the site. The coordinator will perform the duties described in Section 6.4.2.

6.5.2 Establish and maintain information repositories.

In order to allow free and convenient public access to information on the nature of site investigations, findings and response activities, an information repository will be established. The repository will be located in a public facility readily accessible to the community, such as the Sequoyah County Health Department or the Gore Municipal Building. Materials in the repository will include a copy of the community relations plan, plans and reports on site investigations, fact sheets, periodic updates on site activities, and names of the SFC community relations coordinator as well as contacts in the Nuclear Regulatory Commission (NRC), Environmental Protection Agency (EPA), and Oklahoma Department of Environmental Quality (ODEQ). Information will be added as needed and it will be updated on a regular basis.

6.5.3 Develop mailing lists.

Mailing lists will be developed to include residents living near the site and interested groups and organizations. The mailing lists will be used to provide interested groups and individuals with fact sheets about the site. These mailing lists will be maintained as part of the community relations program.

6.5.4 Conduct public meetings.

Meetings with residents will be held if public inquiries indicate a public meeting format would be a better and more effective method to convey investigation information and answer questions. The meetings may include the appropriate technical representative from Sequoyah Fuels as well as the information contact and, as necessary, representatives from the NRC, EPA, and ODEQ.

6.5.6 Prepare fact sheets and technical summaries.

A fact sheet will be prepared at the beginning of the site characterization process and will be available to inform residents and other interested citizens of the respective plans and procedures. At the end of the SCP investigation a fact sheet will be prepared summarizing the Results Report. Additional fact sheets may be prepared at regular intervals, or as necessary, to update the public on the progress at the site.

6.5.7 Provide press releases and information to the media.

Press releases will inform the community of public meetings and provide periodic updates of the site characterization process. The community relations coordinator will be responsible for such press releases.

Table 1. Site Characterization Unit Listing	
Unit No.	Unit Description
1	Main Process Building Area
2	Solvent Extraction Building Area
3	Initial Lime Neutralization Area
4	Surface Water, Entire Facility
5	Solid Waste Burial Area No.1 (South)
6	Emergency Basin
7	Sanitary Lagoon
8	Pond 1 Spoils Pile
9	North Ditch
10	Contaminated Equipment Area
11	Drainage Areas Around Emergency Basin and North Ditch
12	Fluoride Holding Basin No.2 (North)
13	Fluoride Holding Basin No.1 (South)
14	Fluoride Clarifier and Settling Basins (South)
15	Fluoride Sludge Burial Areas
16	South Yellowcake Sump
17	Clarifier 'A' Basin Area
18	Pond 2
19	Area West of Pond 2
20	Solid Waste Burial Area No.2 (North)
21	Yellowcake Storage Pad Area
22	East Perimeter Area (Northern Section)
23	1986 Incident Soil Area Storage
24	Fertilizer Storage Pond Area
25	Former Raffinate Treatment Area
26	Decorative Pond Area
27	Combination Stream
28	Present Lime Neutralization Area
29	DUF_4 Building Area
30	Tank Fa[illegible]d Cylinder Storage Area
31	Front Lawn Area
32	South Perimeter Area
33	Northeast Perimeter Area
34	Drainage/Runoff Areas
35	Scrap Metal Storage Area/Interim Storage Cell Area

Table 2

Surface Contamination Limits for Release of Materials for Unrestricted Use[a]

Isotope	Fixed[c,d,f] dpm/100cm² [b]		Removable[e,f] dpm/100cm² [b]	
	ALPHA	BETA-GAMMA	ALPHA	BETA-GAMMA
U-nat	15,000 max 5,000 avg	15,000 max 5,000 avg	1,000	1,000
Th-230, Ra-226	300 max 100 avg	15,000 max 5,000 avg	20	1,000

[a]The limits established for alpha and beta-gamma apply independently.

[b]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contaminant shall be averaged over more than 1 square meter. For objects of less surface area, the average shall be derived from each such object.

[d]The maximum contamination level applies to an area of not more than 100 cm².

[e]The amount of removable radioactive material per 100 cm² of surface area shall be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels shall be reduced proportionally and the entire surface shall be wiped.

[f]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma shall not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

Table 3. Combined Budget for RFI Workplan and Site Characterization Plan	
Project Management	$ 20,000
Sampling	104,000
Background Survey	5,800
Gamma Walkover Surveys	4,600
Building Surveys	27,000
Sample Analysis	173,000
Miscellaneous Equipment and Supplies	10,000
Data Evaluation and Management	14,000
Report Preparation	26,000
Total Project Cost	**$384,400**

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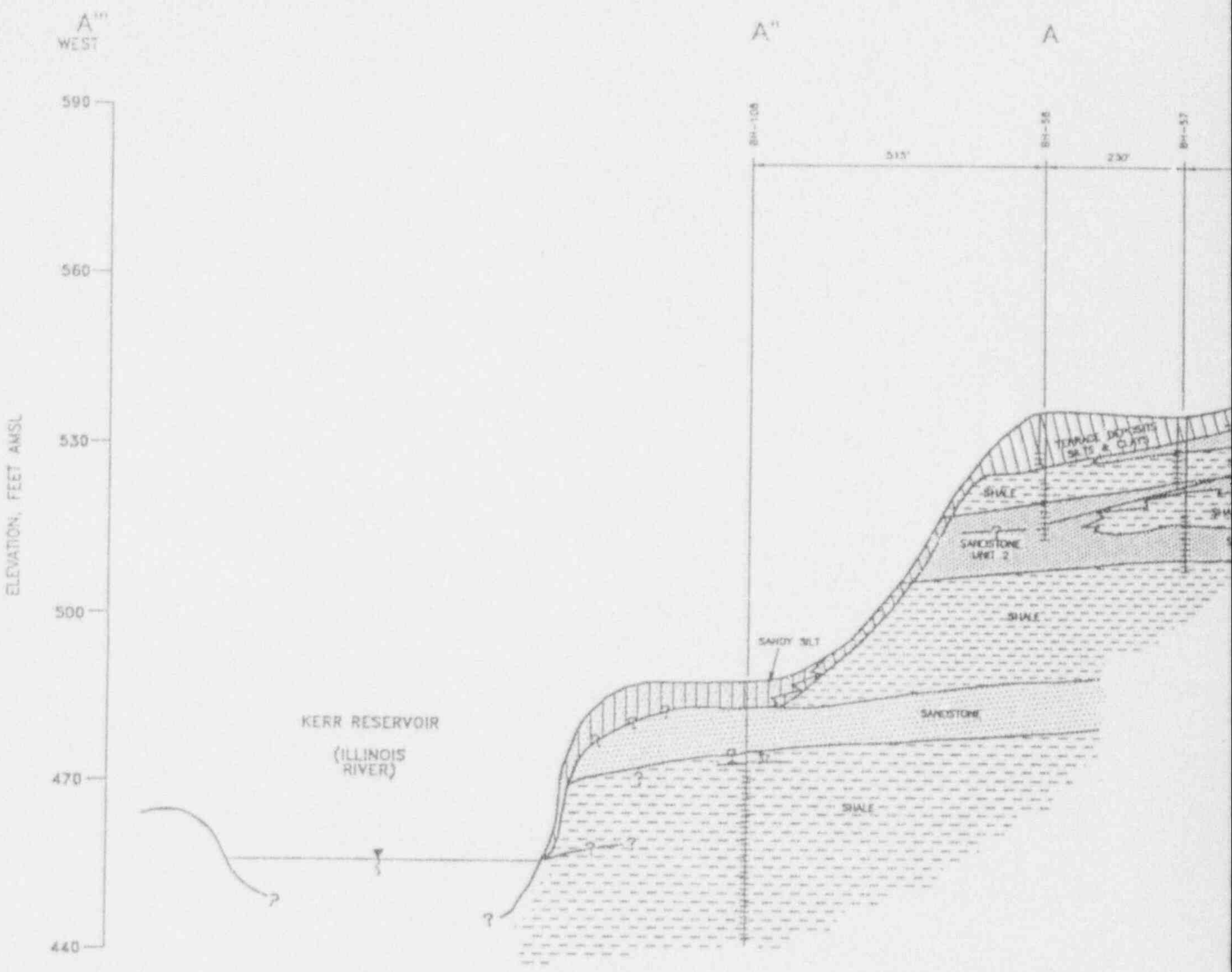

NOTES:

1. GEOLOGIC CROSS SECTION A'''–A''–A–A' ADAPTED FROM SEQUOYAH FUELS CORPORATION ADDENDUM TO THE FACILITY ENVIRONMENTAL FINDINGS REPORT (SFC 1992)

LEGEND

- GROUNDWATER POTENTIOMETRIC SHALE, OCTOBER 21–22, 199
- GROUNDWATER POTENTIOMETRIC SHALE/TERRACE, OCTOBER 21–
- ILLINOIS RIVER STAGE, GORE, (USGS 1974)
- MONITOR WELL SCREEN INTERV

SCALE: VERTICAL 1"=30'
HORIZONTAL 1"=300'
VERTICAL EXAGGERATION

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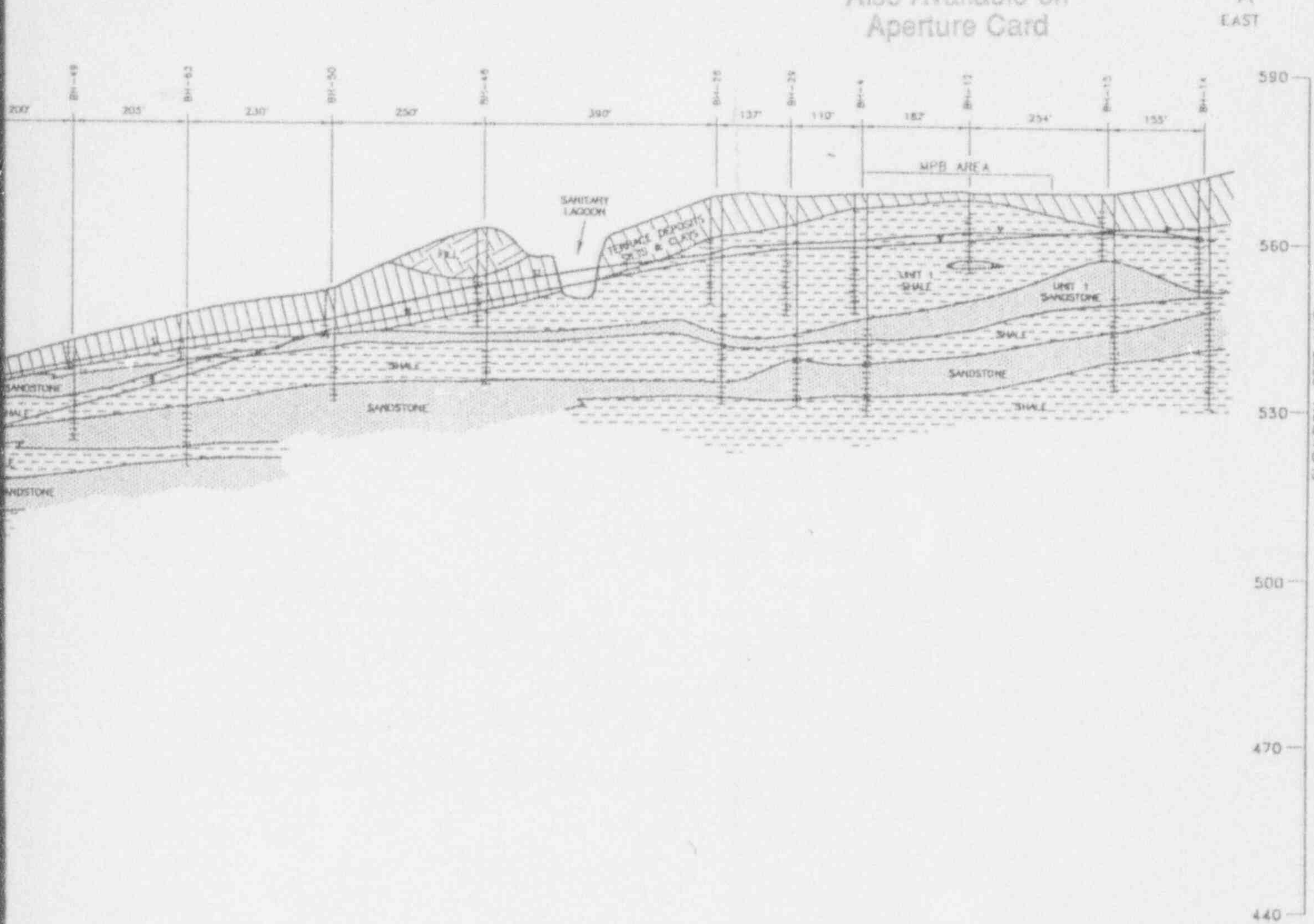

SURFACE, DEEP SANDSTONE/

SURFACE, SHALLOW
22, 1991

K. QUADRANGLE

AL

x10

	SANDSTONE
	TERRACE SILT AND CLAY
	SHALE
	SANDY SILT

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SEQUOYAH FUELS
A GENERAL ATOMICS COMPANY

GEOLOGIC CROSS SECTION A'''-A''-A-A'

DWG NO

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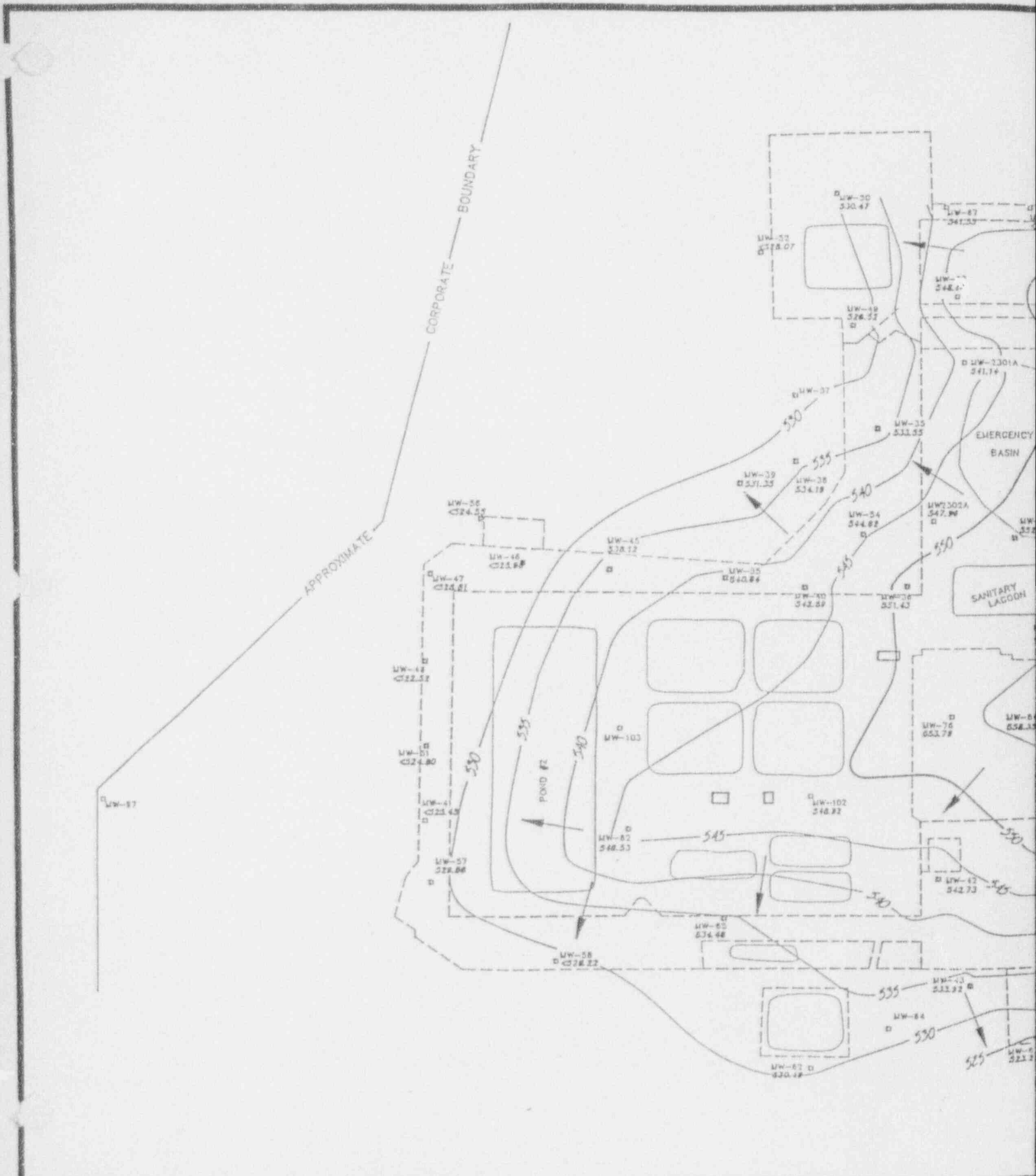
FIGURE 1

SCALE



APPROXIMATE
CORPORATE
BOUNDARY
EMERGENCY
BASIN
SANITARY
LAGOON
POND #2
MW-97
MW-103
MW-102
MW-84
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MW-39
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MW-82
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MW-58
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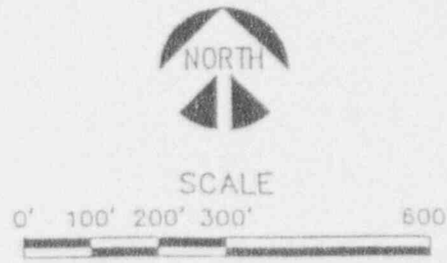

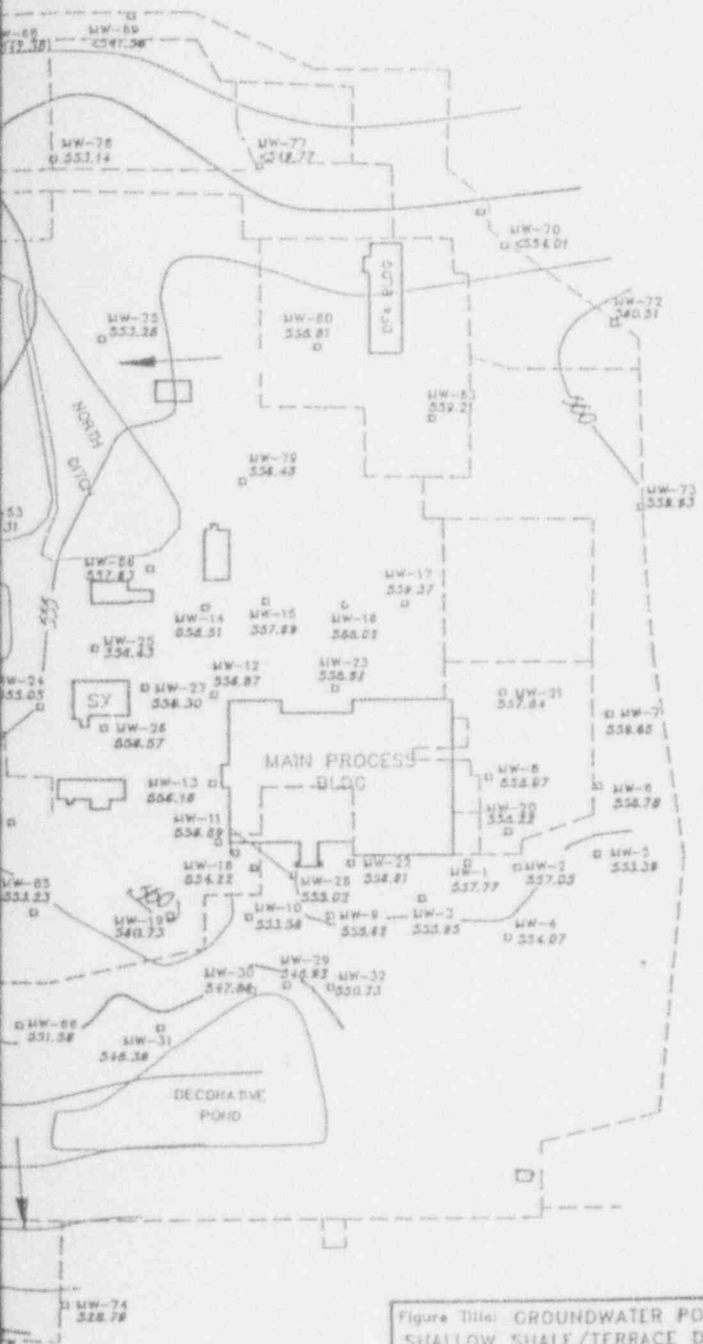

LEGEND

MW-72 540.51 — LOCATION OF SHALLOW SHALE/TERRACE DEPOSITS MONITOR WELL AND GROUNDWATER ELEVATION, FEET AMSL, 10/21–22/91

— 555 — GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR, SHALLOW SHALE/TERRACE DEPOSITS, FEET AMSL, 10/21–22/91

DIRECTION OF GROUNDWATER FLOW

NOTES :

- CONTOUR INTERVAL 5.0 FEET

Figure Title: GROUNDWATER POTENTIOMETRIC SURFACE SHALLOW SHALE/TERRACE DEPOSITS, 10/21–22/91	Client: SEQUOYAH FUELS CORPORATION
Document Title: ADDENDUM FEI FINDINGS REPORT	Location: GORE, OKLAHOMA

ROBERTS/SCHORNICK & ASSOCIATES, INC. Environmental Consultants 3700 West Robinson, Suite 200 Norman, Oklahoma 73072 (405) 321-3895	DATE: 1/30/92	PREPARED BY: K.M.H.
	SCALE: 1"=300'	CHECKED BY: D.J.S.
		DRAFTED BY: RML
	PROJECT NO: 90067.02 K28	FIGURE NO.: 2

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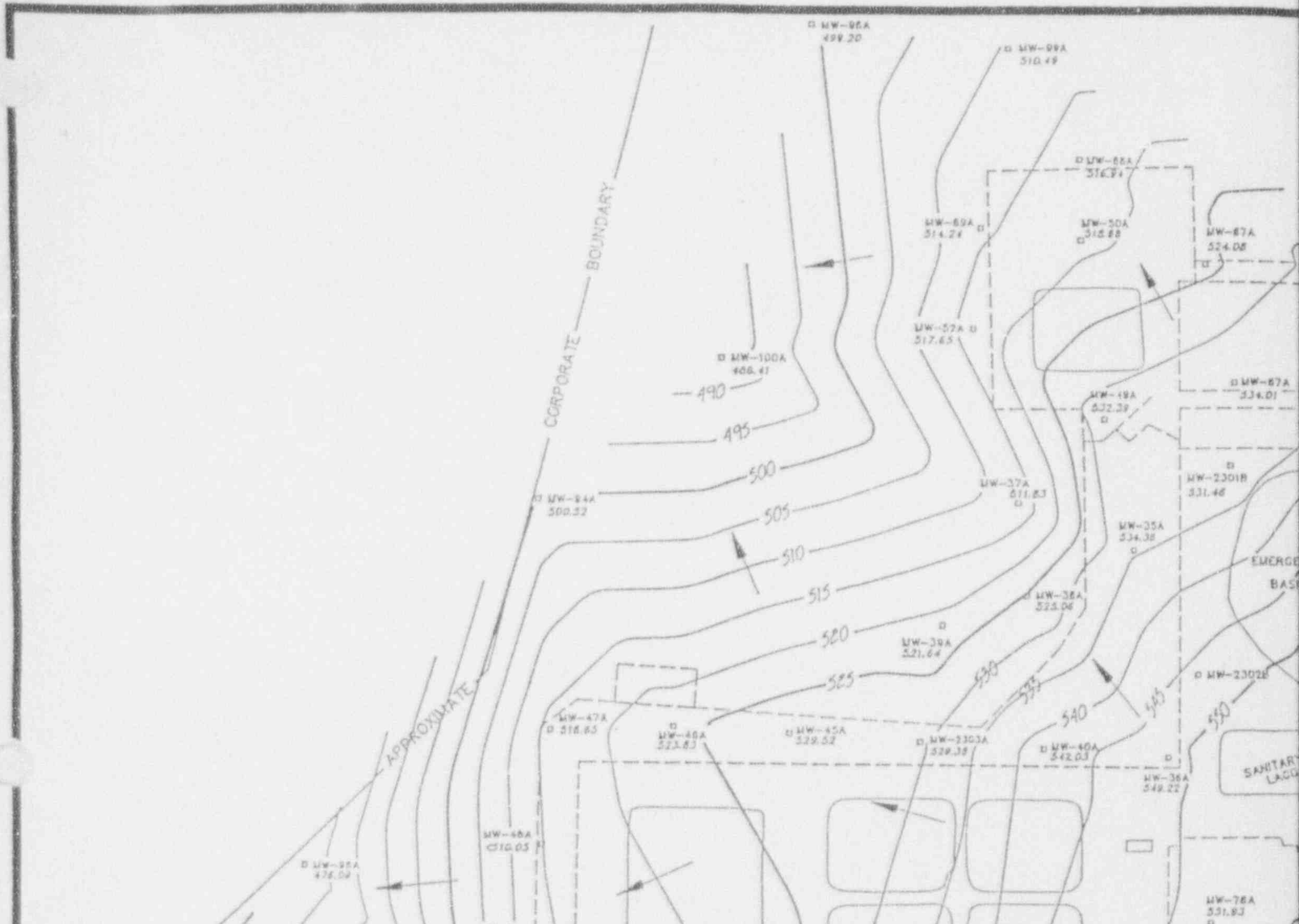
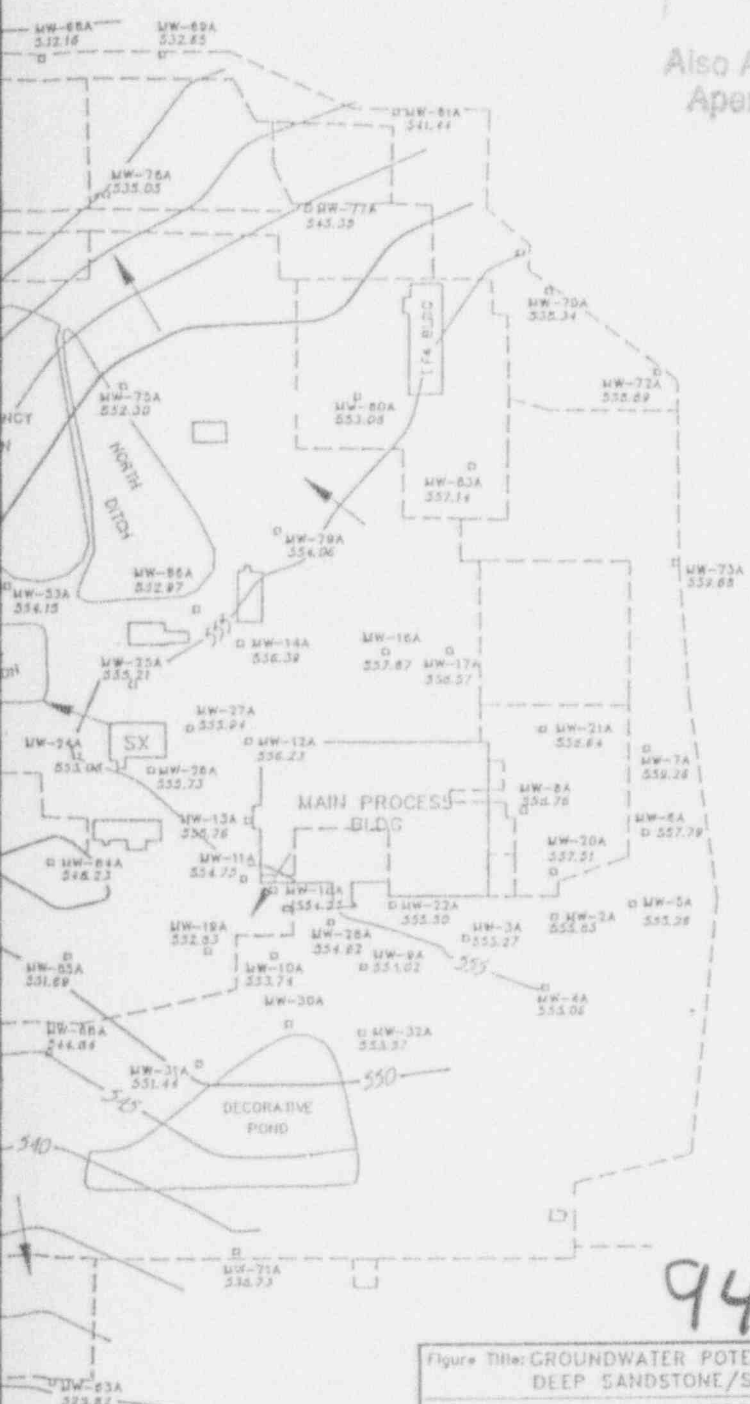


CORPORATE BOUNDARY
APPROXIMATE
POND #2
SANITARY
EMERG
BAS
MW-96A
MW-99A
MW-88A
MW-69A
MW-50A
MW-67A
MW-52A
MW-100A
MW-19A
MW-2301B
MW-24A
MW-37A
MW-35A
MW-38A
MW-39A
MW-2302B
MW-47A
MW-46A
MW-45A
MW-2303A
MW-40A
MW-36A
MW-48A
MW-95A
MW-76A
MW-51A
MW-103A
MW-97A
MW-102A
MW-41A
MW-83A
MW-233D
MW-57A
MW-42A
MW-232B
MW-232B
MW-65A
MW-93A
MW-59A
MW-58A
MW-60A
MW-93A
MW-61A
MW-64A
MW-92A
MW-62A
MW-91A
LOCATED 388 FEET
TO THE SOUTHWEST
MW-90A
MW-101A
490
495
500
505
510
515
520
525
530
535
540
545
550
475
480
485

NORTH

SCALE
0' 100' 200' 300' 600'



LEGEND

MW-72A 558.89 — LOCATION OF DEEP SANDSTONE/SHALE MONITOR WELL AND GROUNDWATER ELEVATION, FEET AMSL, 10/21-22/91

550 — GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR, DEEP SANDSTONE/SHALE UNIT, FEET AMSL, 10/21-22/91

DIRECTION OF GROUNDWATER FLOW

NOTE :
* CONTOUR INTERVAL 5.0 FEET

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Figure Title: GROUNDWATER POTENTIOMETRIC SURFACE DEEP SANDSTONE/SHALE, 10/21-22/91	Client: SEQUOYAH FUELS CORPORATION
Document Title: ADDENDUM FEI FINDINGS REPORT	Location: GORE, OKLAHOMA

ROBERTS/SCHORNICK & ASSOCIATES, INC. Environmental Consultants 3700 West Robinson, Suite 200 Norman, Oklahoma 73072 (405) 321-3895	DATE: 1/30/92	PREPARED BY: HL
	SCALE: 1" = 300'	CHECKED BY: B.J.S.
		DRAFTED BY: RML
	PROJECT NO: 90067.02 K27	FIGURE NO.: 3

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NUMBER OF OVERSIZE PAGES FILMED ON APERTURE CARDS 1

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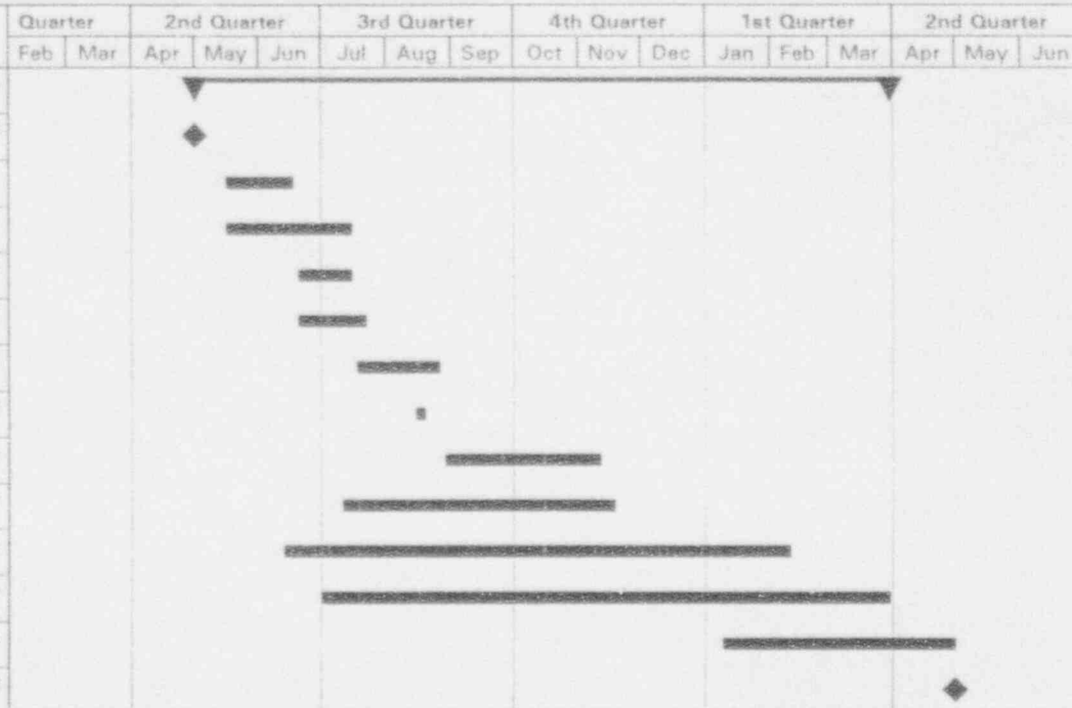
RECORDS AND REPORTS MANAGEMENT BRANCH

Figure 5
Proposed Schedule for SCP Execution

ID	Name	Duration
1	Implement Site Characterization	239d
2	EPA Approval of Final RFI Workplan	0d
3	Hand Auger Sampling	5w
4	Sludge Sampling/Depth Measurements	9w
5	Surface Soil Sampling	4w
6	Miscellaneous Sampling of Solids	25d
7	Gamma Walkover Surveys	30d
8	Background Survey	5d
9	Building Surveys	11w
10	Borehole Sampling	19w
11	Sample Analysis	35w
12	Data Evaluation	39w
13	Prepare Results Report	16w
14	Submit Results Report	0d



LIST OF APPENDICES

APPENDIX	TITLE
A	Soil Sampling Quality Assurance Plan
B	Surface Water Sampling Quality Assurance Plan
C	Sediment / Sludge Sampling Quality Assurance Plan
D	Monitoring Well Installation and Field Sampling Quality Assurance Plan
E	Groundwater Sampling Quality Assurance Plan
F	Examples of Forms
G	Laboratory Quality Assurance Plan
H	Section III Hazardous Work Permit Guidance Document Facility Hazards
I	Radiation Protection Program
J	ALARA Policy
K	Respiratory Protection Program Policy Statement
L	Employee Safety Handbook
M	List of Procedures for Emergency and Contingency Plans

APPENDIX A

SOIL SAMPLING QUALITY ASSURANCE PLAN

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SOIL SAMPLING QUALITY ASSURANCE PLAN

1.0 INTRODUCTION

This Quality Assurance Plan will be used during soil investigations at the Sequoyah Facility. It presents the technical methods used during a soils investigation to achieve adequate quality assurance (QA) and quality control (QC) during implementation of the soils investigation. The procedural elements of the QA Plan are to be followed throughout all phases of the soils investigation. The goals of the QA Plan are to insure that all information, data, and interpretations resulting from the investigation are technically sound, valid and properly documented. The scope of the QA Plan may change depending on the actual field conditions encountered during the investigation. If significant changes to the QA Plan are required, the Facility representative and appropriate regulatory agency will be notified as soon as possible of the change.

The QA Plan presents the technical methodology and rationale for soils investigations. Specific procedures for soil/rock sampling and drilling, physical and chemical testing, field data documentation, equipment decontamination, site safety, abandonment procedures, site reclamation, and sample packaging, handling and chain-of-custody control are included in the QA Plan.

2.0 SOIL SAMPLING PROCEDURES

Activities which will occur during soil sampling are summarized as follows:

- pre-arrangement with laboratories
- assembly and preparation of sampling equipment and supplies (including equipment decontamination)
- soil sampling
  - site reconnaissance to determine sample sites
  - determination of grid size and boundaries, if applicable
  - vertical and horizontal control survey
  - determination of sample equipment type
  - equipment decontamination
- sample preservation and shipment
  - sample preparation
  - sample labeling
- completion of sample records
- completion of chain-of-custody records
- sample shipment

Detailed soil sampling procedures are presented in the following sections.

2.1 Equipment Assembly and Preparation

Prior to the sampling event, all equipment to be used will be assembled and its operating condition verified, calibrated (if required), and properly cleaned (if required). In addition, all record-keeping materials will be prepared. A list of typical equipment used during soil sampling events is presented on Table 1.

2.1.1 Equipment Check

This activity includes the verification that all equipment are in proper operating condition. Also, arrangements for repair or replacement of any equipment which is inoperative are made.

2.1.2 Equipment Calibration

Where appropriate, equipment will be calibrated according to the manufacturer's specifications prior to field use. This applies to the equipment for making on-site measurements of organic vapors, soil conductivity, soil pH, and geophysical instruments. Calibration records or logs will be maintained for each piece of field measurement equipment used on-site. Calibration of equipment will be made between a task specific predetermined number of soil borings and wells.

2.1.3 Sampling Equipment Cleaning

All portions of sampling and test equipment which will contact the soil samples will be thoroughly cleaned before use.

The procedure for <u>initial</u> equipment cleaning is as follows:

- clean with tap water and phosphate-free laboratory grade detergent, brush if necessary;
- rinse with dilute 0.1 normal nitric acid;
- rinse thoroughly with tap water;
- rinse thoroughly with distilled or deionized water;
- equipment cleaned prior to field use will be recleaned after transfer to the sampling site unless carefully wrapped for transport.

Any necessary deviation from these procedures will be documented in the permanent record of the sampling episode.

Laboratory-supplied sample containers will be cleaned, appropriate preservatives added, and sealed by the laboratory before shipping.

2.1.4 Soil Sampling Procedures

Special care will be exercised to prevent contamination of the extracted samples during the sampling activities. The two primary ways in which such contamination can occur are:

- contamination of a sample through contact with improperly cleaned equipment; or
- cross-contamination of ˜mple through insufficient cleaning of equipment or personnel between sample locations.

To prevent such contamination, all sampling equipment will be thoroughly cleaned before and between uses at differer ˜ling locations in accordance with Section 2.1.3. In addition to the use o. properly cleaned equipment, three further precautions will be followed:

- a clean pair of new, disposable latex (or similar) gloves will be worn each time a different sample is obtained; and
- sample collection activities will proc˜d progressively from background (clean) areas to the downgradient (. acted) areas or from areas least affected by releases to areas progressively more affected by releases.
- Personnel handling the environmental samples will be minimized and only pre-designated personnel will be involved in sample handling.

The following paragraphs present procedures for the several activities which comprise soil sample acquisitions. These activities will be performed in the same order as presented below. Exceptions to this procedure will be noted in the permanent sampling record.

3.0 SAMPLING METHODS

3.1 Unconsolidated Soils

3.1.1 Continuous Tube Sampling System

The primary sampling methodology that will be used in unconsolidated soils will be a continuous tube sampling system. This sampling method typically uses a 5.5 foot steel split-barrel sampling tube that is 3.5 inches or 4.0 inches in diameter. This device is usually referred to as a CME sampler. The continuous sampler has a threaded cutting shoe which mounts on the base of the sample tube and a threaded retrieval head which mounts onto the top of the sample tube. A sample retainer can be used in sandy or gravelly soils to improve recovery. The continuous sampler is mounted within the lead hollow-stem auger flight and is adjusted so the cutting head or shoe is even with the auger cutting bits or extends to as much as 0.5 feet below the bit. The continuous sampler is mounted on a drilling rod and does not rotate as the auger is rotated and hydraulically pushed into the subsurface. No drilling fluids are used during sampling with the continuous tube system. The hollow-stem augers are advanced in 5-foot increments. Once the augers have been advanced over a 5-foot interval, the continuous sampler is removed from the borehole (augers remain in position) and the sampling barrel is split open to expose the 5-foot long sample. A properly decontaminated sampler will be used for each sample interval. Once the sample is exposed it will be measured and described by the on-site hydrogeologist. Samples will be retained or submitted for chemical or physical tests.

Another type of continuous sampler consists of a hollow four or five foot long tube of carbon steel. Disposable acetate liners are available to use with the tube. The tube sampler is threaded on both ends but is not split length wise. The tube has a beveled cutting head on one end. Typically, the tube is pushed into the soil and then withdrawn. The soil sample is then removed from the acetate liner.

3.1.2 Shelby Tube Samples

This sampling method will be employed in clay or silt soils where undisturbed soil samples are required for physical tests. Shelby tubes can be used with auger drilling or air/rotary drilling techniques. The shelby tube sampler (ASTM D-1587-83) consists of a 3-inch diameter thin wall (16 gauge) steel tube (24 to 36 inches in length). The bottom of the tube or bit is sharpened so that the bevel is on the outside of the tube. The inside diameter of the bit is slightly less than that of the tube. The basic principle of operation is to hydraulically push the Shelby tube into the undisturbed soil in one continuous 2-foot stroke without rotation. To increase adhesion, the samples should be manually rotated to break off the soil at the bottom of the tube after the sample is allowed to sit approximately 1-minute. The samples containing the soil should be carefully removed from the hole to minimize disturbance to the sample. The ends of the sample tube will be sealed to prevent loss of moisture. The shelby tube will be stored to minimize jarring or shocks until analytical and/or physical testing of the sample is conducted.

3.1.3 Split-spoon Sampler

This sampling method will be used in unconsolidated soils if the continuous sampler is not available or is unable to obtain satisfactory soil recovery. The split-spoon sampler (ASTM D-1586-84) performs satisfactorily in all types of soil and must be driven with a 140-pound hammer falling 30 inches until either 18 inches have been penetrated or 100 blows applied. The sampler is threaded on both ends and split lengthwise. When assembled, the two halves are held together by the shoe at one end and the head at the other end. A space is provided for a sampler retainer. The lengths of all drill rod used should be measured and recorded on the Drill Rod and Auger Length verification form in Appendix F. The drill rod and augers should be measured to insure that the exact depth of the soil sample is precisely known.

3.1.4 Stainless Steel Hand Trowels or Spoons

This soil sample collection method enables samples to be collected from shallow trenches or holes. The method of operation is to use the trowel or spoon to scrape soil off the sidewall of the trench/hole and into either clean stainless steel mixing bowls or directly into the sample container. Alternatively, the trowel or spoon alone can be utilized to collect very shallow (0-6") soil samples.

3.1.5 Hand or Bucket Auger

This sampling method may be used to actually collect a sample or auger to a depth to be sampled further by either a shelby tube or split spoon sampler. The auger is hand rotated in a downward twisting motion approximately 6-inches into the soil. No drilling fluids are used during drilling. The auger is then pulled out of the borehole and the soil in the bucket is either emptied directly into sample container or into a stainless steel mixing bowl for further mixing or compositing with other soils and then transferred into the sample container.

3.2 Consolidated Rock

3.2.1 Double-Tube Corebarrel

A double-tube corebarrel is the preferred sampling method in consolidated rock formations. A hollow diamond or carbide bit which is typically 3.125 inches outside diameter and typically 2.2-inches inside diameter cuts at least a 2-inch core approximately 5 to 10 feet long. Upon coring 5 or 10 feet, the corebarrel is brought to the surface and split open. The core is subsequently removed, and described by the hydrogeologist. All core samples will be labeled, packaged, and placed in water-proof core boxes for temporary storage and reference.

3.3 Drilling Methods

3.3.1 Hollow-Stem Auger

This is the preferred method of drilling through unconsolidated soils. No drilling fluids are used during hollow-stem auger drilling. The different hollow stem augers that may be used at the site are between 6.875-inches to 8.25-inches outside diameter and 3.25-inches to 4.25-inches inside diameter. In this method, the augers are hydraulically pushed and rotated in 5-foot intervals with sampling occurring by lowering equipment through the center of the augers.

3.3.2 Air Rotary

Air rotary drilling involves the use of circulating air to remove the drill cuttings and maintain an open borehole as drilling progresses. The use of air-rotary drilling techniques is best suited for use in hard rock formations. The air from the compressor on the rig must be filtered to ensure that the oil from the compressor is not introduced into the soil or groundwater system. The air rotary drilling method will be the primary drilling method used in hard rock formations. Steel or PVC surface casing may be advanced to assist in borehole stabilization.

3.3.3 Water Rotary

Water rotary is the second preferred method of drilling in hard rock formations. Water rotary involves the introduction of water into the borehole through the drill pipe and subsequent circulation of water back up to the hole to remove drill cuttings. No borehole stabilization additives such as bentonite or revert will be used. Water used in this drilling method will be obtained from a local municipal water system to ensure that the water is potable water. Steel or PVC surface casing may be advanced to assist in borehole stabilization.

3.3.4 Hand or Bucket Auger

This drilling method is used when drilling shallow borings (generally 5 feet or less) through unconsolidated soils. Typically, the hand auger is 4-inches in inside diameter and 4.25 inches outside diameter and the auger bucket is six (6) inches long. In this method, the auger is hand rotated into the ground in six (6)-inch intervals. No drilling fluids are used. The auger is then removed from the borehole and the soil removed from the bucket. The auger is cleaned and then reinserted into the borehole and hand rotated until another six (6)-inches of soil has been removed. A stainless steel hand auger will be used at all times.

3.3.5 Shovel, Backhoe, and/or Post-hole Digger

These boring methods may be used for shallow soils borings (0-5 feet) in unconsolidated soils. In all of these methods a borehole and/or trench is excavated slightly deeper than the anticipated sample interval. The actual soil sample is then collected directly from the sidewall of the borehole or trench. The shovel, backhoe, and post-hole digger will be properly decontaminated prior to and between use.

3.4 Sampling Procedures

The sampling procedures common to undisturbed sampling and disturbed sampling are described in this section. A summary of the procedures are listed below:

- Sampler Preparation
- Drilling Fluid Composition
- Sample Interval
- Sample Identification
- Extruding Sample from Tubes
- Sample Collection and Management

3.4.1 Sampler Preparation

All samplers must be thoroughly clean, free of dents and nicks. The sample tubes should not be lubricated. Any defects in the thin-wall tube or cutting head, split-spoon sampler, or continuous-tube sampler may constitute reasons for the sampling system to be discarded or replaced.

3.4.2 Drilling Fluid Composition

All borings will be advanced using techniques which require no drilling additives. In situations where wet rotary is the preferred method, only potable water will be used. A sample of the potable water used in drilling may be analyzed for the same chemical parameters as the groundwater or soil samples analytical list to insure that no impact occurred from the drilling fluid.

3.4.3 Sample Interval

All borings will be sampled continuously to the designated target depth unless specific sample intervals of interest were previously determined.

3.4.4 Sample and Drill Hole Identification

Each sample shall be identified by drill hole number and by consecutive sample number. The consecutive sample number should correspond to the sample numbers recorded on the borehole logs.

3.4.5 Extruding Sample from Shelby Tubes

The use of hydraulically activated sample jacks is the preferred method for extruding soil samples from the shelby tubes in the field and laboratory. Mechanical sample jacks can be used when hydraulic pressure is not available. The bottom end of the sample should be trimmed, so that the sample ejection jack piston fits flat on the sample surface. The sample should be extruded in one continuous uniform stroke onto clean aluminum foil. The first 1-inch of the sample (where it contacted the extruder) should be trimmed and discarded.

The site hydrogeologist shall designate one "clean" person to handle only the tubes and samples. This person must wear clean surgical gloves and change them after handling each sample.

3.4.6 Sample Collection and Management

Samples shall first be prepared by removing (by trimming with a clean stainless steel knife) the outer layer of soil that had contacted the sampling tube/equipment. This outer layer of soil will be discarded. Samples will then be obtained by cutting the entire length of each core section in half with a clean stainless steel knife. Equal parts of each core will be removed and then handled in incremental sections as described in the site specific data collection plans.

3.4.7 Soil Packaging and Handling

Soil samples collected will be double wrapped first in cellophane then in aluminum foil and finally in plastic tube wrap, then, labeled, and placed in water-proof core boxes. Selected samples may be split in order to conduct the various chemical or physical tests. All samples for the chemical tests will be placed in clean laboratory supplied glass jars and properly labeled. Samples for physical tests will be placed in plastic, glass, or cloth containers and properly labeled. All samples that will be analyzed will have a chain-of-custody form completed.

3.4.8 Physical Testing of Soil Samples

Selected samples of the various lithological units encountered during test drilling may be subject to selected physical testing to identify soil characteristics important to site characterization and assessment. These physical tests may include the following methods:

- Particle size distribution (sieve: ASTM D-1140, Hydrometer ASTM D-2217)

- Saturated vertical hydraulic conductivity (ASTM D-2434 or ASTM D-479)
- Atterberg Limits (ASTM D-4318)
- Visual Classification (ASTM D-1587, and ASTM D-1588)
- Porosity (Density ASTM D-2216, specific gravity ASTM D-854)
- Unified Soil Classification (ASTM D-2487)
- Moisture Content (ASTM D-2216)

3.4.9 Soil Sample Description and Logging

Immediately upon retrieval, all recovered samples will be scanned for the presence of volatile organic compounds utilizing portable air monitoring photoionization instruments such as an organic vapor analyzer (OVA) or an HNU.

All recovered samples will be described and logged by the site hydrogeologist at the drill rig. Description will include amount of recovery; interval thickness, depth of lithology change; color according to the Munsel Color chart; grain size distribution; macro-features and physical characteristics; and type according to the Uniform Soil Classification System (ASTM D2488). All descriptions will be recorded on a soil boring log. Selected samples of each recovered soil interval will be placed in jars; appropriately labeled as to the test boring, sample number, and sample depth and stored on-site.

3.4.10 Sample Preservation

Soil samples for laboratory analysis will be properly prepared for transportation by refrigeration in ice filled chests. Refrigeration is the only preservation requirement for soil samples according to SW-846 recommendations.

3.4.11 Container and Labels

Containers and appropriate container lids (teflon lined) will be provided by the analytical testing laboratory. The containers will be filled and container lids will be tightly closed. A label will be firmly attached to the container side (not lid). The following information will be legibly and indelibly written on the label:

- facility name,
- sample identification,
- sampling date,
- sampling time,
- sample collector's initials,
- preservatives used,
- type of sample,
- sample analysis.

3.4.12 Sample Shipment

Typically, the concentration, volume shipped, and type of constituents potentially present in the soils from the Facility are considered by the U.S. Department of Transportation (D.O.T.) to be non-hazardous materials. Thus, the following packaging and labeling requirements for the sample materials are usually appropriate for shipping the sample to the testing laboratory:

- preserve samples with ice and cool to 4°C,
- package sample so that is does not leak, spill, or vaporize from its packaging;
- label package with
  - sample collector's name, address, and telephone number;
  - laboratory's name, address, and telephone number;
  - description of sample;
  - quantity of sample; and
  - date of shipment;
- attach chain-of-custody forms inside sample shipment container.

Under certain circumstances, such as elevated concentrations of uranium, the D.O.T. has an action limit of where a radioactive material is defined as any material having a specific activity greater than 0.002 microcuries per gram. Radioactive materials have additional shipping requirements that will be followed.

3.4.13 Chain-Of-Custody Control

After samples have been obtained, chain-of-custody procedures will be followed to establish a written record concerning sample movement between the sampling site and the testing laboratory. Each shipping container will have a chain-of- custody form completed by the site sampling personnel packing the samples. The chain-of-custody form for each container will be completed in triplicater. One copy of this form will be maintained at the site, and the other two copies will be shipped with the samples to the laboratory. One of the laboratory copies will become a part of the permanent record for the sample and will be returned with the sample analyses

A copy of a sample chain of custody form is shown in Appendix F.

3.4.14 Sampling Records

To provide complete documentation of sampling, detailed records will be maintained. These records will include the information listed below:

- sample location (facility name);
- sample identification (sample number)
- sample location map or detailed sketch
- date and time of sampling;
- sampling method;
- field observations of
  - sample appearance,
  - sample odor

- weather conditions;
- sampler's identification;
- sample analysis; and
- any other information which is significant.

Soil sampling information will be recorded on the appropriate records and forms described in Section 7.0.

3.4.15 Analytical Methods

Soil samples will be analyzed using the appropriate EPA-approved methodology. The EPA methodology will typically be those methods described in SW-846 or other approved analytical methods.

The laboratory performing the analyses will have a QA/QC program which specifies procedures and references to be used. As a minimum, the program will contain:

1. Laboratory instrument calibration procedures and schedules,
2. Specification of adherence to accepted test methods,
3. Equipment inspection and servicing schedules,
4. The regular use of standard or spiked sample analyses,
5. Operator or analyst training procedures and schedules,
6. A program of continuous review of results, procedures, and compliance with the QA/QC program, and
7. Documentation of compliance with the program.

3.5 Equipment Decontamination

All equipment coming into contact with soils or groundwater will be properly cleaned prior to use. Drilling equipment (i.e. augers, drill rod, sampling equipment, etc.) which contacts the borehole will be cleaned using a hot water pressure washer between boreholes. All sampling equipment will be pressure washed and then rinsed with deionized water prior to use. All sampling equipment and the drill rig will be cleaned with the high pressure hot water washer between borings.

All decontamination will be conducted in an area designated by SFC. All wash water will be collected and managed in accordance with state and federal regulations. All protective clothing and wastes generated by the drilling or soil sampling programs will be containerized for proper disposal.

4.0 BOREHOLE AND MONITORING WELL ABANDONMENT

4.1 Borehole Abandonment

All borings will be plugged and abandoned in accordance with Oklahoma Water Resources Board (OWRB) rules. Plugging and abandonment is typically accomplished by pressure grouting a cement grout mix through a tremie line. The grout will consist of a mix ratio of one (1) ninety-four (94) pound bag of portland cement and approximately 6 gallons of water. All grout will be pumped through a tremie line that extends to the bottom of the boring. The grout mix will then be circulated to about four-feet from surface. If subsidence of the grout mix is noted, additional grout will be placed in the borehole to bring it to a level of approximately four (4) feet from ground level. The remaining four (4) feet is then backfilled with clean compacted soil. The boring location will then be surveyed for horizontal and vertical coordinates. All borehole abandonments are to be recorded on OWRB multi-purpose reports as well as Facility log books and records.

4.2 Site Reclamation

All drilling activities will be conducted in such a manner as to minimize any disturbance to the ground surface in the drilling area. A minimum number of vehicles will be brought to each drill site. All soil cuttings generated during drilling activities will be managed in accordance with state and federal regulations. Steps will be taken to minimize or prevent the discharge of drilling fluids or developed groundwater on the ground surface. Any accidental discharges will be cleaned up. Steps will be taken to minimize rutting of the off-road ground surface by vehicles by typically placing 3/4" plywood on the off-road ground and driving the vehicles on the plywood during periods of heavy precipitation and high ground moisture.

5.0 DOCUMENTATION OF FIELD DATA

Certain records will be maintained in logbooks and on field forms for sampling events and for daily activities. Some or all of the following forms will be used as appropriate to record the data generated at the site. These forms are:

- Borehole Abandonment Record
- Core Boring Field Report
- Chain-of-Custody Form
- Boring Record
- Drillers Log Summary
- Sample Labels
- Photographic Log and Labels
- Drill Rod and Auger Length Verification Form
- OWRB Multi-Purpose Report

Site safety, field measurements, and site activities data will be kept in the field log book. Examples of all field forms are presented in Appendix F. The field log book will be a bound book with consecutively numbered pages that will be suitable for submission as evidence in legal proceedings. The log book will become part of the permanent file for the site investigation. The log book will be used and maintained on a daily basis and all entries will be in ink.

6.0 SITE SAFETY PLAN

A Site Safety Plan will be prepared for use during hydrogeological field investigations. The Site Safety Plan will assess hazards at the site and will be prepared so as to present negligible hazards to site personnel and property owners. Environmental monitoring at the site will be performed in accordance with the Site Safety Plan.

7.0 DATA EVALUATION AND REPORTING PROCEDURES

Results and conclusions will require the review and assessment of the analytical results. Anomalous and unanticipated results may be obtained from the program. Review and assessment activities must, therefore, be able to identify those anomalous occurrences and initiate the proper response to the analytical results. All data review and reporting procedures will be in accordance with the Data Management Plan.

Table 1: List of Equipment and Supplies for Soil Sampling

1. Health and safety equipment required by Site Safety Plan
2. Access keys
3. Logbook
4. Site map
5. Sample location map
6. Chain-of-custody forms
7. Cooler with ice and bubble wrap
8. Disposable vinyl or rubber gloves
9. Distilled or deionized water
10. Alconox detergent
11. Brushes
12. Decon trays
13. 5 gallon buckets
14. Visqueen plastic
15. Glass pint jars
16. Trashbags
17. Ziplock bags
18. Paper towels
19. Acetone or hexane (for heavy organic impacts)
20. Black ink pens
21. Roll clear tape
22. Garden sprayers
23. Tape measure
24. Laboratory sample containers
25. Stainless steel bowls
26. Stainless steel spoons, trowels, or knifes
27. Bucket augers
28. Split spoons or Shelby tubes
29. Continuous tube samplers
30. Portland cement
31. Bentonite powder
32. Shovel
33. pH meter
34. PID organic vapor meter
35. 0.1 normal nitric acid
36. Potable water (for decon)

APPENDIX B

SURFACE WATER SAMPLING
QUALITY ASSURANCE PLAN

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Surface Water Sampling Quality Assurance Plan

1.0 Purpose

This plan presents the procedures to be followed for sampling surface water, storm water run-off and site process impoundment fluids. It also includes procedures for sample management and sample custody control.

2.0 Sampling Procedures

Activities which will occur during surface water sampling are summarized as follows:

- pre-arrangement with analytical testing laboratory
- assembly and preparation of sampling equipment and supplies
- sampling
  - visual inspection for drainage patterns and run-off paths near Units
  - visual inspection for other external contributing flow paths
  - determine a statistically significant number of sample locations
  - pinpointing sample locations
  - sampling, including the type of media, frequency of sample events, sample parameters, and sample event conditions
  - documentation in field note book
- sample preservation and shipment
  - sample preparation
  - on-site measurement of parameters
  - sample labeling
- completion of sample records
- completion of chain-of-custody records
- sample shipment

Detailed sampling procedures are presented in the following sections.

2.1 Equipment Assembly and Preparation

Prior to the sampling event, all equipment to be used (Table 1) will be assembled and its operating condition verified, calibrated (if required), and properly cleaned (if required). In addition, all record-keeping materials will be prepared.

2.1.1 Equipment Check

This activity includes the verification that all equipment is in proper operating condition. Also, arrangements for repair or replacement of any equipment which is inoperative are made.

2.1.2 Equipment Calibration

Where appropriate, equipment will be calibrated in the field on a daily basis according to the manufacturer's specifications prior to field use. This applies to the equipment for making on-site measurements of pH, Eh, specific conductance, dissolved oxygen, and temperature of water. Calibration of all field equipment will be documented in the field log book.

2.1.3 Equipment Cleaning

All portions of sampling and test equipment which will contact the sample will be thoroughly cleaned before use. This includes probes, beakers, scoops, trowels, bailers, lifting line, test equipment for on-site use, and other equipment or portions thereof which are to be immersed. The procedure for <u>initial</u> equipment cleaning is as follows:

- clean with tap water and phosphate-free laboratory grade detergent, brush if necessary;
- rinse thoroughly with tap water;
- rinse with 0.1 normal nitric acid solution;
- rinse thoroughly with distilled or deionized water;
- equipment cleaned prior to field use will be recleaned after transfer to the sampling site unless carefully wrapped for transport.

Any necessary deviation from these procedures will be documented in the permanent record of the sampling episode.

Laboratory-supplied sample containers will be cleaned and sealed by the laboratory before shipping.

2.2 Surface Water Sampling Procedures

Special care will be exercised to prevent contamination of the samples during the sampling activities. Three (3) primary ways in which such contamination can occur are:

- contamination of a sample through contact with improperly cleaned equipment;
- cross-contamination of the sample through insufficient cleaning of equipment between sample locations; or
- cross-contamination by sampling personnel (i.e. dirty boots contacting surface waters which are being sampled).

To prevent such contamination, all sampling equipment will be thoroughly cleaned before each use at different sampling locations in accordance with Section 2.1.3. In addition to the use of properly cleaned equipment, two further precautions will be followed:

- a clean pair of new, disposable latex (or similar) gloves will be worn each time a sample is collected; and
- sample collection activities will proceed progressively from background (clean) area to the downgradient (contaminated) area.

The following paragraphs present procedures for the several activities which comprise surface water sample acquisitions. These activities will be performed in the same order as presented below. Exceptions to this procedure will be noted in the permanent sampling record or field log book.

2.2.1 Selection of Sample Locations

Before actual sample collection, the surrounding sample area should be inspected and the observations recorded for obvious surface water drainage pathways originating as close as possible to the Units. Preferably, the surface water samples should be collected during an actual rainfall event of sufficient magnitude to cause surface water run-off or one to two days after a precipitation event of 0.5 inches or greater. Observations of other contributing sources to the run-off path should also be recorded.

Once the site has been inspected, surface water sample locations will be selected as close to the Unit as possible. Selection of the sample location depends on the surface water body type (e.g., pond, stream, intermittent drainage, run-off), flow rate, depth, and width. In practice, safety and physical access limitations will often affect sample locations and selection of sample equipment.

In all cases, a site map will be drawn to document the surface water flow paths and sample locations during the sample event.

2.2.2 Sampling

Surface water samples can be collected directly by submerging the sample bottle with a gloved hand or telescoping pole into the water. However, a sample collection container such as a beaker, properly cleaned, can be used to transfer the sample to the sample bottle in order to avoid contaminating the outside of the sample bottle. Samples collected for volatile organic compounds must have zero head space in the sample container. The sample container for volatile organic compounds must be glass.

Care must be taken to prevent undue disturbance to the water to cause excessive amounts of sediments to be created. Care must also be exercised to stand downstream and sample upstream. This practice will prevent possible contamination of the water from boots and also prevent stirring up excessive amounts of sediment.

2.2.3 Ponded Water Samples

Vertical composite water samples will be collected using a point source sampler constructed of stainless steel or Teflon which will yield a composite sample of the undisturbed pond water profile. The following procedure will be followed to collect the pond water sample:

1. Locate sample point. Photo document the sample location from shore during the sampling process.
2. Position boat, and anchor.
3. Using a precleaned point-source sampler, lower sampler to approximate depth and obtain sample. Discharge sample into precleaned compositing vessel. Continue this step until the complete sample profile has been obtained.
4. Composite equal or proportioned volumes from each compositing vessel. Continue this step until the complete sample profile has been obtained.
5. Label bottle, transfer to cooler, and record all field data.
6. Mark location in pond with weighted float for future reference.

If a grab sample is collected then the sample will be collected using a telescoping rod with a stainless steel cup on the end. The sample will be collected near the water surface. Follow procedures 3 to 6 above.

2.2.4 On-Site Parameter Measurement

Certain chemical and physical parameters in water can change significantly within a short time of sample acquisition. These parameters cannot be accurately measured in a laboratory located more than a few hours from the

Site, and therefore will be measured on-site with portable equipment. These parameters are:

- pH,
- Eh,
- specific conductance,
- temperature, and
- dissolved oxygen.

These parameters will be measured in unfiltered, unpreserved, "fresh" water collected by the same technique as the samples to be used for laboratory analyses. The measurements will be made in a clean glass container separate from those intended for laboratory analysis. The measured values will be recorded in the field log book.

2.3 Sample Preservation

Water samples will be properly prepared for transportation to the laboratory under refrigeration and chemical preservation, if necessary. The laboratory providing sample containers will add any necessary chemical preservatives to the sealed containers provided. All samples collected while in the field will subsequently be placed in ice filled chests.

2.4 Container and Labels

Containers and appropriate container lids (Teflon lined) will be provided by the analytical testing laboratory. The containers will be filled and container lids will be tightly closed. A label will be firmly attached to the container side (not lid). The following information will be legibly written with indelible ink on the label:

- facility name,
- sample identification,
- sampling date,
- sampling time,

- sample collector's initials,
- preservatives used,
- type of sample,
- sample analysis.

2.5 Sample Shipment

Typically, the concentration, volume shipped, and type of constituents present in surface water samples from the Facility are considered by the U.S. Department of Transportation (D.O.T.) to be non-hazardous. Thus, the following packaging and labeling requirements for the sample materials are usually appropriate for shipping the sample to the testing laboratory:

- preserve samples with ice and cool to 4°C,
- package sample so that is does not leak, spill, or vaporize from its packaging;
- label package with
  - sample collector's name, address, and telephone number;
  - laboratory's name, address, and telephone number;
  - description of sample;
  - quantity of sample; and
  - date of shipment;
- attach chain-of-custody forms inside sample shipment container.

Under certain circumstances, such as elevated concentrations of uranium, the D.O.T. has an action limit of where a radioactive material is defined as any material having a specific activity greater than 0.002 microcuries per gram. Radioactive materials have additional shipping requirements that will be followed as needed.

2.6 Chain-of-Custody Control

After samples have been obtained, chain-of-custody procedures will be followed to establish a written record concerning sample movement between the sampling site and the testing laboratory. Each shipping container will have a chain-of- custody form completed by the site sampling personnel packing the samples. The chain-of-custody form for each container will be completed in triplicate. One copy of this form will be maintained at the site, and the other two copies will be shipped with the samples to the laboratory. One of the laboratory copies will become a part of the permanent record for the sample and will be returned with the sample analyses.

A copy of a sample chain of custody form is shown in Appendix F.

2.7 Sampling Records

To provide complete documentation of sampling, detailed records will be maintained. These records will include the information listed below:

- sample location (facility name);
- sample identification (sample number)
- sample location map or detailed sketch
- date and time of sampling;
- sampling method;
- sample preservation method
- field notes complete with
    - field analyses (e.g., pH, EH, etc.)
    - sample appearance,
    - sample odor
- weather conditions;
- sampler's identification;
- sample analysis; and
- any other information which is significant.

3.0 Analytical Methods

Surface water samples will be analyzed using the appropriate EPA-approved methodology. The laboratory performing the analyses will have a QA/QC program which specifies procedures and references to be used. As a minimum, the program will contain:

1. Laboratory instrument calibration procedures and schedules,
2. Specification of adherence to accepted test methods,
3. Equipment inspection and servicing schedules,
4. The regular use of standard or spiked sample analyses,
5. Operator or analyst training procedures and schedules,
6. A program of continuous review of results, procedures, and compliance with the QA/QC program, and
7. Documentation of compliance with the program.

4.0 Data Evaluation And Reporting Procedures

Results and conclusions will require the review and assessment of the surface water monitoring results. Anomalous and unanticipated results may be obtained from the program. Review and assessment activities must, therefore, be able to identify those anomalous occurrences and initiate the proper response to the monitoring results.

Table 1: List of Equipment and Supplies for Surface Water Sampling

1. Health and safety equipment required by Site Safety Plan
2. Access keys
3. Logbook
4. Site map
5. Sample location map
6. Chain-of-custody forms
7. Cooler with ice and bubble wrap
8. Disposable vinyl or rubber gloves
9. Distilled or deionized water
10. Alconox detergent
11. Brushes
12. Decon trays
13. 5 gallon buckets
14. Visqueen plastic
15. Glass pint jars
16. Trashbags
17. Ziplock bags
18. Paper towels
19. Acetone or hexane (for heavy organic impacts)
20. Indelible black ink pens
21. Roll clear tape
22. Garden sprayers
23. Tape measure
24. Laboratory sample containers
25. Stainless steel bowls
26. Thermometer
27. Stainless steel spoons, trowels, or knifes
28. pH meter
29. Specific conductivity meter
30. EH meter
31. Dissolved oxygen meter
32. Hip waders
33. Rainsuits
34. Glass or plastic beakers
35. Point source sampler
36. Combined liquid waste sampling tube
37. Extention pole
38. Boat
39. Life jackets
40. Discrete water samplers
41. 0.1 normal nitric acid
42. Monofilament line

APPENDIX C

SURFACE WATER SEDIMENT AND SLUDGE SAMPLING

QUALITY ASSURANCE PLAN

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Surface Water Sediment And Sludge Sampling Quality Assurance Plan

1.0 PURPOSE

This plan presents the procedures to be followed for sampling surface water body sediments and sludges, sample management, and sample custody control.

2.0 SAMPLING PROCEDURES

Activities which will occur during sediment and sludge sampling are summarized as follows:

- pre-arrangement with analytical testing laboratory
- assembly and preparation of sampling equipment and supplies
- sludge and sediment sampling
  - site reconnaissance for sample conditions
  - determine statistically significant number of sample locations
  - orientation of grid or coordinate system for sampiing locations
  - determine media to be sampled, sampling conditions and sample types (i.e. grab, composite)
  - sampling
- sample preservation and shipment
  - sample preparation
  - on-site measurement of parameters
  - sample labeling
- completion of sample records
- completion of chain-of-custody records
- sample shipment

Detailed sampling procedures are presented in the following sections.

2.1 Equipment Assembly and Preparation

Prior to the sampling event, all equipment listed on Table 1 to be used will be assembled and its operating condition verified, calibrated (if required), and properly cleaned (if required). In addition, all record-keeping materials will be prepared.

2.1.1 Equipment Check

This activity includes the verification that all equipment is in proper operating condition. Also, arrangements for repair or replacement of any equipment which is inoperative are made.

2.1.2 Equipment Calibration

Where appropriate, equipment will be calibrated in the field on a daily basis according to the manufacturer's specifications prior to field use. This applies to equipment used for performing on-site measurements of soil gas headspace, pH, Eh, specific conductance, and temperature. Calibration of all field equipment will be documented in the field log book.

2.1.3 Equipment Cleaning

All portions of sampling and test equipment which will contact the sample will be thoroughly cleaned before use. This includes probes, scoops, beakers, tubing, bailers, lifting line, test equipment for on-site use, and other equipment or portions thereof which are to be immersed.

The procedure for initial equipment cleaning is as follows:

- clean with tap water and phosphate-free laboratory grade detergent, brush if necessary;
- rinse thoroughly with tap water;
- rinse with 0.1 normal nitric acid solution;
- rinse thoroughly with distilled water;
- equipment cleaned prior to field use will be recleaned after transfer to the sampling site unless carefully wrapped for transport.

Any necessary deviation from these procedures will be documented in the permanent record of the sampling episode.

Laboratory-supplied sample containers will be cleaned and sealed by the laboratory before shipping.

2.2 Surface Water Sediment Sampling Procedures

Special care will be exercised to prevent cross-contamination of the samples during sampling activities. Two primary ways in which such contamination can occur are:

- contamination of a sample through contact with improperly cleaned equipment; or
- cross-contamination of the sample through insufficient cleaning of equipment between sample locations.

To prevent such contamination, all sampling equipment will be thoroughly cleaned <u>before</u> each use at different sampling locations in accordance with Section 2.1.3. In addition to the use of properly cleaned equipment, two further precautions will be followed:

- a clean pair of new, disposable latex (or similar) gloves will be worn each time a different location is sampled; and
- sample collection activities will proceed progressively from unaffected areas to the most affected or contaminated areas.

The following paragraphs present procedures for the activities which comprise sludge and sediment sample acquisitions. These activities will be performed in the same order as presented below. Exceptions to this procedure will be noted in the permanent sampling record or field notebook.

2.2.1 Locate Sample Point

The sample point will be located relative to a grid or coordinate system or a relative benchmark. All sample locations will be recorded in the field records. Prior to sampling, the sample area will be observed for situations that might invalidate the sample results such as unrepresentative materials (i.e., trash, out of place spill material, floating debris, etc.) present on the sample site. The sampling locations should be shifted slightly laterally to avoid the material where such materials exist. Sample collection activities will proceed progressively from background (clean) area to the downgradient (impacted) area.

2.2.2 Sample Methodology

The procedures to be used to collect sediment or sludge samples are dependent on factors controlling accessibility such as, depth of water in the ponds/surface waters, viscosity and density of the sediment or sludge.

One possible method to be utilized in the collection of sediment or sludge samples from the pond/surface water locations is a modification of: Sampling Bottom Sludges or Sediments with a Gravity Corer as referenced in "Characterization of Hazardous Waste Sites - A Methods Manual: Volume 2. Available Sampling Methods, Second Edition", EPA-600/4-84-076, December, 1984. This collection method is conducted as follows:

1. Locate sample point, previously chosen and mapped. Photo document the sample locations during the sampling process.
2. Position and anchor boat, if used.
3. Inspect the corer for proper precleaning and secure one end of safety line to corer and the other end to the boat.
4. Allow corer to free fall through liquid to bottom.
5. Retrieve corer with a smooth, continuous lifting motion, being careful not to bump the corer.
6. Remove nosepiece from corer and slide sample out of cover into a precleaned stainless steel bowl.

(Note: If collecting a composite sample, decontaminant all sampling equipment and repeat steps 1-6. Repeat these steps until composite sample requirements have been met.)

7. Decontaminate all equipment after use and between sample locations.

If there is no liquid layer above the sediment or sludge and pond conditions allow safe access, samples will be collected utilizing procedure modification of: "Collection of Sludge or Sediment Samples with a Scoop" as referenced in the previously mentioned EPA manual. This procedure is as follows:

1. Locate sample point previously chosen and mapped.
2. Using a precleaned stainless steel scoop, or trowel, dredge, or laboratory spoon, collect sample by dredging or digging.
3. Place sample in precleaned stainless steel mixing bowl.
4. Transfer sample into an appropriate sample container with a precleaned stainless steel laboratory spoon.
6. Decontaminate all equipment after use and between sample locations.

If there are liquids overlying the sediment or sludge and the sediment or sludge cannot be collected in the gravity corer, an alternative method will be utilized for pond/surface water sediment or sludge sample collection. This method utilizes two inch diameter stainless steel, acetate, or clear PVC tube capable of being threaded to a specially designed piston. While the tube is pushed to refusal, the piston is simultaneously pulled up inside the tube causing a vacuum effect. Once refusal of the length of the tube is reached, an outer casing is installed around the tube and driven in the underlying formation. The tube is capped on top to hold the vacuum, and then slowly removed from inside the outer casing. The bottom of the tube is subsequently capped, labeled, and extruded in a controlled environment.

The following procedures will be followed to collect the sludge samples.

1. Locate sample point previously chosen and mapped.
2. Position and anchor boat.
3. Utilizing a precleaned tube and piston sampler, collect sample.
4. Slowly remove cover, making sure to be ready to cap tube with a precleaned PVC cap.
5. Decontaminate, label and transfer tube to shore for extrusion.
6. (Extrusion) remove top and bottom cap from tube.
7. Carefully extrude sample material into precleaned stainless steel bowl, using a precleaned extruder rod.
8. Transfer sample using a precleaned stainless steel laboratory spoon into appropriate sample bottle.
9. Decontaminate sampler.

Observations as to the appearance of the sample will be recorded as well as the results of any other field screening methods. A sufficient amount of sample material must be collected to fill all required sample containers.

2.3 Sample Preservation

Samples will be properly prepared for transportation to the laboratory under refrigeration and chemical preservation, if necessary. The laboratory providing sample containers will add any necessary chemical preservatives to the sealed containers provided. All samples collected in the field must be placed in ice filled chests.

2.4 Container and Labels

Containers and appropriate container lids (teflon lined) will be provided by the analytical testing laboratory. The containers will be filled and container lids will be tightly closed. All sample container lids will be sealed with tamper proof tape and a label will be firmly attached to the container side (not lid). The following information will be legibly and written with indelible ink on the label:

- facility name,
- sample identification,
- sampling date,
- sampling time,
- sample collector's initials,
- preservatives used,
- type of sample,
- sample analysis.

2.5 <u>Sample Shipment</u>

Typically, the concentration, volume shipped, and type of compounds present in the sludge and sediment from the Facility are considered by the U.S. Department of Transportation (D.O.T.) to be non-hazardous. Thus, the following packaging and labeling requirements for the sample materials are usually appropriate for shipping the sample to the testing laboratory:

- preserve samples with ice and cool to 4°C,
- package sample so that is does not leak, spill, or vaporize from its packaging;
- label package with
  - sample collector's name, address, and telephone number;
  - laboratory's name, address, and telephone number;
  - description of sample;
  - quantity of sample;
  - date of shipment; and
  - sample analysis;
- attach chain-of-custody forms inside sample shipment container.

Under certain circumstances, such as elevated concentrations of uranium, the D.O.T. has an action limit of where a radioactive material is defined as any material having a specific activity greater than 0.002 microcuries per gram.

Radioactive materials have additional shipping requirements that will be followed.

2.6 Chain-of-Custody Control

After samples have been obtained, chain-of-custody procedures will be followed to establish a written record concerning sample movement between the sampling site and the testing laboratory. Each shipping container will have a chain-of- custody form completed by the site sampling personnel packing the samples. The chain-of-custody form for each container will be completed in triplicate. One copy of this form will be maintained at the site, and the other two copies will be shipped with the samples to the laboratory. One of the laboratory copies will become a part of the permanent record for the sample and will be returned with the sample analyses. A copy of a sample chain of custody form is shown in Appendix F.

2.7 Sampling Records

To provide complete documentation of sampling, detailed records will be maintained. These records will include the information listed below:

- sample location (facility name);
- sample identification (sample number)
- sample location map or detailed sketch
- date and time of sampling;
- sampling method;
- field observations of
  - sample appearance,
  - sample odor
- weather conditions;
- sampler's identification
- sample analysis; and
- any other information which is significant.

3.0 ANALYTICAL METHODS

Sediment and sludge samples will be analyzed using the appropriate EPA-approved methodology. The laboratory performing the analyses will have a QA/QC program which specifies procedures and references to be used. As a minimum, the program will contain:

1. Laboratory instrument calibration procedures and schedules,
2. Specification of adherence to accepted test methods,
3. Equipment inspection and servicing schedules,
4. The regular use of standard or spiked sample analyses,
5. Operator or analyst training procedures and schedules,
6. A program of continuous review of results, procedures, and compliance with the QA/QC program, and
7. Documentation of compliance with the program.

4.0 DATA EVALUATION AND REPORTING PROCEDURES

Results and conclusions will require the review and assessment of the sampling and monitoring results. Anomalous and unanticipated results may be obtained from the program. Review and assessment activities must, therefore, be able to identify those anomalous occurrences and initiate the proper response to the monitoring results.

TABLE 1: List of Equipment and Supplies for Sediment and Sludge Sampling

1. Health and safety equipment required by Site Safety Plan
2. Access keys
3. Logbook
4. Site map
5. Sample location map
6. Chain-of-custody forms
7. Cooler with ice and bubble wrap
8. Disposable vinyl or rubber gloves
9. Distilled or deionized water
10. Alconox detergent
11. Brushes
12. Decon trays
13. 5 gallon buckets
14. Visqueen plastic
15. Glass pint jars
16. Trashbags
17. Ziplock bags
18. Paper towels
19. Acetone or hexane (for heavy organic impacts)
20. Indelible black ink pens
21. Roll clear tape
22. Garden sprayers
23. Tape measure
24. Laboratory sample containers
25. Stainless steel bowls
26. Thermometer
27. Stainless steel spoons, trowels, or knifes
28. pH meter
29. Specific conductivity meter
30. EH meter
31. Dissolved oxygen meter
32. Hip waders
33. Rainsuits
34. Glass or plastic beakers
35. Point source sampler
36. Combined liquid waste sampling tube
37. Extention pole
38. Boat
39. Life jackets
40. Discrete water samplers
41. 0.1 normal nitric acid
42. Monofilament line

APPENDIX D

MONITORING WELL INSTALLATION AND FIELD SAMPLING QUALITY ASSURANCE PLAN

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MONITORING WELL INSTALLATION AND
FIELD SAMPLING QUALITY ASSURANCE PLAN

1.0 INTRODUCTION

This Quality Assurance Plan was developed for use during a typical hydrogeological investigation. It presents the technical methods used during a soils and groundwater investigation used to achieve adequate quality assurance (QA) and quality control (QC) during implementation of the hydrogeological investigation. The procedural elements of the QA Plan are to be followed throughout all phases of the hydrogeological investigation. The goals of the QA Plan are to insure that all information, data, and interpretations resulting from the investigation are technically sound, valid and properly documented. The scope of the QA Plan may change depending on actual field conditions encountered during the investigation. If significant changes to the QA Plan are required, the Facility representative and appropriate regulatory agency will be notified as soon as possible of the change.

The QA Plan presents the technical methodology and rationale for hydrogeological investigations. Specific procedures for soil/rock sampling and drilling, physical and chemical testing, field data documentation, equipment decontamination, site safety, well development, construction, abandonment procedures, site reclamation, and sample packaging, handling and chain-of-custody control are included in the QA Plan.

2.0 SOIL SAMPLING PROCEDURES

Typically, soil samples are collected during the drilling of boreholes prior to installation of groundwater monitoring wells. Activities which will occur during soil sampling are summarized as follows:

- pre-arrangement with laboratories
- assembly and preparation of sampling equipment and supplies (including equipment decontamination)
- soil sampling
  - site reconnaissance to determine sample sites
  - determination of grid size and boundaries, if applicable
  - vertical and horizontal control survey
  - determination of sample equipment type
  - equipment decontamination
- sample preservation and shipment
  - sample preparation
  - sample labeling
- completion of sample records
- completion of chain-of-custody records
- sample shipment

Detailed soil sampling procedures are presented in the following sections.

2.1 Equipment Assembly and Preparation

Prior to the sampling event, all equipment to be used will be assembled and its operating condition verified, calibrated (if required), and properly cleaned (if required). In addition, all record-keeping materials will be prepared. A list of typical equipment used during soil sampling events is presented on Table 1.

2.1.1 Equipment Check

This activity includes the verification that all equipment is in proper operating condition. Also, arrangements for repair or replacement of any equipment which is inoperative are made.

2.1.2 Equipment Calibration

Where appropriate, equipment will be calibrated in the field on a daily basis according to the manufacturer's specifications prior to field use. This applies to equipment used for performing on-site measurements of organic vapors, soil conductivity, soil pH, and geophysical instruments. Calibration records or logs will be maintained for each piece of field measurement equipment used on-site. Calibration of equipment will be made between a task specific predetermined number of soil borings and wells. Calibration of all field equipment will be documented in the field log book.

2.1.3 Sampling Equipment Cleaning

All portions of sampling and test equipment which will contact the soil samples will be thoroughly cleaned before use.

The procedure for initial equipment cleaning is as follows:

- clean with tap water and phosphate-free laboratory grade detergent, brush if necessary;
- rinse with dilute 0.1 normal nitric acid;
- rinse thoroughly with tap water;
- rinse thoroughly with distilled water;
- equipment cleaned prior to field use will be recleaned after transfer to the sampling site unless carefully wrapped for transport.

Any necessary deviation from these procedures will be documented in the permanent record of the sampling episode.

Laboratory-supplied sample containers will be cleaned, appropriate preservatives added, and sealed by the laboratory before shipping.

2.1.4 Soil Sampling Procedures

Special care will be exercised to prevent contamination of the extracted samples during sampling activities. Two primary ways in which such contamination can occur are:

- contamination of a sample through contact with improperly cleaned equipment; or
- cross-contamination of the sample through insufficient cleaning of equipment or personnel between sample locations.

To prevent such contamination, all sampling equipment will be thoroughly cleaned before each use at different sampling locations in accordance with Section 2.1.3. In addition to the use of properly cleaned equipment, three further precautions will be followed:

- a clean pair of new, disposable latex (or similar) gloves will be worn each time a different sample is obtained; and
- sample collection activities will proceed progressively from background (clean) areas to the downgradient (impacted) areas or from areas least affected by releases to areas progressively more affected by releases.
- Personnel handling the environmental samples will be minimized and only pre-designated personnel will be involved in sample handling.

The following paragraphs present procedures for the several activities which comprise soil sample acquisitions. These activities will be performed in the same order as presented below. Exceptions to this procedure will be noted in the permanent sampling record.

3.0 SAMPLING METHODS

3.1 Unconsolidated Soils

3.1.1 Continuous Tube Sampling System

The primary sampling methodology that will be used in unconsolidated soils will be a continuous tube sampling system. This sampling method typically uses a 5.5 foot steel split-barrel sampling tube that is 3.5 inches or 4.0 inches in diameter. This device is usually referred to as a CME sampler. The continuous sampler has a threaded cutting shoe which mounts on the base of the sample tube and a threaded retrieval head which mounts onto the top of the sample tube. A sample retainer can be used in sandy or gravelly soils to improve recovery. The continuous sampler is mounted within the lead hollow-stem auger flight and is adjusted so the cutting head or shoe is even with the auger cutting bits or extends to as much as 0.5 feet below the bit. The continuous sampler is mounted on a drilling rod and does not rotate as the auger is rotated and hydraulically pushed into the subsurface. No drilling fluids are used during sampling with the continuous tube system. The hollow-stem augers are advanced in 5-foot increments. Once the augers have been advanced over a 5-foot interval, the continuous sampler is removed from the borehole (augers remain in position) and the sampling barrel is split open to expose the sample. A properly decontaminated sampler will be used for each sample interval. Once the sample is exposed it will be measured and described by the on-site hydrogeologist. Samples will be retained or submitted for chemical or physical tests.

Another type of continuous sampler consists of a hollow four or five foot long tube of carbon steel. Disposable acetate liners are available to use with the tube. The tube sampler is threaded on both ends but is not split length wise. The tube has a beveled cutting head on one end. Typically, the tube is pushed into the soil and then withdrawn. The soil sample is then removed from the acetate liner.

3.1.2 Shelby Tube Samples

This sampling method will be employed in clay or silt soils where undisturbed soil samples are required for physical tests. Shelby tubes can be used with auger drilling or air/rotary drilling techniques. The shelby tube sampler (ASTM D-1587-83) consists of a 3-inch diameter thin wall (16 gauge) steel tube (24 to 36 inches in length). The bottom of the tube or bit is sharpened so that the bevel is on the outside of the tube. The inside diameter of the bit is slightly less than that of the tube. The basic principle of operation is to hydraulically push the Shelby tube into the undisturbed soil in one continuous 2-foot stroke without rotation. To increase adhesion, the samples should be manually rotated to break off the soil at the bottom of the tube after the sample is allowed to sit approximately 1-minute. Subsequently, the shelby tube soil should be carefully removed from the hole to minimize disturbance to the sample. The ends of the sample tube will be sealed to prevent loss of moisture. The shelby tube will be stored to minimize jarring or shocks until analytical and/or physical testing of the sample is conducted.

3.1.3 Split-spoon Sampler

This sampling method will be used in unconsolidated soils if the continuous sampler is not available or is unable to obtain satisfactory soil recovery. The split-spoon sampler (ASTM D-1586-84) performs satisfactorily in all types of soil and must be driven with a 140-pound hammer falling 30 inches until either 18 inches have been penetrated or 100 blows applied. The sampler is threaded on both ends and split lengthwise. When assembled, the two halves are held together by the shoe at one end and the head at the other end. A space is provided for a sampler retainer. The lengths of all drill rod used should be measured and recorded on the Drill Rod and Auger Length verification form in Appendix F. The drill rod and augers should be measured to insure that the exact depth of the soil sample is precisely known.

3.1.4 Stainless Steel Hand Trowels or Spoons

This soil sample collection method enables samples to be collected from shallow trenches or holes. The method of operation is to use the trowel or spoon to scrape soil off the sidewall of the trench/hole and into either clean stainless steel mixing bowls or directly into the sample container. Alternatively, the trowel or spoon alone can be utilized to collect very shallow (0-6") soil samples.

3.1.5 Hand or Bucket Auger

This sampling method may be used to actually collect a sample or auger to a depth to be sampled further by either a shelby tube or split spoon sampler. The auger is hand rotated in a downward twisting motion approximately 6-inches into the soil. No drilling fluids are used during drilling. The auger is subsequently pulled out of the borehole and the soil in the bucket is either emptied directly into a sample container or a stainless steel mixing bowl for mixing or compositing with other soils and then transferred into the sample container.

3.2 Consolidated Rock

3.2.1 Double-Tube Corebarrel

A double-tube corebarrel is the preferred sampling method in consolidated rock formations. A hollow diamond or carbide bit which is typically 3.125 inches outside diameter and typically 2.2-inches inside diameter cuts at least a 2-inch core approximately 5 to 10 feet long. Upon coring 5 or 10 feet, the corebarrel is brought to the surface and split open. The core is subsequently removed and described by the hydrogeologist. All core samples will be labeled, packaged, and placed in water-proof core boxes for temporary storage and reference.

3.3 Drilling Methods

3.3.1 Hollow-Stem Auger

This is the preferred method of drilling through unconsolidated soils. No drilling fluids are used during hollow-stem auger drilling. Hollow stem augers that may be used at the site range from 6.875-inches to 8.25-inches outside diameter and 3.25-inches to 4.25-inches inside diameter. In this method, the augers are hydraulically pushed and rotated in 5-foot intervals with sampling occurring by lowering equipment through the center of the augers.

3.3.2 Air Rotary

The use of air-rotary drilling techniques is best suited for use in hard rock formations. Air rotary drilling involves the use of circulating air to remove the drill cuttings and maintain an open borehole as drilling progresses. The air from the compressor on the rig must be filtered to ensure that the oil from the compressor is not introduced into the soil or groundwater system. Steel or PVC surface casing may be advanced to assist in borehole stabilization.

3.3.3 Water Rotary

Water rotary is the second preferred method of drilling in hard rock formations. Water rotary involves the introduction of water into the borehole through the drill pipe and subsequent circulation back up to the surface to remove drill cuttings. No borehole stabilization additives such as bentonite or revert will be used. Water used in this drilling method will be obtained from the local potable water source. Steel or PVC surface casing may be advanced to assist in borehole stabilization.

3.3.4 Hand or Bucket Auger

This drilling method is used when drilling shallow borings (generally 5 feet or less) through unconsolidated soils. Typically, the hand auger is 4-inches in inside diameter and 4.25 inches outside diameter and the auger bucket is six

(6) inches long. In this method, the auger is hand rotated into the ground in six (6)-inch intervals. No drilling fluids are used. The auger is subsequently removed from the borehole and the soil removed from the bucket. The auger is cleaned and then reinserted into the borehole and hand rotated to collect another six inch interval of soil. A stainless steel hand auger will be used at all times.

3.4 Sampling Procedures

The sampling procedures common to undisturbed sampling and disturbed sampling are described in this section. A summary of the procedures are listed below:

- Sampler Preparation
- Drilling Fluid Composition
- Sample Interval
- Sample Identification
- Extruding Sample from Tubes
- Sample Collection and Management

3.4.1 Sampler Preparation

All samplers must be clean and free of dents and nicks. The sample tubes should not be lubricated. Any defects in the thin-wall tube or cutting head, split-spoon sampler, or continuous-tube sampler may constitute reasons for the sampling system to be discarded or replaced.

3.4.2 Drilling Fluid Composition

All borings will be advanced using techniques which require no drilling additives. In situations where wet rotary is the preferred method, only potable water will be used. A sample of the potable water used in drilling may be analyzed for the same chemical parameters as the groundwater or soil samples analytical list to insure that no impact occurred from the drilling fluid.

3.4.3 Sample Interval

All borings will be sampled continuously to the designated target depth unless specific sample intervals of interest were previously determined.

3.4.4 Sample and Drill Hole Identification

Each sample shall be identified by drill hole number and by consecutive sample number. The consecutive sample number should correspond to the sample numbers recorded on the borehole logs.

3.4.5 Extruding Sample from Shelby Tubes

The use of hydraulically activated sample jacks is the preferred method for extruding soil samples from the shelby tubes in the field and laboratory. Mechanical sample jacks can be used when hydraulic pressure is not available. The bottom end of the sample should be trimmed, so that the sample ejection jack piston fits flat on the sample surface. The sample should be extruded in one continuous uniform stroke onto clean aluminum foil. The first inch of the sample (which contacted the extruder) should be trimmed and discarded. The site hydrogeologist shall designate one "clean" person to handle only the tubes and samples. This person must wear clean surgical gloves prior to handling each sample.

3.4.6 Sample Collection and Management

Samples shall first be prepared by removing (by trimming with a clean stainless steel knife) the outer layer of soil that had contacted the sampling tube/equipment. This outer layer of soil will be discarded. Samples will then be obtained by cutting the entire length of each core section in half with a clean stainless steel knife. Equal parts of each core will be removed and then handled in incremental sections as described in the site specific data collection plans.

3.4.7 Soil Packaging and Handling

Soil samples collected will be double wrapped first in cellophane then in aluminum foil, labeled, and placed in water-proof core boxes. Selected samples may be split in order to conduct required various chemical or physical tests. All samples for the chemical and physical tests will be placed in appropriate clean laboratory supplied glass containers and properly labeled. All samples requiring analysis will have a chain-of-custody form completed.

3.4.8 Physical Testing of Soil Samples

Selected samples of the various lithological units encountered during test drilling may be subject to selected physical testing to identify soil characteristics important to site characterization and assessment. These physical tests may include the following methods:

- Particle size distribution (sieve: ASTM D-1140, Hydrometer ASTM D-2217)
- Saturated vertical hydraulic conductivity (ASTM D-2434 or ASTM D-479)
- Atterberg Limits (ASTM D-4318)
- Visual Classification (ASTM D-1587, and ASTM D-1588)
- Porosity (Density ASTM D-2216, specific gravity ASTM D-854)
- Unified Soil Classification (ASTM D-2487)
- Moisture Content (ASTM D-2216)

3.4.9 Soil Sample Description and Logging

Immediately upon retrieval, all recovered samples will be scanned for the presence of volatile organic compounds utilizing portable air monitoring photoionization instruments such as an organic vapor analyzer (OVA) or an HNU.

All recovered samples will be described and logged by the site hydrogeologist at the drill rig. Description will include amount of recovery; interval thickness, depth of lithology change; color according to the Munsel Color chart; grain size distribution; macro-features and physical characteristics; and type according to the Uniform Soil Classification System (ASTM D2488). All descriptions will be recorded on a soil boring log. Selected samples of each recovered soil interval will be placed in jars; appropriately labeled as to the test boring, sample number, and sample depth and stored on-site.

3.4.10 Sample Preservation

Soil samples requiring laboratory analysis will be placed in ice filled chests prior to transportation. According to SW-846 recommendations, refrigeration is the only preservation requirement for soil samples according to SW-846 recommendations.

3.4.11 Container and Labels

Containers and appropriate container lids (teflon lined) will be provided by the analytical testing laboratory. The containers will be filled and container lids will be tightly closed. A label will be firmly attached to the container side (not lid). The following information will be legibly and written with indelible ink on the label:

- facility name,
- sample identification,
- sampling date,
- sampling time,
- sample collector's initials,
- preservatives used,
- type of sample,
- sample analysis.

3.4.12 Sample Shipment

Typically, the concentration, volume shipped, and type of constituents potentially present in the soils from the Facility are considered by the U.S. Department of Transportation (D.O.T.) to be non-hazardous materials. Thus, the following packaging and labeling requirements for the sample materials are usually appropriate for shipping the sample to the testing laboratory:

- preserve samples with ice and cool to 4°C,
- package sample so that is does not leak, spill, or vaporize from its packaging;
- label package with
  - sample collector's name, address, and telephone number;
  - laboratory's name, address, and telephone number;
  - description of sample;
  - quantity of sample; and
  - date of shipment;
- attach chain-of-custody forms inside sample shipment container.

Under certain circumstances, such as elevated concentrations of uranium, the D.O.T. has an action limit of where a radioactive material is defined as any material having a specific activity greater than 0.002 microcuries per gram. Radioactive materials have additional shipping requirements that will be followed

3.4.13 Chain-Of-Custody Control

After samples have been obtained, chain-of-custody procedures will be followed to establish a written record concerning sample movement between the sampling site and the testing laboratory. Each shipping container will have a chain-of- custody form completed by the site sampling personnel packing the samples. The chain-of-custody form for each container will be completed in triplicate. One copy of this form will be maintained at the site, and the other two copies at the laboratory. One of the laboratory copies will become a part of the permanent record for the sample and will be returned with the sample analyses.

A copy of a sample chain of custody form is shown in Appendix F.

3.4.14 Sampling Records

To provide complete documentation of sampling, detailed records will be maintained. These records will include the information listed below:

- sample location (facility name);
- sample identification (sample number)
- sample location map or detailed sketch
- date and time of sampling;
- sampling method;
- sample preservation method
- field observations of
  - sample appearance,
  - sample odor
- weather conditions;
- sampler's identification
- sample analysis; and
- any other information which is significant.

Soil sampling information will be recorded on the appropriate records and forms described in Section 7.0.

3.4.15 Analytical Methods

Soil samples will be analyzed using the appropriate EPA-approved methodology. The EPA methodology will typically be those methods described in SW-846 or other approved analytical methods.

The laboratory performing the analyses will have a QA/QC program which specifies procedures and references to be used. As a minimum, the program will contain:

1. Laboratory instrument calibration procedures and schedules,
2. Specification of adherence to accepted test methods,
3. Equipment inspection and servicing schedules,
4. The regular use of standard or spiked sample analyses,
5. Operator or analyst training procedures and schedules,
6. A program of continuous review of results, procedures, and compliance with the QA/QC program, and
7. Documentation of compliance with the program.

3.5 Equipment Decontamination

All equipment coming into contact with soils or groundwater will be properly cleaned prior to use. Drilling equipment (i.e. augers, drill rod, sampling equipment, etc.) which contacts the borehole will be cleaned using a hot water pressure washer between boreholes. All sampling equipment will be pressure washed and then rinsed with deionized water prior to use. All sampling equipment and the drill rig will be cleaned with the high pressure hot water washer between borings. All monitoring well casings will be washed with the pressure washer prior to installation. Clean surgical gloves will be worn by all personnel handling the monitoring well materials during well completion.

All decontamination will be conducted in an area designated by SFC. All wash water will be collected and managed in accordance with state and federal regulations. All protective clothing and wastes generated by the drilling or soil/groundwater sampling programs will be containerized for proper disposal.

4.0 MONITORING WELL CONSTRUCTION

4.1 Shallow Monitoring Wells

All groundwater monitoring wells will be constructed of either 2-inch schedule 40 PVC or stainless steel casing and a factory slotted screen size determined to be suitable for the formation material. The Oklahoma Water Resources Board (OWRB) installation requirements of groundwater monitoring wells have been incorporated into the following sections. The OWRB rules are containeo in Oklahoma Administrative Code (OAC) 785:35. The installation of each monitoring well requires the submittal of a multi-purpose report.

A bottom sump (approximately 0.75 foot long) will extend below the screened interval for fines catchment. Unless otherwise specifically approved, the PVC screen used in all wells will be no greater than 10 feet in length. A properly sized clean silica sand pack will be placed around the screen, with a tremie line when needed, to serve as a filter medium between the well and screen. The sand pack will extend to approximately 2-feet above the top of the screen. A 2-feet thick layer of sodium bentonite pellets will then be placed on top of the sand pack. A cement-bentonite grout mix will be placed to a depth of approximately 2-feet from ground surface. The cement-bentonite grout will have a mix ratio of approximately one 94 pound sack of portland cement to a maximum of six (6) gallons of potable water and a maximum of six percent (6%) bentonite by dry weight. The cement-bentonite mix will be pressure grouted through a tremie line, if necessary (the line will extend to near the top of the bentonite pellets). For above ground completions, a vented cap will be placed on top of the PVC or stainless steel well casing. A sloped concrete pad (typically 3 feet diameter x 3.5 inches to 8 inches thick) and a steel locking protector (4 to 8 inches in diameter) will be placed over the well. Below ground completions, necessary in high traffic areas, will use an at-grade waterproof well protector and a water tight well cap. All monitoring wells will be marked with an appropriate identification numbering system. Typical above grade and below grade monitoring well construction diagrams for monitoring groundwater in shallow, unconfined materials are shown in Appendix F. Typical samples of cement, powdered bentonite, sand pack material, bentonite pellets, potable drilling water (if used), and the cement-bentonite grout mix used in each well completion may be retained as part of the QA/QC field activities.

4.2 Monitoring Well Construction Methods To Prevent Cross-Communication From Shallower Groundwater Zones

Where groundwater occurring in deeper zones (i.e. bedrock) is to be monitored, special precautions must be taken to minimize potential cross-communication from occurring between the targeted well completion depth and the overlying saturated zones which may be impacted. To minimize the cross-communication potential, telescoping monitoring well construction techniques will be utilized. This procedure consists of setting surface casing (and cementing in place) through the upper groundwater impacted zone, thus limiting the potential for soils and groundwater from the upper saturated zone to commingle with soils and groundwater of the deeper zones during the monitoring well installation process. Typical well construction diagrams for various cases are presented in Appendix F. Typical well construction methods presented in these drawings will be followed to insure cross-contamination between formations does not occur.

4.3 Well Development

Following completion of the monitoring well installations, all wells will be thoroughly developed. The purpose of monitoring well development is to remove any fluids lost to the formation during drilling (if fluids were used in the drilling process) and insure proper development of the sand pack and formation surrounding the screen. To insure proper curing of the cement-bentonite grout seals, no development will occur for at least twenty-four (24) hours following well completion. Development will consist of the removal of sufficient casing volumes until the discharged water is free from suspended sediment and the pH, specific conductivity, and temperature of the groundwater has stabilized. In addition, any fluids lost during drilling will b recorded and, at a minimum, this quantity and at least three (3) times the casing and sand pack volume (assume 30% porosity) will be removed. All development water will be collected and managed in accordance with state and federal rules. The basic procedure for well development is to remove any drilling fluids and silt and clay fines from the well screen and surrounding gravel pack by pumping and/or hydraulic surging. Provided that the formation recharge rate is high enough, groundwater will flow from the formation, through the gravel pack and screen, and into the well.

Precleaned dedicated bailers or decontaminated electric submersible pumps will be used to develop the wells. The bailers will be properly decontaminated (cleaned) prior to use in any well. Care will be taken to prevent the bailer line (monofilament nylon line) from contacting the ground. Clean surgical gloves will be worn by all personnel participating in the well development activities. A list of equipment to be used for monitoring well installation and development is presented on Table 2.

Prior to development, the water levels within the well and the well depth will be measured and recorded. These measurements will be used to calculate the fluid volume in the wells and sand pack prior to development. Measurements on the discharge volume, water clarity, pH, temperature and specific conductivity will be recorded on field forms or in a field notebook. Water levels may be taken and recorded before, during, and after well development.

5.0 AQUIFER CHARACTERIZATION TESTS

5.1 Slug Tests

Slug tests will be performed on selected newly installed monitoring wells to estimate the horizontal hydraulic conductivity in the formation monitored at each well site. The procedure involves lowering a slug of known volume into the water in the well and allowing the raised water level to recover to the reinsertion level (falling head test) while measuring the decline. The slug is then quickly removed and the recovery of the lowered water level to static level is measured (rising head test). The horizontal hydraulic conductivity and transmissivity of an aquifer can be estimated with the slug test. Slug tests will be evaluated in accordance with methods presented by Bouwer and Rice (1976) and Lohman (1979).

5.2 Pump Tests

A pump test provides data from which the principal factor of aquifer performance and transmissivity can be calculated. The storage coefficient of the aquifer can also be estimated if observation wells are monitored during a pump test. A test consists of pumping a well at a certain rate and recording the drawdown in the pumping well and in nearby observation wells. Constant rate discharge tests may be conducted at selected well sites if appropriate hydrogeological conditions are determined to be present. Constant rate tests may be conducted to evaluate the possible interconnection of the deeper water-bearing horizons with shallower zones. All drawdown and recovery data will be evaluated using standard methods outlined by Jacob (1946) and Theis (1935).

5.3 Data Collection

To provide accurate data, slug and pump tests are conducted using an automatic data logger and a pressure transducer to measure groundwater levels. Water-level rises or declines are measured using an INSITU Hermit SE-

1000 B Environmental Data Logger and a 10 or 50 psi downhole pressure transducer. A log-type measurement frequency is utilized to allow the frequent measurement (0.5 seconds or less) in the first several seconds and less frequent measurements after about 20 seconds. Measurement of pump discharge rates will also periodically be made.

5.4 Water Level Measurements

Water level measurements will be taken in all wells upon stabilization. The water level data will be evaluated and presented as depth-to-water and potentiometric (groundwater elevation) maps. The potentiometric maps will be prepared to determine the hydraulic gradients and groundwater flow direction. Water level measurements will typically be made with an electric sounder.

6.0 BOREHOLE AND MONITORING WELL ABANDONMENT

6.1 Borehole Abandonment

All borings not completed as monitoring wells will be plugged and abandoned in accordance with OWRB rules. Plugging and abandonment is typically accomplished by pressure grouting a cement grout mix through a tremie line. The grout will consist of a mix ratio of one (1) ninety-four (94) pound bag of portland cement and approximately 6 gallons of water. All grout will be pumped through a tremie line that extends to the bottom of the boring. The grout mix will then be circulated to about four-feet from surface. If subsidence of the grout mix is noted, additional grout will be placed in the borehole to bring the grout level to approximately four (4) feet from ground level. The remaining four (4) feet is then backfilled with clean compacted soil. The boring location will then be surveyed for horizontal and vertical coordinates. All borehole abandonments are to be recorded on OWRB multi-purpose reports as well as Facility log books and records.

6.2 Monitoring Well Abandonment

All monitor wells will be plugged and abandoned in accordance with OWRB regulations in existence at the time of the well abandonment. This typically requires removing or drilling out the well casing and placing cement grout from the bottom of the well to within at least four (4) feet of ground surface. The remaining four (4) feet is back filled with clean compacted soil. An OWRB multi-purpose report is to be completed for each well abandonment.

6.3 Site Reclamation

All drilling activities will be conducted in such a manner as to minimize any disturbance to the ground surface in the drilling area. A minimum number of vehicles will be brought to each drill site. All soil cuttings generated during drilling activities will be managed in accordance with state and federal regulations. Steps will be taken to minimize or prevent the discharge of drilling fluids or developed groundwater on the ground surface. Any accidental discharges will be cleaned up. Steps will be taken to minimize rutting of the off-road ground surface by vehicles by typically placing 3/4" plywood on the off-road ground and driving the vehicles on the plywood during periods of heavy precipitation and high ground moisture.

7.0 DOCUMENTATION OF FIELD DATA

Certain records will be maintained in logbooks and on field forms for sampling events and for daily activities. Some or all of the following forms will be used as appropriate to record the data generated at the site. These forms are:

- Borehole Abandonment Record
- Groundwater Sampling Record
- Core Boring Field Report
- Monitor Well Design Form (3 forms)
- Chain-of-Custody Form
- Boring Record
- Well Completion Record
- Monitoring Well Installation Record
- Drillers Log Summary
- Sample Labels
- Photographic Log and Labels
- Drill Rod and Auger Length Verification Form
- OWRB Multi-Purpose Report

Site safety, field measurements, and site activities data will be kept in the field log book. Examples of all field forms are presented in Appendix F. The field log book will be a bound book with consecutively numbered pages that will be suitable for submission as evidence in legal proceedings. The log book will become part of the permanent file for the site investigation. The log book will be used and maintained on a daily basis and all entries will be in ink.

8.0 SITE SAFETY PLAN

A Site Safety Plan will be prepared for use during hydrogeological field investigations. The Site Safety Plan will assess hazards at the site and will be prepared so as to present negligible hazards to site personnel and property owners. Environmental and radiological monitoring at the site will be performed in accordance with the Site Safety Plan.

9.0 DATA EVALUATION AND REPORTING PROCEDURES

Results and conclusions will require the review and assessment of the analytical results. Anomalous and unanticipated esults may be obtained from the program. Review and assessment activities must, therefore, be able to identify those anomalous occurrences and initiate the proper response to the analytical results. All data review and reporting procedures will be in accordance with the Data Management Plan.

Table 1: List of Equipment and Supplies for Soil Sampling

1. Health and safety equipment required by Site Safety Plan
2. Access keys
3. Logbook
4. Site map
5. Sample location map
6. Chain-of-custody forms
7. Cooler with ice and bubble wrap
8. Disposable vinyl or rubber gloves
9. Distilled or deionized water
10. Alconox detergent
11. Brushes
12. Decon trays
13. 5 gallon buckets
14. Visqueen plastic
15. Glass pint jars
16. Trashbags
17. Ziplock bags
18. Paper towels
19. Acetone or hexane (for heavy organic impacts)
20. Black ink pens
21. Roll clear tape
22. Garden sprayers
23. Tape measure
24. Laboratory sample containers
25. Stainless steel bowls
26. Stainless steel spoons, trowels, or knifes
27. Bucket augers
28. Split spoons or Shelby tubes
29. Continuous tube samplers
30. Portland cement
31. Bentonite powder
32. Shovel
33. pH meter
34. PID organic vapor meter
35. 0.1 normal nitric acid
36. Potable water (for decon)

Table 2: List of Equipment and Supplies for Monitoring Well Installation and Development

1. Health and safety equipment required by Site Safety Plan
2. Access keys
3. Logbook
4. Site map
5. Sample location map
6. Chain-of-custody forms
7. Cooler with ice and bubble wrap
8. Disposable vinyl or rubber gloves
9. Distilled or deionized water
10. Alconox detergent
11. Brushes
12. Decon trays
13. 5 gallon buckets
14. Visqueen plastic
15. Glass pint jars
16. Trashbags
17. Ziplock bags
18. Paper towels
19. Acetone or hexane (for heavy organic impacts)
20. Black ink pens
21. Roll clear tape
22. Garden sprayers
23. Tape measure
24. pH meter
25. Specific conductivity meter
26. Water level meter
27. Organic interface probe
28. PID organic vapor meter
29. 0.1 normal nitric acid
30. Potable water (for decon)
31. Teflon, stainless steel, disposable bailers
32. Monafilament bailing line
33. Electric submersible pump and portable generator
34. Pumplines
35. Appropriate monitoring well components
    - screens
    - risers
    caps and ends
    protective covers
36. Bentonite pellets
37. Locks
38. Well pad materials
39. Slug test equipment
40. Pump test equipment

APPENDIX E

GROUNDWATER SAMPLING QUALITY ASSURANCE PLAN

TABLE OF CONTENTS

GROUNDWATER SAMPLING QUALITY ASSURANCE PLAN

1.0 PURPOSE

This plan presents the procedures to be followed for groundwater monitoring well sampling, sample management, and sample custody control.

2.0 SAMPLING PROCEDURES

Activities which will occur during groundwater sampling are summarized as follows:

- pre-arrangement of sample analytical requests with analytical testing laboratory
- assembly and preparation of sampling equipment and supplies
- determine statistically significant number of groundwater samples for specific tasks
- groundwater sampling
  - determine sample type (i.e. composite or grab), frequency and number of samples, and proper sampling containers
  - inspection of well
  - water-level measurements
  - well depth measurement
  - measurement of any floating product in well
  - visual inspection of borehole water
  - calculation of purge volume
  - well bore evacuation
  - sampling
- sample preservation and shipment
  - sample preparation
  - on-site measurement of parameters
  - sample labeling including date, time, location, sampler's initials, analyses, and tracking number
- completion of sample records (field log book)
- completion of chain-of-custody records
- sample shipment

Detailed sampling procedures are presented in the following sections.

2.1 Equipment Assembly and Preparation

Prior to the sampling event, all equipment to be used (listed in Table 1) will be assembled, and its operating condition verified, calibrated (if required), and properly cleaned (if required). In addition, all record-keeping materials will be prepared.

2.1.1 Equipment Check

This activity includes the verification that all equipment is in proper operating condition. Also, arrangements for repair or replacement of any equipment which is inoperative are made.

2.1.2 Equipment Calibration

Where appropriate, equipment will be calibrated according to the manufacturer's specifications prior to field use. Equipment for making on-site measurements are pH, Eh, dissolved oxygen, specific conductance, and temperature of water.

2.1.3 Equipment Cleaning (Decontamination)

All portions of sampling and test equipment which will contact the interior well casing will be thoroughly cleaned before use. This includes water-level tapes or probes, pumps, tubing, bailers, lifting line, test equipment for on-site use, and other equipment or portions thereof which are to be immersed. The procedure for <u>initial</u> equipment cleaning is as follows:

- clean with tap water and phosphate-free laboratory grade detergent, brush if necessary;
- rinse thoroughly with tap water;
- rinse with 0.1 normal nitric acid solution;
- rinse thoroughly with distilled water;
- equipment cleaned prior to field use will be recleaned after transfer to the sampling site unless carefully wrapped for transport.

Non-dedicated equipment (such as water level or interface probes) which contacts the interior well casing before evacuation of the casing water should be rinsed thoroughly with distilled water (or hexane rinse if organics are noted) between wells. Dedicated bailers should be rinsed thoroughly with distilled water between sampling events. All other equipment which contacts the interior well casing during or after evacuation of the well casing water should be cleaned between well sampling use in accordance with the above detailed procedures.

Any necessary deviation from these procedures will be documented in the permanent record of the sampling episode.

Laboratory-supplied sample containers will be cleaned and sealed by the laboratory before shipping.

2.2 Groundwater Sampling Procedures

Special care will be exercised to prevent contamination of the groundwater and extracted samples during the sampling activities. The two primary ways in which such contamination can occur are:

- contamination of a sample through contact with improperly cleaned equipment; or
- cross-contamination of the groundwater through insufficient cleaning of equipment between wells. This could occur if non-dedicated sampling equipment is used.

To prevent such contamination, all sampling equipment will be thoroughly cleaned before each use at different sampling locations in accordance with Section 2.1.3. In addition to the use of properly cleaned equipment, three further precautions will be followed:

- a clean pair of new, disposable latex (or similar) gloves will be worn each time a different well is sampled; and
- sample collection activities will proceed progressively from background area to the downgradient area or from wells which are least affected by contaminants progressively to wells most affected by contaminants.

The following paragraphs present procedures for the several activities which comprise groundwater sample acquisitions. These activities will be performed in the same order as presented below. Exceptions to this procedure will be noted in the permanent sampling record.

2.2.1 Groundwater Level and Well Depth Measurement

Prior to the water-level and well depth measurements, each well will be inspected thoroughly for signs of damage. Any damage to or repairs needed on the well must be noted on the attached Groundwater Sampling Record form, Appendix F or in the field log book.

Using a pre-cleaned water level meter, the groundwater surface will be measured from the casing datum to the nearest 1/8 inch (0.01 foot). The datum, usually the top of the inner well casing, will be described in monitor well records. A permanent mark or scribe will be visible on inspection of the inner casing. The depth to the bottom of the well must also be measured continually and referenced to the same datum as the water-level measurement. These measurements will be recorded in the Groundwater Sampling Record form or the field log book. The date and time of the water-level measurements must also be recorded.

2.2.1.1 Immiscible Phase and Dense Phase Organic Measurement

If an immiscible floating layer or a heavier-than-water organic phase is thought to be present on the groundwater surface or near the base of the groundwater in the well, its thickness must be measured and recorded. The presence of an immiscible layer precludes the exclusive use of electric (conductivity) sounders to establish an accurate static water level measurement. Electric sounders will not work properly in immiscible liquids.

The measurement of an immiscible layer and the static groundwater directly below it requires specialized measuring equipment and/or methodology. One method used to measure the immiscible phase thickness is to use a clean interface probe which distinguishes between organic liquids and water. When taking measurements in wells where organic immiscible liquids are present, it is important to record: 1) the depth to the top of the immiscible liquid from the reference datum; 2) the thickness of the immiscible layer; and 3) the depth to the top of the groundwater beneath the immiscible layer. Another method of measuring an immiscible layer is through the use of a transparent or semi-transparent sampling device such as a bailer. The bailer is carefully lowered into the well to minimize agitation of the immiscible/water interface. The bailer is then raised to the surface and the thickness of the immiscible layer is measured and recorded. If a clean interface probed is used then the probe should be dropped to the bottom of the well to determine the thickness of dense phase organics. Similarly, if a bottom discharge bailer is used it should be dropped to the bottom of the well to determine the thickness of dense phase organics.

2.2.2 Visual Inspection of Well Water

Prior to well evacuation, but after water level and well depth measurements, a small quantity of water will be removed with a bailer in a manner which will not totally immerse the bailer. The recovered sample is representative of the top of the water column in the well casing. This technique can determine the presence immiscible contaminants accumulate at the top of the water column. The water will be inspected for the presence of a floating film or other indications of contamination. Also, a sample of the groundwater will be removed from the bottom of the well (sump) and inspected for dense phase or heavier-than-water organics. Any distinct sample color or odors will be noted. The thickness of any floating immiscible or dense phase products will be measured and recorded on the Groundwater Sampling Record form. All observations regarding odor or visual evidence of contamination will be recorded on the Groundwater Sampling Record form, (Appendix F) or in the field log book.

2.2.3 Immiscible Phase Sampling

If an immiscible floating layer is present on the groundwater surface in the well it should be sampled prior to well evacuation.

Also, if it is determined that a heavier-than-water or dense phase organics are suspected to be present, then the bottom discharge bailer will be lowered to the bottom of the well and a sample will be collected for analyses prior to well excavation.

The dedicated bailer must be cleaned if immiscible or heavier-than-water organics are detected prior to additional sampling of the well.

2.2.4 Well Casing Evacuation

The water standing in a well prior to sampling may not be representative of in-situ groundwater quality. Therefore, the standing water in the well and sand filter pack must be removed so that formation water can replace the stagnant water. Using the depth-to-water, well depth, and filter pack interval (assume a porosity of 30%) calculate the volume of groundwater to remove from each well. Three casing volumes (including filter pack porewater) must be removed before sampling. The following equations should be used to calculate the volume of groundwater to be removed prior to sampling:

(1) $v_c = \pi r_c^2 h_c \times 7.48 \times 3$

v_c = Three (3) volumes of water in casing storage, gallons

r_c = radius of casing, feet

h_c = length of water column in casing, feet

7.48 = conversion factor from cubic feet to gallons

3 = casing volumes, and

(2) $v_s = (\pi r_s^2 h_s - \pi r_c^2 h_{cs}) \times 7.48 \times 3 \times 0.30$

where: v_s = Three (3) volumes of water in sand pack interval, gallons

r_s = radius of drilled borehole, feet

h_s = length of sand pack interval, feet

r_c = radius of casing, feet

h_{cs} = length of casing/screen in sand pack interval, feet

0.30 = estimated porosity of sand pack

Adding the 3 casing groundwater volumes to the 3 sand porewater volumes equals the amount of water that must be purged from the well prior to sampling. During purging, pH, conductivity, and temperature measurements will be taken and recorded to insure that the water quality in the well has stabilized. If these measurements indicate water quality has not stabilized, then additional casing/sand pack porewater volumes will be removed until stable readings are obtained. All purged groundwater will be containerized in steel 55-gallon drums and managed in accordance with state and federal regulations.

If a well is incapable of yielding 3 casing volumes, then the well will be evacuated to dryness and allowed to recover to near static levels prior to sampling. The purged water will be tested for pH, temperature, and conductivity and compared to the groundwater sample to insure that the water quality in the well had stabilized. If the pH, temperature, or conductivity have not stabilized then additional purging of the well will be required.

The wells can be purged using clean stainless steel or teflon bottom discharge bailers. A clean monofilament nylon line will be used to lower the bailer into the well. Special care will be taken to insure that the bailer or bailer line does not contact the ground. Alternatively, a properly cleaned non-aerating pump system can be used for purging such as a bladder and/or peristaltic pump. Another method which may be used is a Brainard-Kilman hand pump system.

During groundwater collection, no equipment or lifting lines will be allowed to contact the ground. If equipment or lifting lines contacts the ground, they will be replaced or recleaned prior to use.

2.2.5 Sample Extraction

A bailer constructed of stainless steel or teflon will be used to extract water samples from the well. It is much preferable that bailers be dedicated to specific wells. A bailer must be recleaned in accordance with Section 2.1.3 if it was previously used to collect an immiscible phase sample or used to sample more than one (1) well. A new, clean monofilament nylon line should be used during each sampling event. Care must be taken to prevent either the bailer or lifting line from contacting the ground surface and becoming potentially contaminated during sampling. Care will be taken during insertion of sampling equipment to prevent undue disturbance of water in the well. The bailer will be lowered into the water gently to prevent splashing and extracted gently to prevent creation of excessive turbulence in the well. The sample will be poured directly into appropriate containers. While pouring water from a bailer, the water will be carefully poured down the inside of the sample bottle to prevent significant aeration of the sample.

If a significant immiscible layer remains in the well following purging, then care must be taken to avoid sample bias by sampling directly from the top of the water column. A sample of the immiscible layer should have previously been taken.

Excess water collected during sampling will be placed in a container for proper disposal as described in Section 2.2.4.

2.2.6 On-Site Parameter Measurement

Certain chemical and physical parameters in wate; can change significantly within a short time of sample acquisition. These parameters cannot be accurately measured in a laboratory located more than a few hours from the Site, and therefore will be measured on-site with portable equipment. Examples of these parameters are:

- pH;
- specific conductance;
- temperature;
- Eh; and
- Dissolved oxygen

Measurement of these parameters will be obtained from unfiltered, unpreserved, "fresh" water collected by the same technique as the samples taken for laboratory analyses. The measurements will be made in a clean glass container separate from those intended for laboratory analysis. The measured sample will be disposed of as described in Section 2.2.4. The measured values will be recorded in the field log book.

2.3 <u>Sample Preservation</u>

Water samples will be properly prepared for transportation to the laboratory under refrigeration and chemical preservation, if necessary. The laboratory providing sample containers will have added any necessary chemical preservatives to the sealed containers provided. While in the field, all collected samples must be placed in ice filled chests. Table 1 is a list showing appropriate sample containers, preservatives, and holding/extraction times for several inorganic and organic parameters. The preservatives, sample containers, and holding times listed in Table 1 will be followed during groundwater sample collection.

2.4 Container and Labels

Containers and appropriate container lids (teflon lined) will be provided by the analytical testing laboratory. The containers will be filled and container lids will be tightly closed. All sample container lids will be sealed with tamper proof tape and a label will be firmly attached to the container side (not lid). The following information will be legibly and indelibly written on the label:

- facility name,
- sample identification,
- sampling date,
- sampling time,
- sample collector's initials,
- preservatives used,
- type of sample, and
- analysis to be performed.

2.5 Sample Shipment

Typically, the concentration, volume shipped, and type of compounds present in the groundwater from the Facility are considered by the U.S. Department of Transportation (D.O.T.) to be non-hazardous. Thus, the following packaging and labeling requirements for the sample materials are usually appropriate for shipping the sample to the testing laboratory:

- preserve samples with ice and cool to 4°C,

- package sample so that is does not leak, spill, or vaporize from its packaging;
- label package with
  - sample collector's name, address, and telephone number;
  - laboratory's name, address, and telephone number;
  - description of sample;
  - quantity of sample; and
  - date of shipment;
- attach chain-of-custody forms inside sample shipment container.

Under certain circumstances, such as elevated concentrations of uranium, the D.O.T. has an action limit of where a radioactive material is defined as any material having a specific activity greater than 0.002 microcuries per gram. Radioactive materials have additional shipping requirements that will be followed.

2.6 Chain-of-Custody Control

After samples have been obtained, chain-of-custody procedures will be followed to establish a written record concerning sample movement between the sampling site and the testing laboratory. Each shipping container will have a chain-of- custody form completed by the site sampling personnel packing the samples. The chain-of-custody form for each container will be completed in triplicate. One copy of this form will be maintained at the site, and the other two copies will be shipped with the samples to the laboratory. One of the laboratory copies will become a part of the permanent record for the sample and will be returned with the sample analyses.

A copy of a sample chain of custody form is shown in Appendix A.

2.7 Sampling Records

To provide complete documentation of sampling, detailed records will be maintained. These records will include the information listed below:

- sample location (facility name);
- sample identification (well number and/or sample number);
- sample location map or detailed sketch;
- date and time of sampling;
- sampling analysis and method;
- field observations of
  - sample appearance,
  - sample odor
- weather conditions;
- sampler's identification; and
- any other information which is significant.

Groundwater sampling information will be recorded on the Sampling Record as shown in Appendix ^F or in the field log book.

3.0 ANALYTICAL METHODS

Groundwater samples will be analyzed using the appropriate, EPA-approved methodology in accordance with methods outlined in SW-846, "Test Methods for Evaluating Solid Waste", published by the EPA in November, 1986, or a similar EPA apprcved method.

Water samples collected from monitoring wells also include one split or replicate sample for each 10 wells sampled or 1 replicate per day. The decision of which sample to split will be made by sampling personnel. The split or replicate sample will be given a designation which will not be confu vith other samples to be tested.

A trip blank sample of reagent grade water will be shipped from the laboratory to the Site and will be returned to the laboratory for analysis. The blank will not be opened in the field. The trip blank will be used when volatile organic analyses are conducted.

One equipment blank sample of regent grade water will be prepared in the field for the first sampling event and if nondedicated bailers are used, one equipment blank sample will be prepared for each sampling day. Equipment blank samples will be obtained by pouring a blank reagent-grade water sample (provided by the laboratory) into a cleaned, sampling bailer and then filling a sample container in the sample manner that would be used for a groundwater sample. This is done in the field at the time of sample collection.

The laboratory performing the analyses will have a QA/QC program which specifies procedures and references to be used. As a minimum, the program will contain:

1. Laboratory instrument calibration procedures and schedules.
2. Specification of adherence to accepted test methods.

3. Equipment inspection and servicing schedules.
4. The regular use of standard or spiked sample analyses.
5. Operator or analyst training procedures and schedules.
6. A program of continuous review of results, procedures, and compliance with the QA/QC program.
7. Documentation of compliance with the program.

4.0 DATA EVALUATION AND REPORTING PROCEDURES

Results and conclusions will require the review and assessment of the groundwater monitoring results. Anomalous and unanticipated results may be obtained from the program. Review and assessment activities must, therefore, be able to identify those anomalous occurrences and initiate the proper response to the monitoring results. All data review and reporting will be in accordance with the Data Management Plan.

Table 1: List of Equipment and Supplies for Groundwater Sampling Quality Assurance Plan

1. Health and safety equipment required by Site Safety Plan
2. Access keys
3. Logbook
4. Site map
5. Sample location map
6. Chain-of-custody forms
7. Cooler with ice and bubble wrap
8. Disposable vinyl or rubber gloves
9. Distilled or deionized water
10. Alconox detergent
11. Brushes
12. Decon trays
13. 5 gallon buckets
14. Visqueen plastic
15. Glass pint jars
16. Trashbags
17. Ziplock bags
18. Paper towels
19. Acetone or hexane (for heavy organic impacts)
20. Black ink pens
21. Roll clear tape
22. Garden sprayers
23. Tape measure
24. pH meter
25. Specific conductivity meter
26. Water level meter
27. Organic interface probe
28. PID organic vapor meter
29. 0.1 normal nitric acid
30. Potable water (for decon)
31. Teflon, stainless steel, or disposable bailers
32. Monafilament bailing line
33. Eh meter
34. Pumplines
35. Dissolved oxygen meter

TABLE 2 : ANALYTICAL METHODS, CONTAINERS AND SAMPLE PRESERVATION FOR TARGET PARAMETERS, RCRA FACILITY INVESTIGATION, SEQUOYAH FUELS CORPORATION, GORE, OKLAHOMA

PARAMETERS	EPA METHOD*		RECOMMENDED CONTAINER**		PRESERVATIVE		MAX. HOLD TIME DAYS+		MINIMUM VOLUME REQUIRED FOR ANALYSES	
	WATER	SOIL/SED	WATER	SOIL/SED	WATER	SOIL/SED	WATER	SOIL/SED	WATER	SOIL/SED
TOTAL METALS										
ARSENIC	6010	6010	P	G, TL	NITRIC ACID, pH <2, 4°C	4°C	[illegible]	180	100 ML	10 G
BARIUM	6010	6010	P	G, TL	NITRIC ACID, pH <2, 4°C	4°C	180	180	100 ML	10 G
BERYLLIUM	6010	6010	P	G, TL	NITRIC ACID, pH <2, 4°C	4°C	180	180	100 ML	10 G
CADMIUM	6010	6010	P	G, TL	NITRIC ACID, pH <2, 4°C	4°C	180	180	100 ML	10 G
COPPER	6010	6010	P	G, TL	NITRIC ACID, pH <2, 4°C	4°C	180	180	100 ML	10 G
LEAD	6010	6010	P	G, TL	NITRIC ACID, pH <2, 4°C	4°C	180	180	100 ML	10 G
NICKEL	6010	6010	P	G, TL	NITRIC ACID, pH <2, 4°C	4°C	180	180	100 ML	10 G
SELENIUM	6010	6010	P	G, TL	NITRIC ACID, pH <2, 4°C	4°C	180	180	100 ML	10 G
SILVER	6010	6010	P	G, TL	NITRIC ACID, pH <2, 4°C	4°C	180	180	100 ML	10 G
VANADIUM	6010	6010	P	G, TL	NITRIC ACID, pH <2, 4°C	4°C	180	180	100 ML	10 G
ZINC	6010	6010	P	G, TL	NITRIC ACID, pH <2, 4°C	4°C	180	180	100 ML	10 G
VOLATILE ORGANICS										
1,1,1-TRICHLOROETHANE	8240	8240	G, TL	G, TL	HCL, pH<2, 4°C	4°C	14	14	3 x 40 ML	50 G
TRICHLOROFLUOROMETHANE	8240	8240	G, TL	G, TL	HCL, pH<2, 4°C	4°C	14	14	3 x 40 ML	50 G
BENZENE	8240	8240	G, TL	G, TL	HCL, pH<2, 4°C	4°C	14	14	3 x 40 ML	50 G
TOLUENE	8240	8240	G, TL	G, TL	HCL, pH<2, 4°C	4°C	14	14	3 x 40 ML	50 G
ETHYLBENZENE	8240	8240	G, TL	G, TL	HCL, pH<2, 4°C	4°C	14	14	3 x 40 ML	50 G
XYLENES	8240	8240	G, TL	G, TL	HCL, pH<2, 4°C	4°C	14	14	3 x 40 ML	50 G
SEMI-VOLATILE ORGANICS										
PHENANTHRENE	8270	8270	AG, TL	G,TL	4°C	4°C	7	14	1000 ML	50 G
NAPHTHALENE	8270	8270	AG, TL	G,TL	4°C	4°C	7	14	1000 ML	50 G

NOTES:
1. TEST METHODS FOR EVALUATING SOLID WASTE, #SW846, THIRD EDITION, NOVEMBER, 1986.
2. ** : G - GLASS, P - POLYETHYLENE, TL - TEFLON LINED LID, AG - AMBER GLASS.
3. + : HOLDING TIME STARTS ON DAY SAMPLE OBTAINED.
4. SED : SEDIMENT, ALSO APPLIES TO SLUDGE.

M:\LOTUS\TABLE1.WK1

APPENDIX F

Example Forms

CHAIN OF CUSTODY/SPE[illegible]AL ANALYSIS REQUEST

SFC-40[illegible]4

REQUESTING DEPARTMENT	DATE NEEDED:	CHAIN OF CUSTODY TRANSFERS			
COPIES TO:		SAMPLED BY: (PRINT NAME)			
		RELINQUISHED BY:(SIGNED)	RECEIVED BY:(SIGNED)	DATE	TIME
STAMP SAMPLE TYPE HERE		RELINQUISHED BY:(SIGNED)	RECEIVED BY:(SIGNED)	DATE	TIME
		RELINQUISHED BY:(SIGNED)	RECEIVED BY:(SIGNED)	DATE	TIME

SAMPLE MEDIA: ☐ GROUND WATER ☐ SOIL ☐ SEDIMENT ☐ OTHER______ ☐ SURFACE WATER ☐ EFFLUENT ☐ VEGETATION

SAMPLE I.D. OR DESCRIPTION	SAMPLE DATE	SAMPLE TIME	NUMBER OF SAMPLES AND METHOD: Comp.	NUMBER OF SAMPLES AND METHOD: Grab	ANALYSIS REQUESTED							

COMMENTS:

Sample Disposition: Discard___ Return___ Retain___
Note: Sample Bottles Must Be Flagged if for Return or Retain.

PERSON NOTIFIED: ________ DATE: ______ TIME: ______

METHOD USED:

☐ HAND TO HAND (INITIAL) ☐ PHONE ☐ MAIL ☐ FAX

Date Reported	Lab Approval	Lab Report Number

BORING RECORD

GEOLOG UNIT	DEPTH (FEET)	LITHOLOGIC DESCRIPTION	UNIFIED SOIL CLASSIFICATION	GRAPHIC LOG	PENETRATION RESISTANCE, "N" BLOWS PER FOOT (20 40 60 80)	SAMPLE				REMARKS
						NUMBER	TYPE	RECOVERY	DEPTH	
	0									

CME CONTINUOUS AUGER SAMPLER	WATER TABLE (TIME OF BORING)
STANDARD PENETRATION TEST	L LABORATORY TEST LOCATION
UNDISTURBED SAMPLE	+ PENETROMETER, (TONS / FT^2)
WATER TABLE (24 HOURS)	

ROBERTS/SCHORNICK
& ASSOCIATES, INC.
Environmental Consultants

JOB NAME / NUMBER:

BORING NUMBER:

DATE DRILLED

DRILLING METHOD

DRILLED BY

LOGGED BY

CHECKED BY

PAGE OF

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BORING RECORD

GEOLOG UNIT	DEPTH (INCHES)	LITHOLOGIC DESCRIPTION	UNIFIED SOIL CLASSIFICATION	GRAPHIC LOG	HNU SOIL GAS SURVEY PPM x ____ 2 4 6 8 10 12 14 16 18	SAMPLE NUMBER	SAMPLE HNU READING	SAMPLE RECOVERY	SAMPLE DEPTH	REMARKS BACKGROUND HNU READING: SOIL: ____ PPM AIR: ____ PPM
	0									

	CME CONTINUOUS AUGER SAMPLER
	STANDARD PENETRATION TEST
	UNDISTURBED SAMPLE
	WATER TABLE (24 HOURS)
	WATER TABLE (TIME OF BORING)
L	LABORATORY TEST LOCATION
+	PENETROMETER, (TONS / FT^2)

JOB NAME / NUMBER:

BORING NUMBER:

DATE DRILLED ____

DRILLING METHOD ____

DRILLED BY ____

LOGGED BY ____

CHECKED BY ____

PAGE

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Environmental Consultants

RSA FORM 4 2/84 REV 1

MONITORING WELL INSTALLATION RECORD

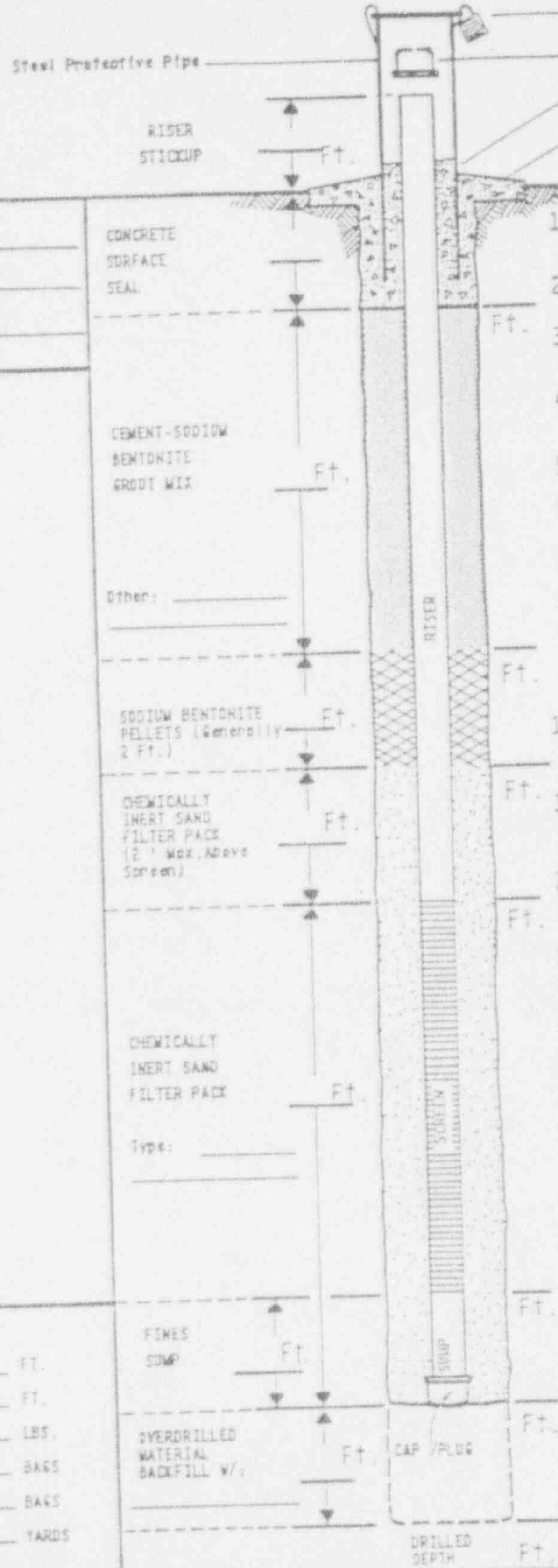
OBSERVATIONS

DATE DRILLING STOPPED: ____

DATE WELL INSTALLATION BEGAN: ____

DATE WELL INSTALLATION FINISHED: ____

WELL



SPECIFICATIONS

Lock: Yes ☐ No ☐

Riser Cap w/Vent. Yes ☐ No ☐

Weep Hole: Yes ☐ No ☐

Concrete Pad: Yes ☐ No ☐

Size: ____

1. Type of Riser: PVC ☐ Galvanized ☐ Teflon ☐ Stainless Steel ____ ☐ Other ____ ☐
2. Type of Riser/Screen Joints: Screw-Couple ☐ Glued-Couple ☐ Other ☐ ____
3. Type of Well Screen: PVC ☐ Galvanized ☐ Teflon ☐ Stainless Steel ____ ☐ Other ____ ☐
4. Diameter of Riser and Well Screen: (I.D.): Riser ____ Inches, Screen ____ Inches
5. Slot Size of Screen: ____
6. Type of Screen Perforation: Factory Slotted ☐ Other ☐ ____
7. Installed Protector Pipe w/Lock: Yes ☐ No ☐
8. Borehole Diameter = ____ Inches
9. Were Drilling Additives Used? Yes ☐ No ☐ Revert ☐ Bentonite ☐ Water ☐ Air ☐ Gallons / Volume Used: ____
10. Was Fines Sump or Dense Phase Sampling Cup Installed? Yes ☐ No ☐
11. Was Outer Steel Casing Used? Yes ☐ No ☐ Depth: ____ to ____ Feet.
12. How Was Well Developed? Bailing ☐ Pumping ☐ Air Surging (Air or Nitrogen) ☐ Other ____ ☐
13. Time Spent on Well Development? ____ / ____ Minutes/Hours
14. Approximate Water Volume Removed? ____ Gallon
15. Water Clarity Before Development? Clear ☐ Turbid ☐ Opaque ☐
16. Water Clarity After Development? Clear ☐ Turbid ☐ Opaque ☐
17. Did the Water have Odor? Yes ☐ No ☐ If Yes, Describe: ____
18. Did Water have any Color? Yes ☐ No ☐ If Yes, Describe: ____
19. Water Level Summary (From Top of Riser)
    Before Development ____ Ft. Date ____
    After Development ____ Ft. Date ____
    Water Level ____ Ft. Date ____
    ____ Ft. Date ____
20. Ground Surface Elevation: ____ Feet
    Top of Riser Elevation: ____ Feet

WELL COMPLETION MATERIALS:

LENGTH OF SCREEN USED: ____ FT.

LENGTH OF RISER USED: ____ FT.

AMOUNT OF BENTONITE USED: ____ LBS.

AMOUNT OF SAND FILTER USED: ____ BAGS

AMOUNT OF CEMENT USED: ____ BAGS

AMOUNT OF CONCRETE USED: ____ YARDS

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Environmental Consultants

WELL NUMBER: ____

JOB NAME/ NUMBER: ____

LOCATION: ____

INSTALLATION DATE: ____

RSA REPRESENTATIVE: ____

DRILLING CONTRACTOR: ____

DRILLING METHOD: ____

FIELD FORM: RSA 8/87

GEOL. UNIT	DEPTH (Feet)	DESCRIPTION	U.S.C.	SAMPLE INTERVAL	"N" VALUE	GRAPHIC LOG	WELL COMPLETION DETAIL	DEPTH (Feet)
	0	GROUND SURFACE :					VENTED CAP; LOCKING STEEL PROTECTOR; CASING DATUM: ______; WEEP HOLE; CONCRETE PAD	

CME CONTINUOUS AUGER SAMPLER
STANDARD PENETRATION TEST
UNDISTURBED SAMPLE
WATER TABLE (24 HOURS)
WATER TABLE (TIME OF BORING)
L LABORATORY TEST LOCATION
+ PENETROMETER, (TONS/FT.^{2})

WELL NUMBER ______

JOB NUMBER ______

DATE DRILLED ______
DRILLING METHOD ______
DRILLED BY ______
LOGGED BY ______
CHECKED BY ______ PAGE ____ OF ____

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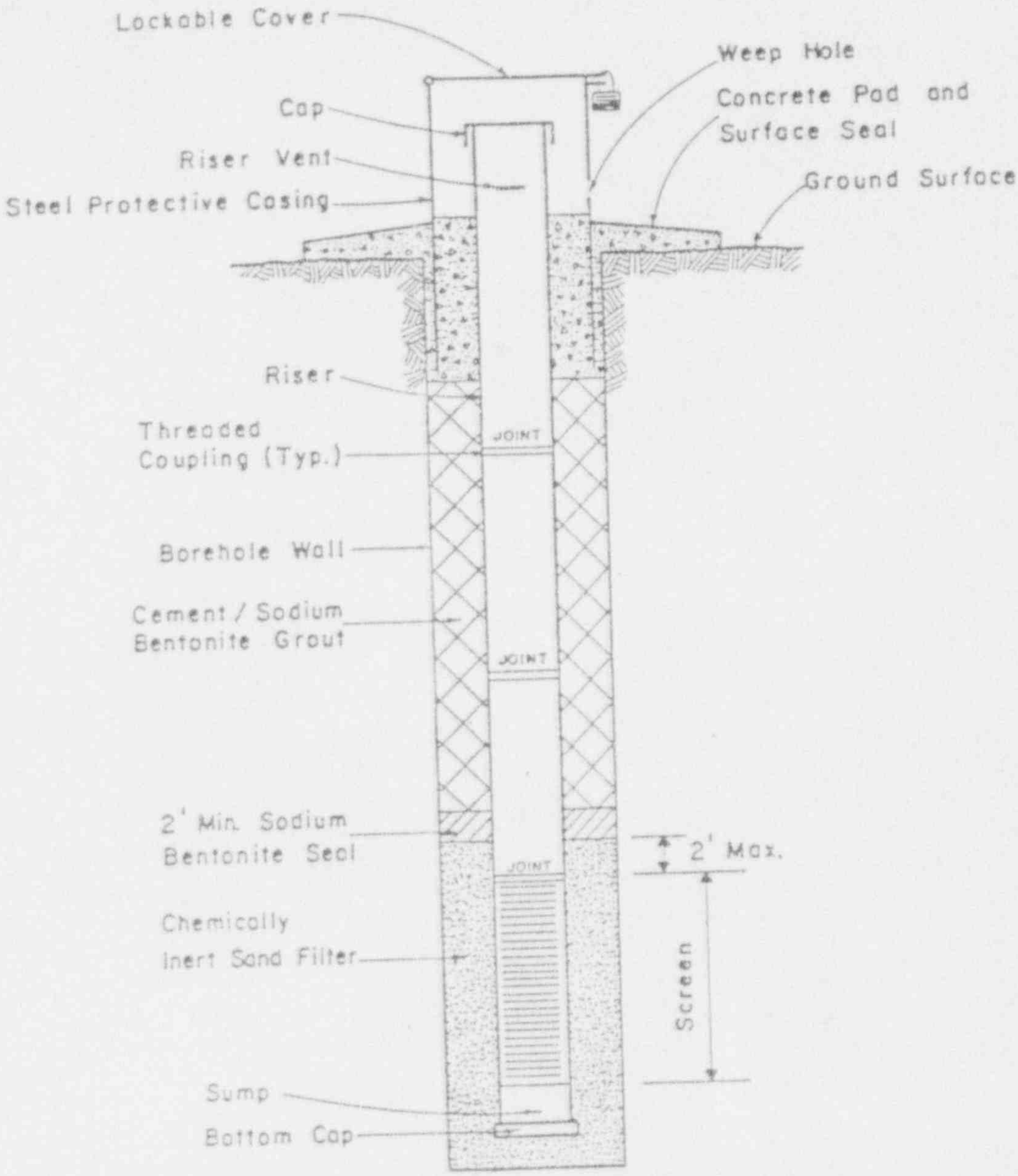
RSA FORM 9/87



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MONITORING WELL DESIGN

RSA FORM 9/87

DRILL ROD AND AUGER LENGTH VERIFICATION

DRILL RIG # ____________

Rod Number	Auger Number	Rod Length, ft.	Auger Flt. Length, ft.	Bit Length, ft.	Comments

Approved by Engineer ____________

Form RSA 1.3

& ASSOCIATES, INC.
800 Copperfield Drive, Suite A Norman, Oklahoma 73072

GROUNDWATER SAMPLING RECORD

CLIENT ______________ SAMPLING LOCATION ______________

PROJECT NO. ______________ SAMPLING DATES ______________

REASON FOR SAMPLING: ____ Regular Sampling; ____ Special Sampling

DATE AND TIME OF SAMPLING: ____________, 19___ ______________ a.m./p.m.

SAMPLE COLLECTED BY: ______________ of ______________

WEATHER: ______________

DATUM FOR WATER DEPTH MEASUREMENT (Describe): ______________

____

MONITOR WELL CONDITION:

____ Locked: ____ Unlocked
Well Number (IS - IS NOT) Apparent
Steel Casing Condition is: ______________
Inner PVC Casing Condition is: ______________
Water Depth Measurement Datum (IS - IS NOT) Apparent
Total Depth of Well: Actual ________ (ft.): Installed ________ (ft.)

____ Deficiencies Corrected by Sample Collector
____ Repairs Required (Describe): ______________

____

____

CHECK-OFF AS COMPLETED

1 ____ FIELD EQUIPMENT CLEANING BEFORE USE:
Items Cleaned and Method: ______________

____

____

2 ____ WATER DEPTH ______________ FT. BELOW DATUM
Measured with: ______________

3 ____ WATER CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: ______________
Odor: ______________
Other Comments: ______________

4 ____ WELL EVACUATION:
Volume of Water in Well Bore: ______________
Evacuation Method: ______________ If bailer, give size: ______________
Volume Removed: ______________ Full Bailers ______________ gallons
Observations During Evacuation:
Water Clarity (Clear - slightly cloudy - very cloudy)
Water level (rose - fell - no change)
Water odors: ______________
Other comments: ______________

SAMPLING RECORD (cont'd) - Monitor Well ________ Job Number ________
(number)

5 ___ SAMPLE EXTRACTION METHOD:
___ Bailer made of: ________
___ Pump, type: ________
___ Other, describe: ________

Sample obtained is: ___ GRAB; ___ COMPOSITE SAMPLE

6 ___ ON-SITE MEASUREMENTS
Temp: ______ o ______ Measured with: ________
pH ________ Measured with: ________
Conductivity: ________ Measured with: ________
Color: ________ Odor: ________
Other: ________

7 ___ SAMPLE CONTAINERS (material, number, size): ________

8 ___ ON-SITE SAMPLE FILTRATION:
___ None
___ On-Site (describe below)
Method ________ Containers: ________
Method ________ Containers: ________

9 ___ ON-SITE SAMPLE PRESERVATION:
___ None; ___ Added by laboratory to containers.
___ Added in field (describe below)
Method ________ Containers: ________
Method ________ Containers: ________
Method ________ Containers: ________

10 ___ CONTAINER HANDLING:
___ Container Sides Labeled and Labels Taped
___ Container Lids Taped
___ Containers Placed in Ice Chest

11 ___ OTHER COMMENTS: ________

12 ___ SAMPLER'S SIGNATURE ________ Date: ________

SOIL INDEX PROPERTY TESTS

Check List For Description of Fine-Grained And Partly-Organic Soils

1. *Typical Name* Sandy Silt Silt Clayey Silt Sandy Clay Silty Clay Clay Organic Silt Organic Clay
2. *Maximum Particle Size* Note percentage of boulders and cobbles
3. *Size Distribution* Approximate percent gravel, sand and fines in fraction finer than 3 in. (76 mm)
4. *Dry Strength* None Very Low Low Medium High Very High
5. *Dilatancy* None Slow Rapid
6. *Plastic Thread* Weak and Soft Medium Stiff Very Stiff
7. *Plasticity of Fines* None Slight (low) Medium High
8. *Color* Use Munsell notation, if possible. Note presence of mottling or banding.
9. *Odor* None Earthy Organic
   May be neglected except for dark-colored soils.
10. *Moisture Content* Dry Moist Wet Saturated
11. *Consistency* Soft Firm (Medium) Stiff Very Stiff Hard
12. *Structure* Stratified Laminated (Varved) Fissured Slickensided Blocky Lensed Homogeneous (Nonstratified)
13. *Cementation* Weak Strong
    Note reaction with dilute hydrochloric acid as none, weak or strong.
14. *Local or Geologic Name*
15. *Group Symbol* - Estimate if desired. See Classification Chart, Fig. 1, ASTM Method D 2487

Check List For Description of Coarse-Grained Soils

1. *Typical Name* Boulders Cobbles Gravel Sand
   Add descriptive adjectives for minor constituents.
2. *Gradation* Well graded Poorly graded (Uniformly graded or Gap-graded)
   Describe range of particle sizes or predominant size or sizes as coarse, medium, or fine sand or gravel.
3. *Maximum Particle Size* Note percent boulders and cobbles
4. *Size Distribution* Approximate percent gravel, sand and fines in fraction finer than 3 in. (76 mm). Indicate plasticity of fines (See 7.5).
5. *Grain Shape* Angular Subangular Subrounded Rounded
6. *Mineralogy* Rock type for gravel, predominant minerals in sand.
   Note especially presence of mica flakes, shaly particles and organic material.
7. *Color* Use Munsell notation, if possible
8. *Odor* None Earthy Organic
   May be neglected except for dark colored soils.
9. *Moisture content* Dry Moist Wet Saturated
10. *Natural Density* Loose Dense
11. *Structure* Stratified Lensed Nonstratified
12. *Cementation* Weak Strong
    Note reaction with HCl as none, weak or strong.
13. *Local or Geologic Name*
14. *Group Symbol* Estimate if desired. See Classification Chart, Fig. 1, ASTM Method D 2487.

Identification of Fine-Grained Soil Fractions From Manual Tests

Typical Name	Dry Strength	Dilatancy Reaction	Toughness of Plastic Thread	Plasticity* Description
Sandy silt	none—very low	rapid	weak—soft	none—slight
Silt	very low—low	rapid	weak—soft	none—slight
Clayey silt	low—medium	rapid—slow	medium stiff	slight—medium
Sandy clay	low—high	slow—none	medium stiff	slight—medium
Silty clay	medium—high	slow—none	medium stiff	slight—medium
Clay	high—very high	none	very stiff	high
Organic silt	low—medium	slow	weak—soft	slight
Organic clay	medium—very high	none	medium stiff	medium—high

* The term low may be substituted for slight in the description of plasticity.

Identification of Consistency of Fine-Grained Soils From Manual Tests

Consistency	Identification Procedure	Shear Strength, tons/ft² or kg/cm²
Soft	Easily penetrated several inches by thumb	less than 0.25
Firm (medium)	Penetrated several inches by thumb with moderate effort	0.25 to 0.50
Stiff	Readily indented by thumb, but penetrated only with great effort	0.50 to 1.00
Very stiff	Readily indented by thumb nail	1.00 to 2.00
Hard	Indented with difficulty by thumbnail	over 2.00

ROBERTS/SCHORNICK
& ASSOCIATES, INC.
860 Copperfield Drive, Suite A Norman, Oklahoma 73072

DRILLER'S LOG SUMMARY

Bore Hole Number: ____________________ Rig Number: ______________

Date Bore Hole Started: _____________ Ground Elevation: ________

Time Bore Hole Started: _____________ Weather: __________________

Date Bore Hole Completed: ___________

Time Bore Hole Completed: ___________

Driller's Name: ______________________

Helper's Name ________________________

Technician's Name: ___________________

Auger Drilling: From ________ feet to ________ feet, and ____________

Rotary-Air/Wash Drilling: From ____ feet to ________ feet, and

Completed Bore Hole Depth: ____________________________________

Bottom Sample Depth: From ______________ to ______________ feet ________

Groundwater First Noted: ______ feet @ ______ hours (date:)

Depth to groundwater ___________ hours/minutes after bore hole

completion: ___________________ (date:)

Number and Type of Samples Collected: (Please List)

Number | Type of Sample

LOCATION/PROJECT NUMBER: ________________

FORM RSA 1.1 9/87

ROBERTS/SCHORNICK
& ASSOCIATES, INC.

Environmental Consultants

RECORD OF PHOTOGRAPHS

Type__________

Number__________

Project Code______________

	DATE	TIME	FOCAL LENGTH	WEATHER CONDITIONS	LOCATION	DESCRIPTION OF PHOTOGRAPH

Notes: (1) Express Time in 24 hour clock notation; (2) Focal Length is of lens used.

Signature of Photographer______________

RSA FORM 4/88

ROBERTS/SCHORNICK
& ASSOCIATES, INC.

Environmental Consultants

PHOTOGRAPH IDENTIFICATION RECORD

****

PROJECT/CASE NO: ____________________

SUBJECT: ____________________

LOCATION: ____________________

____

CITY: __________ COUNTY: __________ STATE: ______

DATE: __________ TIME: __________

WEATHER: (SUN) (HAZE) (CLOUDY) (RAIN) (SNOW)

PHOTOGRAPHER (Sig.): ____________________

WITNESS: ____________________

CAMERA: ____________________

FILM TYPE: __________ ASA: ______ T:1/ _____ f: _____

NEGATIVE LOCATION: __________ FILE #: __________

PROCESSED BY: ____________________

PHOTO #: ____________________

RSA FORM 4/88

Photograph Identification Record

CORE BORING FIELD REPORT

BORING NO. ______________

PROJECT NAME ______________ PROJECT NO. ______________ BORING LOCATION ______________

DRILLED BY ______________ LOGGED BY ______________ CHECKED BY ______________

DRILLING DATES - FROM ______ TO ______ DATUM ______ DATUM ELEVATION ______

DEPTH (FEET)	CORE INFO.		RQD		DISCONTINUITIES JOINTS / FRACTURES			PARTINGS BEDDING / FOLIATION			ROCK WEATHERING	GEOHYDROLOGIC INFORMATION	PENETRATION RATE (MIN./FT)	DEPTH	LITHOLOGIC DESCRIPTION	DEPTH (FEET)
	CORE SZ. RUN NO.	REC. %	PIECE LN.	RQD	NATURE	SPACING	DIP & DIRECTION	NATURE	SPACING	DIP & DIRECTION						

& ASSOCIATES, INC.
860 Copperfield Drive, Suite A Norman, Oklahoma 73072

BOREHOLE ABANDONMENT RECORD

Project Name/Number: ______________________________

Bore Hole Number: ______________________________

Depth to Groundwater: __________ feet from ground level, (Date__________)

Measured Bore Hole Depth __________ feet, (Date __________)

Number bags/pounds cement used: __________ bags/pounds

Quantity of water used: __________ gallons

Quantity of Bentonite Powder used: __________ pounds

Grout mixed by (method): ______________________________

Date and Time of Bore Hole Abandonment (Grout Placement):

__________ at __________ hours.

Field Personnel: ____________________, ____________________

____________________, ____________________

Cement-Bentonite Grout placed to ______ feet from ground surface followed

by ______ feet of Portland cement-sand grout to ground surface.

Field Approval: ______________________________ has inspected this bore hole and verified that it was properly grouted, labeled, and abandoned.

From RSA 1.2

APPENDIX G

Laboratory QA / QC Plan

SUBJECT: **ENVIRONMENTAL LABORATORY QUALITY ASSURANCE**

TABLE OF CONTENTS

ADDENDA

1.0 INTRODUCTION

This procedure describes the Sequoyah Environmental Laboratory Quality Assurance (QA) Program, and delineates the general responsibilities for approval and control of this Quality Assurance Program.

1.1 Purpose

The purpose of this document is to ensure that all laboratory data is scientifically valid, defensible and of known precision and accuracy. The QA program shall help identify any deficiencies in procedures or instrumentation.

1.2 Scope

This program applies to both analytical and radiological measurements. It shall describe the quality assurance policies, intentions and criteria for establishing acceptable performance. Quality control measurements shall be developed and incorporated into each analytical and radiological procedure.

1.3 Responsibilities

The Environmental Laboratory organizational structure is shown in Attachment 1.

* | 1.3.1 The **Manager, Quality Assurance/Laboratory Support** shall be responsible for ensuring that an adequate Quality Assurance Program is implemented by the Environmental Laboratory.

| 1.3.2 The **Supervisor, Laboratory Support** shall be responsible for the implementation, maintenance and control of the Environmental Laboratory Quality Assurance program, and providing an environment in which quality work can be produced. It is his/her responsibility that quality assurance requirements are strictly followed. The Supervisor shall assign analyses to the technicians according to priority and analyses requested, and review completed Chain of Custody (COC) forms to ensure that the data reported is valid.

| 1.3.3 The **Environmental Laboratory Technicians** are responsible for performing analyses in accordance with written procedures. It is the

responsibility of each technician to keep complete records of all work or operations performed. The minimum requirement shall be that records shall be understandable to one versed in the field yet not directly connected with the work described.

1.4 Definitions

1.4.1 Quality Assurance (QA) comprises those planned and systematic actions that are necessary to provide adequate confidence in the results reported.

1.4.2 Quality Controls (QC) are means of measuring and controlling the characteristics of process and of the measuring equipment to established requirements.

1.5 Qualifications for Laboratory Personnel

1.5.1 A Junior Laboratory Technician shall have one year college chemistry and math, and/or one year related experience.

1.5.2 The Laboratory Technician shall have one year college chemistry and math and/or one year experience plus four months experience in the Environmental Laboratory. He/she shall have a good knowledge of analytical chemistry. Informal training will be the most appropriate way to train new technicians. A technician will be taught the analyses procedure by the Supervisor, Laboratory Support or Laboratory Technical Specialist. He/she shall be able to perform all analyses with accuracy and reliability.

1.5.3 A Senior Laboratory Technician shall have one year college chemistry and math and/or three years laboratory experience. He/she shall be able to perform all analyses with accuracy and reliability. He/she shall possess the ability to recognize and report any abnormalities in sample characteristics and analytical results. He/she shall also be able to assist with trouble shooting and in the training of technicians to use high-technology laboratory equipment.

1.5.4 A Laboratory Technical Specialist shall have a BS degree in Chemistry or related field and/or 5 years related experience. He/she shall be able to perform all analyses with accuracy and reliability. He/she shall possess the ability to recognize and report any abnormalities in sample characteristics and analytical results. He/she shall also be able to assist with trouble shooting and in the training of technicians to use high-technology laboratory equipment. He/she may also be called upon by * the Supervisor, Laboratory Support to assume his duties in his absence.

1.5.5 The Supervisor, Laboratory Support shall have a B.S. degree in Chemistry, 5 years of laboratory experience and 2 years supervisory experience. He/she shall be able to develop, adapt and refine analytical procedures to provide accurate and efficient methods of analysis. He/she is responsible for training laboratory technicians in new or revised procedures. He/she shall develop the capabilities to perform rapid identification and analysis of special and non-routine samples to assist in trouble shooting environmental difficulties. He/she is responsible for trouble shooting in the Environmental Laboratory on instrumentation, methods and sample matrixes. He/she shall be able to assess the adequacy of the Quality Assurance Program or related activities under his/her control on a regular basis.

1.6 Training Records

1.6.1 Records shall be kept of the dates on which a given individual was trained on unit operations in analytical procedures. This data is stored in the Laboratory Support Supervisor's files, and a copy shall be placed in the employee's training file.

1.6.2 Records of seminars and meetings attended, special courses taken or training in advanced instrumental techniques shall also be part of the employee's training file.

2.0 REFERENCES

2.1 Applicable Source Material License Requirements, none.

2.1.1 U.S. Nuclear Regulatory Commission Regulatory Guide 4.15: Quality Assurance for Radiological Monitoring Programs-Effluent Streams and the Environment.

2.1.2 U.S. Nuclear Regulatory Commission Regulatory Guide 4.16: "Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants."

2.2 Applicable Federal or State Regulations

2.2.1 Handbook for Analytical Quality Control in Water and Wastewater Laboratories, EPA-600/4-79-019.

2.2.2 EPA, Methods for Chemical Analysis of Water and Wastes, March, 1983.

2.3 Material Safety Data Sheets (MSDS), none.

2.4 Developmental References

2.4.1 ASTM-C 1009, Standard Guide for Establishing a Quality Assurance Program for Analytical Chemistry Laboratories within the Nuclear Industry.

2.4.2 Quality Assurance of Chemical Measurements, John Kyenan Taylor.

2.4.3 Quality Assurance Manual, Sequoyah Fuels Corporation, 1992.

2.4.4 Quality Assurance Plan for Radiation Safety Measurements, H. Morton, 1992.

2.4.5 Sequoyah Fuels Operating Procedure G-001, "Sequoyah Facility Operating Procedure System", 1992.

* 2.4.6 Sequoyah Fuels Operating Procedure G-002, "Temporary Operating Procedures", 1993.

3.0 SAFETY PRECAUTIONS AND LIMITATIONS

None.

4.0 PROCEDURE

The Environmental Laboratory Instructions, Analytical Methods are considered Departmental Procedures under G-001, Section 2.4. The format of each procedure shall follow the outline shown in Attachment 2. Subtopics may vary according to procedure.

4.1 Procedure Development and Approval

4.1.1 Procedures shall be written under assignment from the Supervisor, Laboratory Support. *

4.1.2 Procedures shall be reviewed and approved by the Supervisor, Laboratory Support; the Manager Quality Assurance/Laboratory Support; and the Vice President, Technical Services.

4.1.3 Procedures shall be reviewed at intervals of approximately 24 months.

4.1.4 The Licensing Engineer shall review and approve SFL/ENV/SOP-23 at the 24 month interval or any time it is revised to insure that applicable licensing requirements are addressed (commitment).

4.2 Laboratory Temporary Operating Procedure (LTOP)

A Laboratory Temporary Operating Procedure (LTOP) shall be written to document procedural steps necessary to correct an operational or analytical deviation.

4.2.1 Preparation and Implementation of LTOP

Before an LTOP can be authorized, the form (see Attachment 4) must be properly completed by the requestor. It then must be reviewed and approved by the Supervisor, Laboratory Support and the Manager, Quality Assurance and Laboratory Support.

4.2.2 The requestor shall enter the required information on the LTOP form which includes:

a. Date Requested
b. Name of Requestor
c. Duration
d. Check Procedure Status Block
e. Enter Reason for Proposed Changes
f. Enter a clear concise statement of the proposed changes to the procedure.
g. Forward the form to the Supervisor, Laboratory Support.

4.2.3 An LTOP approval is given after the Supervisor, Laboratory Support reviews it for analytical validity and laboratory opertion consideration. The Manager, Quality Assurance/Laboratory Support then reviews the LTOP for license conditions or regulatory requirements.

4.2.4 The control of all LTOPs is to be maintained by Technical Support, Quality Assurance/ Laboratory Support Department.

4.2.5 The duration time for an LTOP begins with the approval of the Manager, Quality Assurance/ Laboratory Support and is not to exceed a time limit of 90-days. If the event requiring the LTOP is to exceed the 90-days, a new LTOP will be required after the expiration date.

4.3 Quality Control Measures, Responsibility and Records

Quality Control measures are described in each procedure as applicable. Quality Control data is mapped on control charts and is retained along with hard copies of data.

4.3.1 All radiological data except for uranium analysis shall include error estimates. Accuracy is based on counting error and standard deviations. Any significant problems encountered during the measurement process shall be resolved before reporting, or the data shall be qualified by a statement describing the problem and its implications, if necessary.

4.3.2 When a sample and corresponding COC form are received by the Environmental Laboratory, the sample and COC shall be checked to ensure the information on the sample matches the information on the COC. A unique lab code shall be assigned to each sample or group of shall be assigned to each sample or group of samples and COC form. That code represents both the COC and sample. Each code shall be recorded in the Environmental Laboratory's Sample Log Book. The original COC shall be filed, and a copy is given to the requestor.

4.3.3 Quality Control records for laboratory counting systems shall include the results of measurements of radioactive check sources, calibration sources, backgrounds, and blanks. Records relating to overall laboratory performance, both chemical and radiological, shall include the results of analyses of quality control samples such as analytical blanks, splits, duplicates, inter-laboratory cross-check samples and other quality control analyses. The use of standards to prepare working standards, preparation and standardization of carrier solutions and calibration of analytical balances, calibration of counting systems shall also generate QC records that shall be maintained.

4.3.4 Additional records that are needed shall include the verification and documentation of computer programs, qualifications of personnel, and results of audits.

4.3.5 The minimum period of retention of the records shall be specified. In general, only the final results of the monitoring programs need to be retained for the life of the facility. At a minimum, documentation shall be stored for three years from submission of the final report.

4.4 Quality Control in Packaging, Shipping and Storage of Samples

Procedures for packaging, shipping and storage of samples shall be designed to maintain the integrity of the sample from time of submission to time of analysis. Holding times shall be determined from when the samples were collected.

4.5 Quality Control in the Laboratory

Radionuclide Reference Standards, use for calibration of Radiation Measurement Systems.

4.5.1 Reference standards shall be used to determine counting efficiencies for specific radionuclides or, in the case of gamma-ray spectrometry systems, to determine counting efficiency as a function of gamma-ray energy. A counting efficiency value is used to convert a sample counting rate to the decay rate of a radionuclide or to a radionuclide concentration. Guidance on the calibration and usage of germanium detectors for measurement of gamma-ray emission rates of radionuclides has been prepared as an ANSI N 42.14-1991.

4.5 2 Radionuclide standards that have been certified by National Institute of Standards and Technology (NIST), or standards that have been obtained from suppliers who participate in measurement assurance activities with NIST, shall be used when such standards are available.

4.5.3 Physical standards and measuring devices shall have currently valid calibrations, traceable to national standards, primarily NIST.

4.5.4 Chemical standards shall be prepared using methods reflecting state of the analytical art and materials of known purity. Commercial chemical standards shall be traceable to NIST or certified by EPA.

4.5.5 The details of the preparation of working standards from certified standard solutions shall be recorded. The working standard will be prepared in the same form and matrix as the unknown samples, or as close an approximation as possible.

4.5.6 Efficiency calibrations shall be checked periodically (typically monthly to yearly) with NIST traceable standard sources.

4.6 Performance Checks of Radiation Measurement Systems

4.6.1 Background count rates shall be determined for each radiation detector system on a routine basis for counting systems in regular use. The results of these measurements shall be recorded in a log and plotted on a control chart. Appropriate investigative and corrective action shall be taken when the measurement value falls outside the pre-determined range of control values.

4.6.2 A check source for determining changes in counting rate or counting efficiency shall be of sufficient purity to allow correction for decay but need not have an accurately known disintegration rate, i.e., need not be a standard source.

4.6.3 For systems in which samples are changed manually, check sources are measured daily. For systems with automatic sample changers, it may be more convenient to include the check source within each batch of samples and thus obtain a measurement of this source within each counting cycle. For proportional counting systems, the plateau or response to the check source shall be checked after each gas change. Background measurements shall be made frequently, usually daily or before each use, to ensure that background radiation levels are within the expected range. For systems with automatic sample changers, background or reagent blank measurements shall be included within each measurement cycle.

4.6.4 For alpha and gamma-ray spectrometry systems, energy calibration sources shall be counted to determine the relationship between channel number and alpha or gamma-ray energy. The frequency of energy calibration checks depend on the stability of the system, but usually is performed daily to weekly. The results of these measurements shall be recorded and compared to predetermined limits to determine whether or not system gain and zero level need adjustment. Adjustments shall be made as necessary.

4.6.5 Additional checks needed for spectrometry systems are the energy resolution of the system and the count rate of a check source. These shall be performed periodically (usually weekly to monthly for energy resolution and daily to weekly for count rate) and after system changes, such as power failures or repairs, to determine if there has been any significant change in the system.

The results of these measurements shall be recorded when the system is in use.

4.7 Analysis of Quality Control Samples

4.7.1 The analysis of quality control samples provides a means to determine the precision and accuracy of the laboratory's analytical method and includes both intra-laboratory and inter-laboratory measurements.

4.7.2 The analysis of replicate samples provides a means to determine precision; while the analysis of samples containing known concentrations of analyte provides a means to determine accuracy. The analysis of laboratory blanks provides a means to detect and measure contamination of analytical samples, a common source of error in analysis of low-level samples.

4.7.3 Generally, the fraction of quality control samples required to assure valid analytical results depends on:

A) the mixture of sample types in a particular time period, and

B) the history of performance of that laboratory procedure and the ability to accurately and consistently analyze quality control samples.

For environmental laboratories, standard industry practice allocates at least 5%, and typically 10%, of the analytical load for quality control samples.

4.8 Intra-laboratory Analyses

4.8.1 Duplicate samples shall be analyzed routinely. These samples shall be prepared from material or solutions that are as homogeneous as possible. Duplicate samples may be monitoring program samples, reference test materials or both. The size and other physical and chemical characteristics of the duplicate samples shall be similar to those of single samples analyzed routinely.

4.8.2 Analysis of intra-laboratory blank and spiked samples is an important part of each environmental laboratory's quality control program. To check for contamination from reagents and other sources, known analytical blanks shall be included frequently into groups of unknown environmental samples that are analyzed. Periodically blank, replicate and spiked samples shall be submitted to the Environmental Laboratory for analysis as unknowns to provide an intra-laboratory basis for estimating accuracy of the analytical results.

4.9 Inter-laboratory Analyses

4.9.1 Analysis of samples split with one or more independent laboratories is an important part of the quality assurance program because it provides a means to detect errors that might not be detected by intra-laboratory quality control techniques. As required, the Environmental Laboratory splits approximately 2% of radiological samples of measurable activity or concentration with an outside contract lab. Analysis of split field samples is particularly important in environmental monitoring programs to provide an independent test of the laboratory's ability to accurately measure radionuclides at very low concentrations.

4.9.2 The Environmental Laboratory and it's contractors that perform environmental radiological measurements shall participate in the EPA's Environmental Radioactivity Laboratory Inter-comparison Studies (Cross-Check) Program, or an equivalent program. This participation shall include all the determinations that are both offered by EPA and included in the licensee's environmental monitoring program. Participation in the EPA program provides an objective measure of the accuracy of the analyses because the EPA measurements are traceable to NIST. If the mean result of a cross-check analysis exceeds the control limit as defined by EPA, an investigation shall be made to determine the reason for this deviation and corrective action shall be taken as necessary.

Similarly, an investigation and any necessary corrective action shall take place if the "normalized range," as calculated by EPA, exceeds the control limit, as defined by EPA. A series of results that is within the control limits but that exhibits a trend toward these limits may indicate a need for an investigation to determine the reason for the trend.

4.10 Method for Handling Outliers

This is based on Quality Control, split, certification and cross-check samples.

4.10.1 If a QC sample fails to fall within control limits it shall be reanalyzed. If the QC sample proves to be within specifications the group of samples the QC sample represents shall be reanalyzed. If the QC sample remains outside control limits, the samples shall be reprepared along with a known standard to identify the problem and where in the process the problem may be occurring.

4.10.2 If there is a disagreement of more than two (2) standard deviations between the known value of the QC sample and the obtained value of the QC sample, samples split with outside laboratories or EPA valuation programs, a discrepancy report will be completed to determine the reasons for the discrepancy. (See Attachment 3.)

4.11 Computational Checks

4.11.1 Procedures for the computation of the concentration of analytical results shall include independent verification of a substantial fraction of the results by a person other than the one performing the original computation.

4.11.2 For computer calculations, the input data shall be verified by a knowledgeable individual. All computer programs shall be documented and verified before initial routine use and after each modification of the program. Verification documents shall be maintained on file. The verification process shall include verification of the algorithm used followed by test runs in which the output of the computer computation for a new input can be compared to "true" values that are known or determined independently of the computer calculation. Documentation of the program shall include a description of the algorithm and, if possible, a current listing of the program.

4.12 Controls of Materials and Equipment

4.12.1 Reagents and Standards

Unless otherwise indicated in the procedures, all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.

Reagents and standards shall be labeled to include the following information: name, activity or concentration, solvent if other than deionized water (for liquids), matrix, if solid, date prepared, and special limitations on storage and preparer's initials. Improperly labeled materials shall be discarded or labeled properly, depending on the certainty of identification when found.

Storage containers shall protect materials from contamination by impurities and from change in concentration. Storage conditions shall meet special requirements such as exposure to light, exposure to humidity, temperature, time, etc. These requirements shall be stated in the appropriate procedures.

4.12.2 Equipment Quality Control

Analytical Balances shall be checked weekly, and calibrated every 6-months by a certified technician.

Constant Temperature Chamber shall be checked daily with temperature range of 19° to 21° C.

Constant Temperatura Oven shall be checked daily with temperature range of 100° to 104° C.

Deionized Water - All taps shall be checked with conductivity meter, and are equipped with a light that indicates when a filter needs to be changed.

Refrigerators shall be checked daily with temperature range of 0° to 4° C.

4.12.3 Instrument Quality Control

Ammonia - A calibration curve shall be prepared before each set of samples are analyzed.

DO Probe - Both meter and electrode shall be adjusted to proper settings before analysis can be performed.

Fluoride Electrode - A calibration curve shall be prepared daily before each analysis.

Nitrate (electrode) - A calibration curve shall be prepared before samples are analyzed.

pH Probe - Instrument shall be checked daily with 4.0, 7.0 and 10.0 STDS, and calibrated if needed.

Uranium Analyzers - A deionized water blank and 50 ug/L U Std are analyzed daily before analysis. QC samples are included in every run to monitor instrument and method performance. Ultra low level uranium standards shall be run once a week to check the instrument.

4.13 Contract Lab Analysis

Any contract laboratory which performs analyses on samples submitted by SFC shall be required to perform and provide evidence of an acceptable Quality Assurance Program, and to provide program data summaries consistent with Reg. Guide 4.15 and ASTM Guide C-1009. These records are maintained in the Environmental Laboratory QC files.

5.0 APPROVAL

Approved By: ______________________ Date: 7-8-93
Supervisor, Laboratory Support

Approved By: Billy W. Reid ______________________ Date: 7/12/93
Manager, Quality Assurance/Laboratory Support

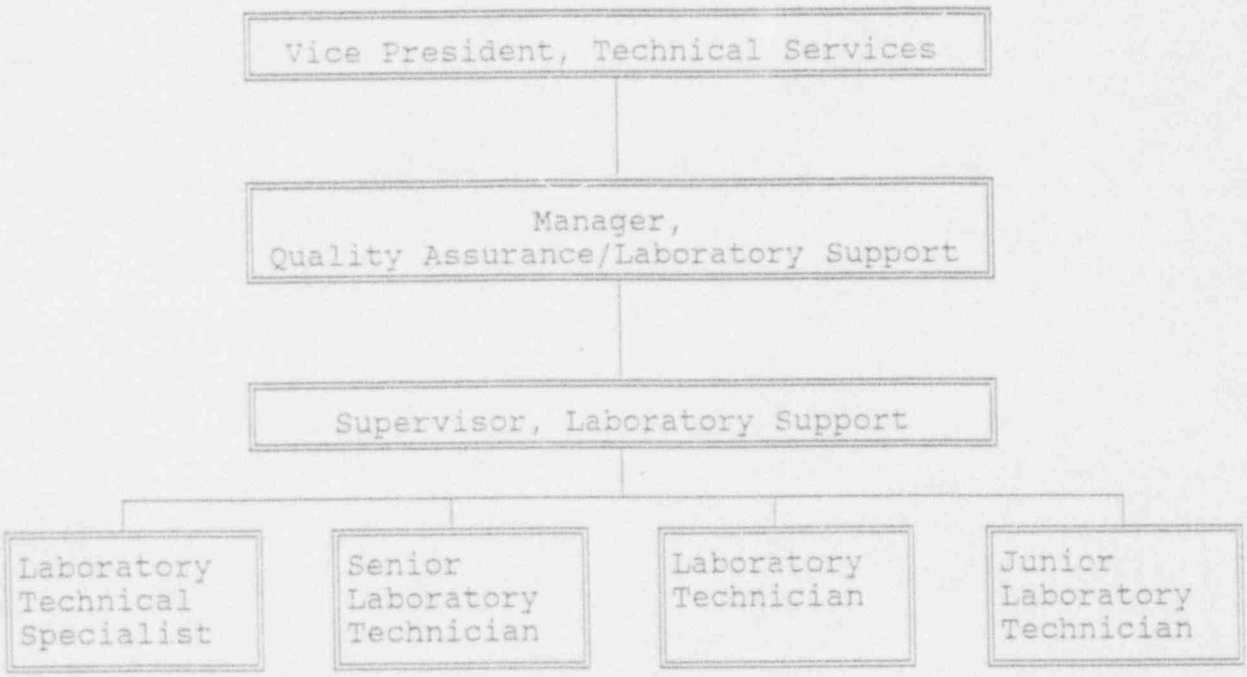
Approved By: Robert Miller ______________________ Date: 07-15-93
Nuclear Licensing Engineer

Approved By: ______________________ Date: 7/19/93
Vice President, Technical Services

ATTACHMENT 1

SEQUOYAH FACILITY ENVIRONMENTAL LABORATORY

ORGANIZATION STRUCTURE



ATTACHMENT 2

Table A-1. Procedure Format

Table of Contents*

1.0 INTRODUCTION*
- 1.1 Purpose *
- 1.2 Scope*
- 1.3 Background
- 1.4 Responsibilities
- 1.5 Definitions
- 1.6 Materials

2.0 REFERENCES*
- 2.1 Applicable Source Material License Requirements*
- 2.2 Applicable Federal or State Regulations
- 2.3 Material Safety Data Sheet**
- 2.4 Performance References
- 2.5 Developmental References (optional, used for procedure development)

3.0 SAFETY PRECAUTIONS AND LIMITATIONS*
- 3.1 Hazardous Chemicals/Equipment
- 3.2 Radiological Hazards
- 3.3 Industrial Hygiene
- 3.4 General Safety
- 3.5 Reference to Operating Procedure G-106**

4.0 PROCEDURE*
- 4.1 Prerequisite Actions
- 4.2 Startup (or Standby Readiness)
- 4.3 Normal Operation
- 4.4 Shutdown
- 4.5 Infrequent Operations (if needed)

5.0 SPECIAL PERFORMANCE SECTION (optional)

ADDENDA (as applicable)

- Attachments
- Appendices
- Exhibits
- Figures
- Tables
- Process Parameter Sheets (Next to last)**
- Review and Approval Sheet (Last)*

*Required for all procedures.
**Required for N-series procedures.

ATTACHMENT 3

ENVIRONMENTAL LABORATORY DISCREPANCY REPORT

REPORT # ______

DATE:

INITIATED BY: ______________________ ENV. LAB LOG # __________

DISCREPANCY: ____

____

____

WAS THE DISCREPANCY WITH A CONTRACT LABORATORY? YES NO
WHO? ______________________

WAS THE DISCREPANCY WITH ONE OF THE EPA PROGRAMS? YES NO
WHAT PROGRAM? WP STUDY, DMR QA STUDY, OR CROSSCHECK PROGRAM

WAS THE DISCREPANCY WITH NRC? YES NO

WHAT ANALYSIS WAS INVOLVED? __________
RESULTS SFC ENV. LAB ________ OTHER ________

INVESTIGATION RESULTS: ______________________________

____

____

____

DETERMINATION:

REASON FOR DISCREPANCY: ______________________________

____

____

CORRECTIVE ACTION TAKEN: ______________________________

____

____

____

COMPLETED BY: ______________________ DATE: __________

REVIEWED BY: ______________________ DATE: __________

ATTACHMENT 4

LABORATORY TEMPORARY OPERATING PROCEDURE

Date: ____________________

LTOP # ____________________ Requestor: ____________________

Precedure Involved: ____________________ Duration: ____________________
(Not to exceed 90-days)

PROCEDURE STATUS

☐ Revision Required ☐ New SOP Required ☐ Temp/No Permanent Change

☐ Test or Evaluation ☐ Non-Routine Activities

Reason for LTOP: ____________________

____

Procedure: ____________________

____

____

____

____

(If necessary, continue on attached sheet.)

Approvals:

____________________ Date ____________________
Supervisor, Laboratory Support

____________________ Date ____________________
Manager, Quality Assurance/Laboratory Support

APPENDIX H

Section III

of the

Sequoyah Fuels Facility

Hazardous Work Permit Guidance Document

Facility Hazards

III

Facility Hazards

III. FACILITY HAZARDS

Hazards In The Yellowcake Pad & Sampling Plant

-The hazards in this area include but in no way are limited to the following:

- * Natural Uranium

  - The dry powder or "yellowcake", as it is commonly known, is a significant contamination hazard. It can be spread around the plant by leaks in the process equipment, improper work practices or improper contamination control practices. It is an internal hazard primarily due to its chemical toxicity, rather than it's radioactivity. However, all three major radioisotopes, U^{238}, U^{235}, and U^{234} are Alpha particle emitters with very long half-lives, therefore exceptional care should be taken to avoid inhalation or ingestion of the material. Frequent hand washing, good personal hygiene and avoidance of eating, drinking or smoking in the Restricted Area will minimize the potential for intake. Good contamination control practices can als keep the spread of radioactive materials under control.

- * Airborne Contamination

  - Another potential hazard is airborne contamination and subsequent inhalation of the material. There are numerous places the dry powder can become airborne while in the sample plant environment. Dust Collector system operation and proper maintenance of seals are vital elements in minimizing this hazard. There are always going to be minor leaks and the material will be present in the work environment. For the radioactive material in this area the chemical toxicity outweighs the radiological hazard; however we can measure the radiological hazard in the air <u>before</u> it gets into the body and thereby control the amount breathed in to lessen the overall toxicological hazard.

HAZARDS IN YELLOWCAKE PAD & SAMPLING PLANT AREAS

- There exists a low level radiological hazard in and around the yellowcake pad area and to a lesser degree the Sampling Plant. The predominant hazard is in receiving chronic or repeated small doses of low level ionizing radiation. Scientists can readily agree that chronic doses of low level ionizing radiation are harmful, the disagreement comes in where to set the threshold or minimum amount that is necessary to cause notable damage. Any dose which can be avoided, should be avoided. This is the basis for ALARA, or As Low As Reasonable Achievable. The most widely accepted consequence of chronic exposure to low level ionizing radiation is a slightly elevated incidence of cancer.

* Ammonium Diuranate [$(NH_4) U_2O_7$]

- A fairly soluble compound found mixed with various uranium oxides in yellowcake materials. The predominant hazard is from chemical toxicity. If the material is not ingested due to poor work practices or lack of personal hygiene, there is a minimal hazard to the worker. Due to the solubility in water, environmental impact is a major concern.

* Uranium Slurry

- Received in either 55 gallon drums or stainless steel tanker trucks, this material presents the same hazards as dry yellowcake material except there is a significant reduction in the airborne hazard as the material is wet and more difficult to aerosol. Care must be exercised in pumping out the tankers or drums so that the wet slurry is not contacted by exposed skin or the hands where it can be easily transported to the mouth and ingested.

HAZARDS IN YELLOWCAKE PAD & SAMPLING PLANT AREAS (continued)

- Spills of the slurry material present a concern in that immediate cleanup is required if the material is to be prevented from drying out and aerosoling, thereby causing an airborne radiological hazard. Spills can also be tracked or spread around much more easily if allowed to dry and become much more mobile. The application of good contamination control practices can significantly reduce the spread of the radioactive materials.

* Nitric Acid

  - Nitric acid is used in this area to dissolve the slurry in the Receiving Tank. Contact with the skin or inhalation of the concentrated vapors or fumes generated during initial digestion or heating of the slurry mix in the Receiving Tank could cause acid burns and could also present an acute toxicity problem for the exposed individual.

* Potential Effects of Exposure

  Eyes: Initial Exposure - Eye irritation with tearing or blurring of vision. Higher exposures may lead to eye corrosion with corneal or conjunctival ulceration.

  Skin: Initial Exposure - Skin irritation with discomfort or rash. Higher exposure - burns or ulceration with yellow skin discoloration.

Inhalation: Inhalation of nitric acid mist or fumes, (yellow or brown in color), at 2 to 25 ppm, over an 8 hr period, may cause pulmonary irritation and symptoms following inhalation, including chest constriction and bluish discoloration of the skin, may be delayed for hours. Concentrations over 200 ppm can cause severe pulmonary damage and may be fatal (in 5-10 hours) after several minutes of exposure. Chronic overexposure to "nitrous gas" fumes may cause chronic obstructive pulmonary disease. Inhalation - 1 hour (rats) LC(50): 2500 ppm.

Individuals with pre-existing diseases of the lungs may have increased susceptibility to the toxicity of excessive exposures. Tests in animals demonstrate no carcinogenic activity.

Ingestion: Ingestion will corrode teeth followed by jaw nercosis and produce burns of the digestive tra[illegible] stomach pain, vomiting of blood, and circulatory collapse. A 1 ml [illegible]lume of nitric acid has been reported as a fatal dose.

-The following jobs in the Sampling Plant and Yellowcake Pad areas can pose significant hazards and should be covered by Hazardous Work Permits.

1. Rotary val[illegible]e repair
2. Elevator repairs
3. Vacuum system bag changeout
4. Repairs on and around the drum dumper
5. Digest feed bin repairs
6. Repairs to powder sampling equipment either primary or secondary
7. Repairs to the weigh bin
8. Repairs to the Receiving Tank, the Weigh Tank, or to the Storage Tank
9. Repairs to the Receiving Pump/Recirculating Pump
10. Repairs to the Transfer Pump or any of the transfer piping or valves

HAZARDS IN DIGESTION AREA

-Hazards to be found in this area include, but in no way are limited to:

- * **Dry Uranium Powder**
  - Concerns associated with dry uranium in the sample plant and yellowcake pad areas are present in the Digestion Area. Effective contamination control practices and very good personal hygiene are again essential elements for protection of personnel.
- * **Concentrated Nitric Acid**
  - Nitric Acid is used and either presents a significant hazard if contacted directly or if vapors, mists or fumes are inhaled or allowed to concentrate on skin or clothing.
- * **Thermal Extremes**
  - Thermal requirements for proper system operation present increased hazards to burns and heat exhaustion or heat stress related problems, the hazard increases in the summer months

-The following jobs pose significant hazards and should be covered by Hazardous Work Permits, whenever conducted:

1. Feed conveyor repairs
2. Acid feed line repairs
3. Digest Tank liner repairs
4. Adjust Tank repairs
5. Pump removal or repairs
6. Digest Feed Bin work
7. Off-Gas Wet Scrubber repairs
8. Nitric Acid Recovery system repairs
9. Slurry Feed Tank repairs

MISCELLANEOUS DIGEST AREA HAZARDS

-Hazards in this area include any and all forms of uranium feed materials.

* **Uranium, in all forms**
  - The hazards of dry uranium powder posed by potential ingestion or inhalation exist any time the product is allowed to go uncollected and to dry out, the process is accelerated by the high temperature environment found in this area. Rapid cleanup of spills, good personal hygiene and strong contamination control practices are needed here.
* **Nitric Acid**
  - Nitric Acid poses a hazard due to potential contact with the material or it's mists, vapors or condensates. Airborne concentrated mists can also pose a hazard if breathed or allowed to accumulate on clothing or skin.
* **Extreme heat**
  - Can be a problem due to the use of steam to heat the process liquids, especially in summer months when a significant heat exhaustion potential exists.
* **HydroFluoric Acid**
  - May exist in multiple feed materials introduced into the process
* **High Radiation levels**
  - May exist due to use of this area to store ash and by-product materials from ash receivers and fluorination towers.

- The following jobs pose significant hazards and should be covered by Hazardous Work Permits, when conducted:

1. Conveyor repairs
2. Acid feed line repairs
3. Miscellaneous Digester Tank liner or internal repairs
4. Any repairs or maintenance on pumps or valves
5. Work on steam heating system
6. Work on slurry transfer lines
7. Receiving Tank repairs
8. Weigh Tank repairs

HAZARDS IN SOLVENT EXTRACTION AREA

-Hazards to be found in this area include, but in no way are limited to, the following:

* **Uranyl Nitrate Hexahydrate (UNH)**
  - A D Class Uranium compound, the chemical toxicity of this material is the controlling factor, the decomposition products are also hazardous to humans

* Nitric Acids
  - Various concentrations of Nitric Acid could be encountered especiallv in the RAC (recovered acidic concentrate) system.

* Hexane
  - May cause irritation to eyes, skin and respiratory system. Avoid liquid, mist, and vapor contact. Harmful or fatal if swallowed. Aspiration hazard, can enter lungs and cause damage. May cause irritation or be harmful if inhaled or absorbed through the skin. Flammable liquid. Vapors may explode and pose a significant hazard.

* Tributylphosphate (phosphoric acid) (TBP)

  - Acute exposure: May be irritating to skin, eyes, and mucous membranes. Large doses (oral or I.P.) have been reported to cause dyspnea, weakness, pulmonary edema, and twitching in rats.

    Chronic Exposure: Reduced nerve conduction velocity and electron-microscopic changes (sciatic nerve) were observed in rats orally dosed with TBP (14 days). Microscopic changes in the seminiferous tubules observed in rats repeatedly administered tributyl phosphate (14 days) were not found in suesequent longer-term studies conducted with rats at compatable dose level. In the longer-term studies, urinary bladder hyperplasia and, in one study, increased liver weight were observed. There was no inhibition of acetylchol-inesterase activity.

* Thermal
  - As with other areas the need for heat to effect proper reactions poses a hazard from burns and also a heat stress or heat exhaustion potential.

HAZARDS IN SOLVENT EXTRACTION AREA

-Nearly all jobs in SX (Solvent Extraction) require Hazardous Work Permits due chiefly to the extreme explosion hazards. The below listed jobs are examples of those that require HWP's:

1. Floor and sump repairs
2. Tank repairs on pumper/decanters
3. Acid and feed line repairs
5. Pit area work
6. Pump repairs
7. Most electrical repairs
8. Ventillation system repairs
9. Scrub/Decant tank repairs
10. Pulse column repairs
11. Solvent rework system repairs
12. Recovered Acid Concentrate (RAC) system work
13. Work on RAC Evaporator
14. Work on UNH Surge Tank

BOILDOWN & DENITRATION AREA HAZARDS

-Hazards to be found in this area include, but are not limited to the following:

* Thermal

  - Both steam heating coils and electrical furnaces are used to heat the product to concentrate, denitrate and dehumidify it. There exists a significant potential for burns and heat stress.

* Acids

  - The concentration of uranyl nitrate hexahydrate drives off nitric acid in steam and vapor form. This acid is then condensed and recovered to minimize the associated handling and disposal problems. The primary recovery occurs in the vapor condensers and the acid, at about 40% concentration, is stored for reuse in the digestion process.

* Uranyl Nitrate Hexahydrate (UNH)

  - A Class D mostly soluble in body fluids. Chemical toxicity to the kidneys is a consideration as well as short term deposition in the lungs and resultant dose.

* Uranium Trioxide

  - A Class W, fairly soluble compound. It is the end point product of this phase of the process. It is toxic and contact is to be avoided.

* Nitrogen Oxides

- Toxic by-product gas of this phase. They are treated by a special system to recove some Nitric Acid and to prevent release of the fumes to the atmosphere or environment.

BOILDOWN & DENITRATION AREA HAZARDS

-The following jobs pose significant hazards and should be covered by HWP's whenever they are conducted:

1. Boildown steam coil replacement or repair
2. UNH Surge Tank or piping repairs
3. Feed point repairs
4. Packing leaks on any system valves
5. Denitrator internal repairs
6. Feed line repairs
7. NO system repairs or replacements
8. Vapor condenser repair or maintenance
9. Any work on HNO_3 absorbers or piping systems
10. Repairs or maintenance on NO Chemical Scrubber
11. Work on Recovered 40% Nitric Acid tank or piping
12. UO_3 Storage bin repairs (may need SSWP, also)

HAZARDS IN REDUCTION AREA

-Hazards to be found in this area include, but in no way are limited to the following:

* **Anhydrous Ammonia**

    - Dissociated into hydrogen and nitrogen gasses. The hydrogen is used to burn in the reduction reactors to achieve high temperatures. The ammonia itself is toxic and a severe nasal and bronchial irritant. It can also damage eyes and cause irritation to mucous membranes and skin in elevated concentrations.

* **Uranium Tri-oxide (UO_3 / orange oxide)**

    - Class W, fairly soluble compound and the feed material for the reduction process, readily absorbed into body fluid. Must be kept from internal deposition in workers by eliminating airborne and surface contaminants.

* **Uranium Dioxide - Typically black in color.**

    - Class Y compounds, mostly insoluble in body fluids. Mostly a long term deposition problem if the material is inhaled and deposited in the lungs. With Class Y compounds the radiotoxicity outweighs the chemical toxicity.

* Hydrogen

    - An explosive and flammable gas, created from the "cracking" or dissociation of anhydrous ammonia. Used to react with the Uranium Tri-oxides to reduce it to uranium dioxide. This reduction is an exothermic reaction which itself also produces exceptionally large amounts of heat. There is an operational requirement to maintain the nitrogen purge on the system until a gas sample by Health & Safety shows system hydrogen concentration is below 2%, so that explosive atmospheres are not generated.

HAZARDS IN REDUCTION AREA

* Hydrogen Sulfide (H_2S)

- Highly toxic by-product of the combination of hydrogen and sulfites. The hydrogen is added in excess of stoichiometric requirements to insure complete chemical reaction of the feed material. The sulfites are carryover products from the uranyl nitrate hexahydrate (UNH) in the Denitration phase. This toxic effect is IDLH at 700 ppm; lower doses or concentrations cause eye irritation, loss of sense of smell, nasal and respiratory irritation, headache, nausea, dizziness, unconsciousness and eventual death due to respiratory paralysis.

* Nitrogen

- Used as system purge gas and generated during the "cracking" or dissociation of anhydrous ammonia. Poses a significant suffocation hazard as simple asphyxiant since it readily displaces oxygen from the breathing zone of workers and is relatively unnoticeable by smell. There are license and operating requirements which force maintaining a nitrogen purge on the Reduction Reactor system to preclude a hydrogen gas explosion and exposure of the UO_2 to air, which causes the rapid formation of U_3O_8. There is also an operating requirement to maintain the nitrogen blowback on the primary filter and the UO_2 filter bin for four hours after shutdown.

* Thermal Burns

- The reactors in this section typically burn at 1200 degrees fahenheit, and burns are likely if personnel must work close to unshielded metals. Because of the high temperatures and the thick walled reactors extensive cooldown times are necessary.

HAZARDS IN REDUCTION AREA

-The following jobs pose significant hazards and should be covered by HWP's whenever they are conducted:

1. Inner or outer reactor vessel repairs
2. Repairs on the crossover piping system
3. Feedscrew repairs or replacement
4. Bin repairs (may also require Sealed Source Work Permit)
5. Pressure taps
6. Primary or backup filter tube changeout
7. Ammonia storage tank repair
8. Ammonia Cracker (dissociator) repairs
9. Hydrogen or Off-Gas Burner repairs.

HYDROFLUORINATION AREA HAZARDS

-Hazards to be found in this area include, but in no way are limited to the following:

* **Uranium Oxides (UO_2)**

  - Class Y compounds mostly insoluble in body fluids and primarily long term dose hazards when deposited in the lungs by inhalation. With Class Y Compounds, the radiotoxicity is more controlling than the chemical toxicity.

* **$U_3 O_8$ or Black Oxide**

  - A primary decomposition product of air reacting with UO_2

* **Hydrofluoric Acid (HF)**

  - This is the primary treatment chemical utilized in this process. It is used in great quantities to react with the UO_2 to create UF_4 which is the feed product for the next stage or fluorination step.

  - Health Effects: Human health effects of overexposure by eye of skin contact with the liquid severe eye and skin corrosion, excruciatingly painful, deep-seated and slow healing burns and ulcers. Causes immediate burns and rapid destruction of tissue accompanied by severe pain at concentrations about 50%; in 20% to 50% concentrations, the burns can be delayed 1-8 hours; in concentrations less than 20%, painful red skin delayed 24 hours; latent skin burns with death of living tissue can occur even at concentrations of 2%. The fluoride ion readily penetrates the skin and deep tissue causing destruction of soft tissue and decalcification of bone. Tissue destruction and neutralization of HF proceed for days.

    Ingestion of the liquid may cause severe burns to the mouth and tissues of the upper gastrointestinal tract with severe pain, bleeding, vomiting, diarrhea, and collapse of blood pressure.

- Overexposure by skin or eye contact with the vapors may cause skin irritation or corrosion with discomfort and rash; eye irritation with discomfort, tearing, or blurring of vision; or eye corrosion with corneal or conjunctival ulceration.

- HF can be absorbed through the skin in toxic amounts.

- Overexposure by inhalation can cause choking and coughing; severe eye, nose, and throat irritation followed, after an asymptomatic period of 1 to 2 days, by fever, chills, difficulty in breathing, cyanosis and pulmonary edema; hypocalcemia which leads to life-threatening cardiac arrhythnias; or kidney and liver damage. Overexposure by inhalation to concentrated hydrogen fluoride vapors can cause pulmonary edema and death within 2 to 3 hours. Prolonged overexposure to the vapors can cause fluorosis which may also result in weight loss, brittle bones, anemia, weakness and stiffness of joints.

- SCBA should be specified if direct contact with HF or it's vapors is possible. a supplied air respirator is an acceptable alternative to SCBA if extensive mobility is not required.

- Contact or mixing of HF with small quantities of water can result in violent or explosive reactions. Any use of water to dilute or flush HF should be under the direct supervision of the area supervisor and the water must be added in large quantities to insure the heat of the reaction is properly dissipated.

- Medical help must be obtained without delay any time HF is known or suspected to have come into contact with skin, eyes or has bee inhaled or ingested.

- Reaction between HF and carbonates, sulfides and / or cyanides results in the formation of toxic gasses, Carbon Dioxide, Hydrogen Sulfide and Hydrogen Cyanide.

- Contact of HF with silicon, glass, concrete or other silicon bearing material will cause a reaction which yields silicontetrafluoride, a highly toxic gas which is more toxic than the HF.

- Pressure buildup from the reaction of HF with glass containers has been known to result in explosion of the container.

- HF is extremely corrosive to rubber, leather and most organic materials.

HYDROFLUORINATION AREA HAZARDS

-The following jobs pose significant hazards and should be covered by HWP's whenever they are conducted:

1. Clean-up Reactor repairs
2. Feed screw repairs or maintenence
3. Seal bin repairs (may need Sealed Source work permit)
4. Acid line repairs
5. Pressure taps
6. Primary or backup filter repairs
7. Discharge bin repairs (may need SSWP)
8. UO^2 feed bin repairs (may need SSWP)
9. HF-Off gas scrubber line repairs
10. HF Acid storage tank or line repairs
11. HF vaporizer repairs
12. First or Second stage reactor

FLUORINATION AREA HAZARDS

-Hazards to be found in this area include, but in no way are limited to the following:

* Uranium Hexafluoride (UF_6)
  - Class D, highly soluble material, highly toxic and the end point product for this step of the process and for the entire facility.
  - Must be contained, will decompose rapidly giving off hydrofluoric acid, fluorine gas, and $UO_2 F_2$.
* Uranium Tetrafluoride (UF_4)
  - Class W compound, soluble in body fluids, the feed material of this process. Decomposes into HF upon contact or exposure to moisture.
* Hydrofluoric Acid (HF)
  - A highly toxic decomposition byproduct of UF_6 and UF_4, causes severe burns and the fluorine content can cause accelerated bone decomposition (hypocalcemia).
  - Extremely corrosive to skin, eyes, and mucous membranes (See Health Effects of Hydrofluoric Acid on page 31).
* Fluorine (F_2)
  - Elemental fluorine is the most reactive substance and most oxidizing agent known. It is the primary catalyst in this stage of the process and is generated in large volumes from the electrolytic decomposition of Hydrofluoric acid in the fluorine cell room. The major hazard to humans from fluorine is two fold, first the acute effect is that it is highly toxic and corrosive, the second is a chronic effect from a condition known as hypocalcemia. There is a gradual erosion or decomposition of bone tissue very similar to extreme osteoporosis, and eventual severe skeletal damage may occur.
  - There is another unwanted side-effect of fluorine in that it will make nearly every material flammable and will support combustion in even the most unlikely materials. The only way to extinguish a fluorine catalyzed fire is to shut off the source of the fluorine and then extinguish the blaze.

FLUORINATION AREA HAZARDS

- Another hazard of fluorine generation is the electricity used in the electrolytic decomposition process to make fluorine. Large amounts of electrical current must be rectified from AC (alternating current) to DC (direct current) and this poses additional shock hazards and generates enormous amounts of heat.

* Hydrogen (H_2)
  - Generated in large quantities as part of the decomposition of hydrofluoric acid to create fluorine. Hydrogen is explosive and highly flammable and must be routed to the off-gas burner system for safe disposal by burning.

* Nitrogen (N_2)
  - Used to blow back filters and to provide purge capabilities, this gas is a simple asphyxiant and readily displaces oxygen from workers breathing zone to cause suffocation.

* Ionizing Radiation
  - The fluorination area is one of the few areas in the facility where radiation and contamination levels reach significant values. The ash receiving and ash grinding areas can be "High Radiation" areas and the drummed material from this area is stored in isolated portions of the Miscellaneous Digest Area for 60-90 days to allow the short-lived daughter products responsible for the high levels of beta-gamma radiation to decay off. These ash products can also present significant internal dose problems if allowed to enter the body through inhalation of the dusts.

  - Another by-product of this area is potential UF_6 vapor while pulling the ash receivers. This hazard can be somewhat lessened by feeding a layer of UF_4 on top of the ash, but the UF_4 material must be kept dry to prevent it's decomposition to hydrofluoric acid in the presence of moisture.

FLUORINATION AREA HAZARDS

* Thermal Extremes

  - The fluorine cells and cell room are very hot when in operation. They pose burn hazards as well as heat stress to humans who must work around them.

  - The fluorination towers and the cleanup reactor burn at temperatures approaching 1800 degrees Fahrenheit and are extreme burn hazards.

  - The steam tracing coils used to cool the walls of the reactors and the filters pose burn hazards to workers

  - The secondary cold traps operate at 70 degrees below zero and can easily cause frostbite to skin. The released vapors from the freon system can also freeze exposed skin as well as present an asphyxiation hazard by displacing air from the worker's breathing zone.

* Freon and Ethylene Glycol

  - Used as refrigeration agents in the cold traps. Freon displaces air readily and poses a potential asphyxiation problem if workers are exposed to high concentrations, such as in a confined or poorly ventilated space. This group of Trichlorofluoromethanes, the halogenated hydrocarbons, are also moderately toxic to humans and if breathed in concentrations of 2% - 2.5% for two hours or more they can be lethal. If the vapors are exposed to very high temperatures, the generation of phosgene gas occurs, this is a toxic gas with high irritation potential to lung tissue and the aveoli of the lungs.

  - Ethylene glycol is mildly toxic to humans. It does, however, work on the central nervous system causing convulsions and coma in acute doses. Inhalation and ingestion are to be avoided. Skin contact will result in mild irritation and is slightly toxic on long term contact. The eyes will be irritated and show signs of conjunctivitis but no long term serious corneal damage is anticipated.

HAZARDS IN THE TANK FARM AREA

-The hazards to be expected in this area include, but in no way are limited to the following:

* Anhydrous Ammonia

  - Delivered by tanker trucks and designated for use in the Fertilizer Production process and for "cracking", or disassociation into Hydrogen gas ond Nitrogen gas. The Hydrogen gas is used in the Reduction process to achieve high temperature combustion. Ammonia poses multiple hazards to humans, it is toxic and a severe nasal and bronchial passage irritant. It can cause rapid incapacitation and severe swelling of nasal and bronchial passages which can cut off or severely restrict air flow to the lungs not only causing pain but potential asphyxiation, as well. It can also damage eyes and cause irritation to the skin in elevated concentrations. Fortunately, the gas is very easily detected by its highly characteristic odor and the threshold for damage is somewhat higher than the detection threshold.

* Anhydrous Hydrofluoric Acid

  - Delivered by tanker truck and designated to be used in the Hydrofluorination process and also for electrolytic decomposition into Fluorine gas and Hydrogen gas for use in the fluorination process (See Health Effects of Hydrofluoric Acid Page 31).

* N-Hexane

  - Delivered by tanker truck and designated for use in the Solvent Extraction process. This liquified gas is highly explosive and flammable.

* Nitric Acid

  - See Page 23

* Nitrogen Gas

  - See Page 29

HAZARDS IN THE FERTILIZER PRODUCTION AREA

-The hazards in this area include, but in no way are limited to the following:

* Uranium and Uranium Daughter Products
  - Initially the Solvent Extraction "Raffinate" solution is in a thin slurry of weak liquid nitric acid, and suspended solids. This solution must be neutralized and the ph slowly raised to allow precipitation of the various dissolved and undissolved minerals and metals. It is these minerals and metals which contain the radioactivity from uranium and uranium daughter products. The neutralization is performed by the addition of Anhydrous Ammonia and the metals precipitate out with the increasing ph to settle in the sludge at the bottom of the first Clarifier Pond. Barium Chloride is added as the clarified ammonia nitrate supernatant is transferred to the next intermediate storage basin. This results in the occlusion of the Radium daughter products which settle to the bottom of the basin and the resultant "fertilizer grade" ammonia nitrate supernatant is pumped from this settling basin to the fertilizer holding basin and subsequently to fertilizer distribution trucks.
  - The precipitates, from the neutralization step in the Clarifier Ponds, form a finely divided sludge. The solids contain small amounts of Uranium which could not be removed in the Solvent Extraction Process. This material is allowed to accumulate in each of the four clarifier ponds for further recovery of the Uranium. The major hazard of this area is the airborne contamination potential of this precipitated material if it is allowed to dry out and become suspended in the breathing air of workers. This can occur from the pond liner side walls, from the sludge itself if the liquids are pumped out for processing, and from the deliberate concentration of the solids when processing for shipment to the mills for recovery operations.
  - In Ponds 2, 4 and the Sludge Centrifuge Area TH 230 is the controlling isotope. TH 230 is much more restrictive than Uranium and requires special sampling and protective measures. It is necessary to sample larger volumes of air to reach minimum detectability for Th^{230} Special equipment is required to detect the levels of contamination that are required by procedure. Survey methodology is spelled out in procedure.

HAZARDS IN THE FERTILIZER PRODUCTION AREA

* Uranium and Uranium Daughter Products (continued)

  - The piping and pumps used in the clarifier area also present a significant contamination hazard as they are rigged or unrigged to support various operations to change ponds in service. The hazard is due primarily to ingestion of the Uranium compounds and the resultant heavy metal toxic effect, particularly on the kidneys. The chronic hazard is due to the carcinogenic, or cancer causing, capacity of low level ionizing radiation.

* Anhydrous Ammonia

  - Used as a neutralizing agent in this phase of the process. The ammonia is added to the nitric acid based raffinate slurry to raise ph and encourage precipitation of the solids. Ammonia is toxic, the vapors cause irritation of the eyes and respiratory tract. Ammonia is poisonous to the point of being lethal if inhaled in significant concentrations. The effects may be somewhat delayed at lower doses or concentrations so victims of exposure should be watched to insure the delay is not misinterpreted as a non-exposure or minor exposure.

* Barium Chloride

  - This material is toxic to humans. It is added to the supernatant ammonia nitrate liquid as it is transferred from the Clarifier Ponds to the Storage Ponds.

  - The predominant hazard is encountered by those personnel who must mix the dry powder into the addition tank or those personnel who may be in the mixing area and exposed to the fumes or dust from the powder.

HAZARDS IN THE FERTILIZER PRODUCTION AREA

* Barium Chloride (continued)

- Acute exposure, by ingestion, results in severe gastrointestinal irritation, nausea, vomiting, diarrhea and excessive salivation. There may also be excessive sensation of dryness and constriction of the mouth and throat accompanied by a metallic taste. Systemic effects follow and may include ocular changes causing blurred vision, heart functions and central nervous system functions may be adversely affected, varying from minor weakness to the point of paralysis. Gradual increasing sleepiness with mental confusion. Hemorrhages may occur in the stomach, intestines or kidneys. Kidney damage and kidney failure are possible. Collapse and death due to respiratory failure, severe hypokalemia and cardiac arrest may occur.

- Acute exposure, by inhalation, is Immediately Dangerous to Life or Health (IDLH) at the $250 mg/m^3$ level. May cause irritation of the respiratory tract with sore throat, coughing and labored breathing. Large doses result in symptoms similar to those described previously for acute ingestion.

- Acute exposure by contact with the skin may cause dermatitis and irritation to the affected areas. If exposure is sufficient the same effects as associated with acute ingestion are possible.

HAZARDS IN THE FERTILIZER PRODUCTION AREA

* Thorium

  - One of the many radioactive daughter products of Uranium are Thorium 234 and Thorium 230. The chemical compositions of these daughters are in the form of Thorium oxides which are Class Y compounds. Thorium 230 and Thorium 234 are the most restrictive alpha and beta-gamma emitting nuclides respectively that are present at the facility. Where Thorium 230 is present at sufficiant levels to be the controlling isotope, ie. Pond 2, 4, and the Sludge Centrifuge Area, special sampling and personnel protection techniques are necessary. Studies are underway at this time to characterize the entire facility to determine the extent of Thorium 230 and 234 contamination to provide assurance that proper radiological controls are in place.

HAZARDS IN THE DUF_4 PLANT AREA

-Hazards to be found in this area include, but in no way are limited to the following:

* Depleted Uranium (DUF_6)
  - The feed material for this process step is "used" or "depleted" UF_6 returned from the DOE facilities after extraction of a partial percentage of the Uranium 235 isotope. These "Tails" as they are known, are returned in the same shipping container they were sent out in and are loaded into the autoclave for processing.
  - Radiation levels on these returned cylinders must be monitored, as past experience has shown levels as high as 300 Mrem/hr, on contact with the cylinder.
  - The products of this process are "Metal Grade Uranium Hexafluoride" (UF_4) and Anhydrous Hydrogen Fluoride (HF).
* Uranium Tetrafluoride (UF_4)
  - See Page 34
* Hydrogen Gas
  - See Page 28
* Nitrogen Gas
  - See Page 29
* Hydrofluoric Acid
  - See Page 31
* Ammonia Gas
  - See Page 28
* Steam
* Thermal Heat
  - See Page 26
* Activated Carbon
* Refrigerants R-13 and R-502
* Radiation
  - See Page 2

MISCELLANEOUS HAZARDS IN THE BALANCE OF THE PLANT

-The following hazards exist in the plant, this list is in no way considered to be complete, but rather a listing of known hazards:

* Asbestos

  - This material is currently known to exist in the #1, #2, and #3 Motor Control Centers. It is used in brake linings on vehicles and as fire or flame retardant material such as insulation in various areas of the plant. The material is an exceptional hazards to humans as it is a known "carcinogen" or cancer causing agent when inhaled and deposited in the lungs. Work on the material requires respiratory protection, special training of workers, containment of the material and keeping the material wet at all times when working with it.

  - Asbestos is also used in the arc shields in large electrical breakers and can be a hazard to electricians who work on these components.

APPENDIX I

Sequoyah Fuels Facility

Radiation Protection Program

SEQUOYAH FACILITY

RADIATION PROTECTION PROGRAM

SEQUOYAH FUELS CORPORATION

Radiation Protection Program
Sequoyah Fuels Corporation

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1.0 Policy

Sequoyah Fuels Corporation is committed to providing a safe work environment for all employees, contractors and visitors at the Sequoyah Facility. All work shall be performed in such a manner that exposures to personnel and the environment are maintained ALARA, "As Low As Is Reasonably Achievable". To ensure that this condition exists, the company will provide a Health and Safety Department with the primary responsibility of establishing a safe work environment. To ensure that the radiation protection program is adequately administered, this radiation protection program document provides a description of the basic radiation protection program organization and requirements.

This document, Sequoyah Fuels Radiation Prot[illegible]tion Program, has been prepared for use by facility personnel during the performance of licensed activities at the Sequoyah Facility. General program requirem[illegible] are provided to ensure that the elements of a com[illegible]rehensi[illegible]lation protection program are in place at the f[illegible]cility. Implementation of the requirements will be in accordance with written approved facility procedures. The Radiation Protection Program and the facility operating procedures are the primary documents used to ensure compliance with 10CFR20, Standards for Protection Against Radiation.

2.0 ORGANIZATION

2.1 Organizational Structure

The radiation protection program for the Sequoyah Facility has been designed to comply with 10CFR20. The intent of this program is to achieve the required protection against radiation exposure while maintaining doses ALARA. Although the Health and Safety Department has direct responsibility for control of exposure to radiation and hazardous materials at this facility, it is important to realize that safety ultimately depends upon the knowledge, training, and attitude of each individual.

The organization for Sequoyah Fuels Corporation and its corporate oversight is described in detail in Source Material License SUB-1010. Organizational responsibilities for protecting the health and ensuring the safety of all personnel are discussed below.

The President of Sequoyah Fuels Corporation shall have overall responsibility for the protection of all persons against radiation exposure, and for compliance with NRC regulations, and license conditions. This responsibility is in turn delegated to all Sequoyah Fuels Corporation managers and supervisors. All personnel are required to work safely and to follow the regulations, rules, and procedures that have been established for their protection.

The Radiation Protection Officer (RPO) shall be responsible for the facility's radiation health and safety activities which include:

- Initiating, directing, and monitoring programs to ensure that radiation exposure of personnel is maintained at a level that is within the regulatory limits and is as low as is reasonably achievable,

- Establishing and maintaining systems for recording facility radiation survey and personnel exposure data,

- Coordinating on-site contacts with representatives of federal and state agencies responsible for regulating radioactive materials,

- Identifying and proposing new and revised radiation health and safety standards and procedures as needed, and

- In the event of a radiation-related incident or emergency situation, the RPO shall conduct or have conducted a thorough investigation, including preparation of an incident report which will be distributed to the appropriate individuals.

- Function in an advisory capacity to assist all personnel in carrying out their radiation protection responsibilities.

Corporate support is available through the General Atomics staff through the Vice President, Human Resources. Services that are available include:

- Corporate criteria and standards for contamination control and radiation protection for manufacturing processes and equipment.

- Corporate standards for procedures to be followed by operations management in assuring that processes and equipment are operating in a way to prevent spread of contamination and radiation exposure.

- Independent inspections against the criteria, standards and procedures of the facility program.

- Professional advice and counsel to Sequoyah Facility Management in health and safety matters.

2.2 Specific Responsibilities

The primary function of the Health and Safety Department is to implement the radiation protection program that the Company has established for the protection of facility personnel, other workers, the general public and the environment.

In implementing this program, the Health and Safety Department provides various services to the station. These services include the following:

- General surveillance of all activities involving radioactive materials and radiation and control of radiation exposure of personnel.

- Conducting a continuous program of evaluating, eliminating and/or controlling radiological hazards.

- Provide technical assistance to the training personnel for training all station personnel in radiation protection.

- Furnishing consulting services for all aspects of radiation protection to all persons or groups at any time, including assisting individuals and supervisors in discharging their responsibilities for radiation protection.

- Providing radiation exposure control activities, such as:

  - Distributing and processing personnel monitoring equipment and maintaining personnel exposure records;

  - Advising individual and supervisors of their exposure and initiating and implementing appropriate measures to maintain exposures ALARA;

  - Measuring radiation levels, assigning work times, and preparing hazardous work permits (HWPs);

  - Maintaining and issuing protective clothing and respiratory protective equipment;

  - Considering respiratory protective equipment for all work where the concentration of airborne radioactive material exceeds or is likely to exceed derived air concentration (DAC) levels or if the area is posted as an "Airborne Radioactivity Area." The decision to wear or not to wear a respirator should minimize the total dose to the worker.

  - Posting Radiation and Contamination Areas;

  - Ensures all containers are properly labeled.

- Providing bioassay analyses for determining internal dose.

- Providing maintenance and calibration of radiation monitoring systems, portable survey instruments, counting instruments and equipment necessary for radiation measurement.

- Providing technical assistance for the disposal of solid, liquid, and airborne radioactive wastes.

- Providing assistance in the decontamination of personnel, areas, system components, equipment, and materials.

- Providing technical supervision of the use, handling, storage, and shipment of all radioactive materials.

- Maintaining records of personnel monitoring, radiation surveys, waste disposal, and radioactive shipments, as required by NRC regulations.

Health and Safety technicians on each shift also ensure the immediate availability of personnel with radiological emergency training and experience to the Shift Supervisors.

Each radiation worker is responsible for:

- Familiarizing themselves with the radiation protection practices, requirements, and procedures applicable to their work, as outlined in this document, and described in facility procedures.

- Contacting H&S for any information they need about radiation protection and about the protective measures required for their job, and making sure they understand all of the requirements of a HWP before beginning work.

- Performing all work with radioactive materials or radiation under an appropriate, approved HWP or procedure.

- Ensuring work does not begin with radioactive materials until:

  - they have a complete working knowledge of the methods to be employed for minimizing exposure to themselves and to other personnel, and

  - they are aware of the proper procedure to follow in case of an accident.

- Preventing or minimizing their exposure to external radiation, the uptake of radioactive materials into the body, and the spread of contamination.

- Wearing assigned personnel monitoring equipment at all times in the Restricted Area.

- Ensuring themselves that adequate monitoring has been performed by H&S before work is begun where radioactive or hazardous materials are present.

- Keeping a clean and tidy workplace.

- Monitoring protective clothing as appropriate and changing them at intervals during the day while on the job. Monitoring body surfaces prior to leaving the Restricted Area.

- Not smoking, drinking or preparing food in contaminated areas.

- Not removing materials or equipment from the Restricted Area unless released by the Health and Safety Department.

- Bagging or packaging low-level radioactive solid waste (contaminated trash) as necessary to preclude the spread of contamination and depositing in radioactive waste containers for pickup and disposal.

- Informin affected persons of all radioactive materials transferred to their work areas to avoid possible exposure or spread of contamination.

- Notifying H&S as soon as possible of all emergencies involving radiation or radioactive or hazardous materials, and of all radiation or contamination events.

- Familiarizing themselves with the Contingency Plan.

Each supervisor is responsible for ensuring that the individuals under their supervision have complied with the above rules. Supervisors are also responsible for:

- Assuring that their personnel follow proper and safe work techniques and approved radiation protection practices.

- Providing personnel for decontamination work involved in the cleanup of work areas and spills and for the proper disposal of any contaminated waste for which they are responsible.

- Contacting Health and Safety whenever major changes are anticipated, such as the addition of new activities involving exposure to radiation or contamination.

- Ensuring that assigned personnel properly monitor themselves (i.e., frisk) at designated locations.

Since radiation protection is a responsibility of all facility groups, close cooperation is required between all facility personnel.

2.3 Program Assessment

The Health and Safety program will be audited on an annual basis by the Quality Assurance Department. Technical assistance may be provided by an outside organization if desired.

The Sequoyah Facility plant review committee is composed of senior facility managers having key roles in ensuring that facility activities are conducted safely and in compliance with regulatory requirements. This committee is responsible for reviewing and approving new and revised operating procedures; determining training requirements prior to implementing new or revised procedures; and reviewing revisions to the qualification and certification system.

2.4 Changes to the Radiation Protection Program

The Radiation Protection Program can only be changed if the following conditions are met:

- The change has prior approval of the facility's plant review committee.
- The change is justified in writing and becomes part of the permanent files covering the Radiation Protection Program.
- The change does not prevent the Radiation Protection Program's stated objectives from being met.
- All changes to the Radiation Protection Program are submitted along with the written justification to the NRC within 60 days after the changes are completed.

3.0 Quality Assurance

3.1 Sequoyah Fuels Quality Assurance Department

3.1.1 Facility expectations

It is the policy of Sequoyah Fuels Corporation to conduct all operations without jeopardy to the health and safety of its employees or the public. The Quality Assurance Program shall be implemented, maintained and updated as necessary to assure that systems and equipment used to operate, dismantle or decontaminate the facility or to treat, store or transport waste or byproducts are utilized in a safe manner. Deviations from the Quality Assurance Program shall be permitted only upon written authority from the corporate management position which originally approved the program or implementing procedure. If that position does not exist due to organizational changes, deviations must be approved by the manager responsible for quality assurance and the Vice President of the applicable organization. The Quality Assurance Program is established and described in the SFC Quality Assurance Manual.

3.1.2 Description of Audit Program

Audits shall be conducted in accordance with the SFC Quality Assurance Manual and applicable implementing procedures.

3.1.3 Evaluation and Disposition of Findings

Audit findings shall be evaluated and dispositioned in accordance with the SFC Quality Assurance Manual and applicable implementing procedures.

3.2 Other Audits

Audits are performed on a planned and periodic basis in accordance with an audit schedule, as addressed in the Quality Assurance Manual. The audit schedule is prepared in consideration of the operational status of the facility and activities which are occurring or are expected to occur at the facility during the time covered by the audit schedule. Consideration will be given to the following specific areas during the development of the audit schedules. These include, but are not limited to:

- Contingency Plan
- Waste Packaging and Shipping
- Environmental Program
- Radiation Protection Program
- ALARA

4.0 Training

4.1 Scope of Training

4.1.1 Purpose

Training and orientation is provided for all newly hired employees, contract personnel and visitors. This training is intended to provide personnel with the information and guidance needed to help maintain a safe work environment.

4.1.2 Content

Training is conducted for all occupationally exposed individuals including the following:

- Facility Description and Project Overview
- Basic Atomic Physics Review
- Radiation Protection Principles
- ALARA
- Safety and Hazard Communication
- Respiratory Protection
- First Aid
- Emergency Response
- Regulatory Standards (e.g. applicable details of 10CFR19 and 20, Regulatory Guides and SFC License requirements)
- Facility/Restricted Area Tour

Upon completion of training, individuals should be required to satisfactorily complete an examination on the training program and acknowledge by signature receipt of the training and the general safety and hazard communication booklets. Administration personnel will issue the appropriate identification badges and maintain a record of the completed training, a file of completed examinations and safety and hazard communication acknowledgement sheets.

Training program content and requirements shall be included in facility operating procedures.

4.1.3 Organizational Support

Human Resource personnel schedule all newly hired employees for general employee training. The host or person assigned responsibility for contract personnel will ensure that contractors performing work under an HWP have received the appropriate job-specific training.

4.2 Documentation of Training

4.2.1 Initial Training

Initial training is provided for all new employees, contract personnel and visitors in accordance with Section 4.1.2 above. Documentation of the training includes daily attendance records, written and oral examinations, job performance evaluations and specific task certifications. These records are maintained by the individual responsible for the training program.

4.2.2 Retraining

The individual responsible for the training program will coordinate the scheduling of annual refresher training, annual respiratory protection training, contractor retraining etc. with the appropriate supervisory and management personnel.

4.3 Training Requirements

4.3.1 Health and Safety Management and Supervision

Health and Safety Department management and supervisory personnel shall have formal training in health physics and radiation protection principles. Additional training shall be provided to ensure that these individuals are aware of changing requirements and new technologies which may enhance the radiation protection program at the facility.

4.3.2 Health and Safety Technicians

A Health and Safety Technician training program is provided at the facility. This training course must be successfully completed prior to a new technician performing health and safety duties. Health and Safety Technicians coming to work at the facility with prior health physics experience and training are eligible for an abbreviated form of the training program. The Radiation Protection Officer (RPO) shall approve the abbreviated training schedule on an individual basis.

Technicians shall be required to test out of sections of the training which they are not required to attend. They shall be provided a copy of an outline of topics to be included on each examination prior to administration of the test. Adequate time should be provided between distribution of the outline and the examination so that the technician can review the material on their own.

Health and Safety Technicians receive additional training during routine technician meetings which are provided to inform the staff of new requirements and status of the facility. Training is also provided for new procedural policy and regulatory requirements.

4.3.3 Radiation Workers

Individuals who will be performing work on radiologically contaminated systems under a hazardous work permit must receive radiation worker training in addition to general employee training or contractor training. This training will address contamination control practices and the associated protective clothing, respiratory protection and other precautions which must be taken. Part of this training may include mock ups which require each participant to walk through the process of putting on protective clothing and respiratory protective equipment; enter a staged controlled access area; double bag a "contaminated item" and exit the area.

4.3.4 Technical Support Personnel

Technical support personnel, including project managers, engineers and supervisors may need additional training in certain areas of radiation protection. This training should be provided. ALARA Committee members shall also receive training in the ALARA program for the facility and their respective responsibilities.

4.3.5 Respiratory Protective Equipment Training

Respiratory protection training is required for all personnel prior to issuance of respiratory protective equipment to them. This training is required on an annual basis and should include the following topics:

- Airborne contaminants against which the wearer is to be protected;
- Construction, operating principles and limitations of respiratory protective equipment used at SFC;

- Reasons for using the types of respiratory protection provided;
- Procedures for ensuring that the respirator is in proper working condition;
- Proper fitting of respirator and checking for adequacy of fit;
- Proper use and maintenance;
- Application of various cartridges and canisters available for air purifying respirators;
- Emergency actions in the event of malfunction;
- Radiation and contamination hazards; and
- Use of other protective equipment which may be used with respirators.

5.0 Survey and Monitoring

5.1 Scope

5.1.1 Basis

A survey and monitoring program is established at the facility to monitor work activities for compliance with procedures, policies and regulatory requirements. This program includes surveys, personnel monitoring, air sampling, effluent monitoring, environmental monitoring, evaluation of ventilation adequacy and evaluation of instrumentation. The Health and Safety Department, Environmental Department, and Quality Assurance Department have primary responsibility for performance of these activities and reporting their findings and results to facility management.

5.1.2 Procedures

Approved written procedures are provided to ensure that work activities are performed in accordance with accepted practices and that the required monitoring is performed and the results reported to the appropriate individuals on a timely basis. Facility procedures exist at several levels including Facility Administrative Procedures, Sequoyah Operating Procedures, Departmental Procedures (or Instructions) and Temporary Operating Procedures. A plant review committee reviews and approves the facility procedures to ensure the operations are conducted safely, efficiently and in compliance with regulatory requirements.

5.1.3 Responsibility Assignment

The Radiation Protection Officer (RPO) has primary responsibility for the surveillance activities described in this section.

5.1.4 Job Assessment

Work to be performed at the facility must be reviewed prior to execution to determine if the procedures adequately cover the activity or if a hazardous work permit (HWP) or other guidance is needed. This determination is made job-specific in accordance with written operating procedure. HWP's and special procedures are prepared with assistance from all departments involved in the job to ensure that appropriate protective measures and controls are specified.

Supervisors overseeing the work activity have primary responsibility for ensuring that the job is performed properly and safely. These individuals shall monitor all work activities closely to ensure that all procedural requirements are being followed and that individual workers understand their responsibility to follow the procedures. The supervisor should act as the interface with the Health and Safety personnel in obtaining required work permits and resolving work practice issues. The supervisor shall inspect the job site after work has been completed to ensure that the area has been cleaned and secured and that all equipment used for the job has been returned to the proper locations.

Health and safety technicians and quality assurance personnel review work activities in progress to assess whether the job is being performed safely or whether additional controls are indicated. Activities are also evaluated to determine if the work is being performed in accordance with policy, procedural and regulatory requirements. These individuals have full authority to stop work activities when safety related concerns exist.

5.1.5 Records

Complete and accurate documentation shall be maintained of all surveys, sampling, personnel monitoring and other records required by regulatory requirements and Sequoyah Fuels Corporation policy and procedure. Records should be maintained in legible form and organized in such a manner that they can be provided for audit or inspection purposes. Each person completing a record must recognize that a record may be used as the legal basis for the settlement of claims under workmen's compensation laws or other legal proceedings. Records are also necessary for planning work to keep radiation exposures as low as is reasonably achievable (ALARA).

5.2 Radiation and Radioactive Materials Surveys

5.2.1 Air Sampling

Air sampling is performed to provide concentration information of airborne radioactivity in work areas, call attention to poor work practices and measure releases of airborne radioactivity to the environment. During incidents, air samples are necessary to evaluate the consequences of the release. In addition, the air sampling program will monitor the general level of airborne radioactivity in working areas and provide the data necessary to estimate individual exposures.

The air sampling program at the Sequoyah Facility utilizes stationary samplers located throughout the facility, temporary area samplers which are set up in work areas where stationary samplers are not available and lapel samplers which are placed on workers. From a worker exposure assessment standpoint the a breathing zone sample is the most representative of airborne concentrations to which the worker is exposed.

Samples that are to be representative of the airborne concentrations in the work area of individuals should be taken from one or more points in the breathing zone of the worker. Samples should be collected for the duration of the work period.

The location of air samples should be as close to the breathing zone as practical without interfering with the work or the worker. Filter heads may be used on hoses and may be placed on the worker or just above and in front of him. The filter head should be protected from gravity settling of large particulate matter. Keep the filter paper in the vertical plane if possible.

There may be situations where special sampling considerations must be understood. For example, if the derived air concentration (DAC) is very low, a lapel sample collected over a relatively short period of time may not have an adequate minimum detectable concentration (MDC). In this situation special sampling is necessary so that artificially high exposures (DAC-hours) and doses (total effective dose equivalent, committed effective dose equivalent, organ committed dose equivalents, etc.) are not assigned to an individual. Primary considerations in this process are the sample flow rate and duration of sampling.

During sample collection, complete and accurate information relating to the sampling parameters must be recorded. This information shall include sample date, sample start and stop times, start and stop flow rates, sample type, exposure duration, isotope of concern, inhalation class, respiratory protection provided, work location and the name of the individual sampled. Any additional information which will be valuable for personnel evaluating the sample results should be included with the sample collection results. For example, if the sample had a visible splatter, finger print or appears to have been contaminated from some other source - this should be noted in the comments section of the sampling results.

Samples are generally stored prior to analysis to permit the radon progeny activity to decay. Typical decay times are at least four (4) hours for radon-222 decay products and seventy-two (72) hours for radon-220 decay products. An initial count should be performed approximately 4 hours after collection and a final count 4 days after collection.

Permissible levels for inhalation of radioactive materials are specified in Appendix B of 10 CFR 20. Derived Air Concentrations (DAC's) and Annual Limit on Intakes (ALI's) are specified therein. Derived Air Concentration means the concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI. An Annual Limit on Intake means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems (0.05 Sv) or a committed dose equivalent of 50 rems (0.5 Sv) to any individual organ or tissue.

Action levels are established for the air sampling program to alert facility personnel to problem areas so that corrective actions can be taken before regulatory limits are exceeded. These action levels are specified in Attachment A and will be implemented by the Radiation Protection Officer. Levels which exceed regulatory limits or facility actions levels will be reported to appropriate management personnel and regulatory agencies, if required.

Allowable effluent concentrations are specified in Appendix B of 10 CFR 20 for both air and water. The annual average concentrations of radioactive materials released in gaseous and liquid effluents at the boundary of the unrestricted area shall not exceed the values specified in Appendix B of 10CFR20. Air sampling is performed and documented to demonstrate compliance with the limits. The Sequoyah Facility environmental program document describes the effluent monitoring program in more detail.

5.2.2 <u>Surface Contamination</u>

Surveys must be performed in contamination controlled areas when the area is established and before any work is performed within the area. Additional surveys are performed as necessary to retain control of the operation. A final contamination survey is performed after cleanup and before the area is released from control.

Surface contamination guidelines for the facility are established. Action levels which specify acceptable levels in various areas of the facility, including the unrestricted area, have been established. Contamination which exceeds these action levels shall be reported to appropriate facility personnel and actions are taken to complete decontamination in a timely manner. Evaluations of the results and any additional controls which are established shall be made to determine if reporting to the Nuclear Regulatory Commission is required.

Removable surface contamination is routinely monitored using disc smears. The paper disc is wiped over the surface to be surveyed using enough pressure to remove loose materials from the surface. A smear sample should cover a surface area of 100 cm^2. A 100 cm^2 area is equivalent to a 4 inch square or an area 2" X 8". Typically an "S" shaped wipe is made using a 2" diameter smear over a distance of approximately 8 inches. The smear paper should be placed individually between the pages of a folded piece of paper or in individual envelopes to prevent cross contamination between smears. Adequate identification should be provided on the paper or envelop housing the smear samples, since there will be a delay between collection and analysis. The smears should be counted using a suitably calibrated counter and analyzed using calibration techniques appropriate for the radioactive material that may be present on the smear.

Parts and equipment that have been used in restricted areas must be monitored before release from the restricted area. If the equipment is believed to be internally contaminated it must be handled carefully to allow assessment of the potential internal contamination. If the inner surfaces cannot be accessed for survey purposes and they are potentially contaminated the item shall be assumed to be contaminated. Special probes may be available to survey the inside of piping and vessels. Smears can be collected by using special tools. Release of parts and equipment under special conditions such as these will require the approval of the RPO.

5.2.3 Penetrating (beta and gamma) Radiation

Penetrating radiation levels at the Sequoyah Facility are evaluated by taking direct measurements with survey instrumentation and by issuance of personnel dosimetry to instrumentation and by issuance of personnel dosimetry to facility personnel. Radiation survey instrumentation consists of GM detectors, ionization chambers, scintillation detectors, and associated electronics. Beta/gamma dose rates are based on measurements obtained using ionization chamber instrumentation. Gamma measurements are normally made using an ion chamber but may be obtained using a GM detector or scintillation based instrument provided the instrument has been calibrated using the isotope which is being measured. GM detector and scintillation based instrumentation are used primarily for the purpose of detecting contamination or radioactive material.

Monitoring mixed radiation fields where both beta and gamma radiation are present is done by taking measurements with the ion chamber in the open and closed positions. Beta radiation is determined by taking the difference in the open window and closed window measurements. The appropriate beta calibration factor must be used to convert the beta dose rate to mrad/hr.

Beta radiation measurements in mrad/hr may be made if the reading is corrected for the geometry of the source. The measurement must be made with the beta window open (window thickness 7 mg/cm^2) and, if the source is larger than the detector window, a geometry factor for beta radiation must be applied. The beta correction factor is used to estimate surface dose rates. For field readings away from the source the beta correction factor helps correct for side wall absorption in the ion chamber. For beta sources smaller than the detector (or the same diameter), readings should be made at 10 cm (4"), source to window distance, and the beta correction factor taken as 1.0. Beta measurements of small sources should not be made at distances less than or much greater than 10 cm due to the effect of air absorption on the beta particles and non-uniformity of the ionization within the chamber.

When gamma radiation is the only type of radiation present, the instrument response will be the same with the window closed as it is with the window open. Gamma radiation measurements will ordinarily be "field" measurements made when the radiation intensity is uniform throughout the chamber. There will be no appreciable difference in readings as the instrument is rotated about the center of the chamber so long as this point is held the same distance from the source. Where a beam of radiation smaller than the chamber dimension is to be measured, the reading must be multiplied by the ratio of the total chamber volume to the irradiated chamber volume. Contact measurements of sources larger than the chamber do not ordinarily represent the dose rate at contact but rather, are measurements at approximately the center of the detector. This distance should be noted and recorded as the measured distance to the source. Measurements of sources smaller than the detector should be done carefully since it is easy to have non-uniform radiation intensities within the chamber volume. Small sources should be measured from a distance of 3 detector diameters or more to achieve a "field" radiation reading. The intensity at a closer point is then estimated.

5.3 Personnel Monitoring

5.3.1 Personnel Surveys

Surveys of personnel exiting the restricted areas are performed to ensure that they are not contaminated with licensed materials. Restricted Area 1 (Main Process Area) is the primary area entered by personnel. Personnel exit this area through change rooms which are equipped with personnel contamination monitors (PCM's). Hand carried items such as clip boards and pads of paper are surveyed using portable instrumentation which is provided near the control line. Card readers are included on the PCM's for identification of personnel being surveyed. If contamination is detected a representative from the Health and Safety Department is contacted, assists with decontamination, confirms that the individual has been decontaminated and documents the results of the surveys performed.

Personnel surveys are also performed when exiting other restricted areas which have been designed as areas requiring surveys when exiting. Some restricted areas may not require surveys when exiting. If a survey is required, and a PCM is not available, portable instrumentation may be used to perform a whole body frisk of the individual exiting the area. This may done by a Health and Safety Technician or at a survey station set up near the control line for the area. Personnel shall be instructed in the proper survey techniques. If contamination is detected personnel must contact a Health and Safety Technician and wait at the control line for assistance.

5.3.2 External Exposure

Thermoluminescent dosimeters (TLDs)or film badges are used for personnel dosimetry at the facility and are exchanged on a quarterly and monthly frequency, respectively. Pocket dosimeters may also be used for work in high radiation areas and in other situations in a timely manner. Ring or wrist badges may be used for special conditions where the extremity exposure needs to be monitored.

Personnel dosimetry reports received from a vendor are forwarded to the RPO or to a designated individual with appropriate qualifications for review. Action levels shall be established for the facility.

Shallow dose equivalent and deep dose equivalent results are maintained in a data management system, recorded on an NRC Form 5 or equivalent and reported to workers annually.

5.3.3 Internal Exposure

5.3.3.1 Airborne Radioactivity Exposure

Air sampling is the primary method utilized at the Sequoyah facility to assign internal exposures to individuals from normal activities and concentrations. Air sample results are also used to identify situations where elevated airborne radioactivity concentrations indicate the need to perform post event bioassay sampling to aid in the estimation of the intake and calculation of internal exposures.

Air sampling results are used to estimate the DAC-hour exposure, intake, committed effective dose equivalent and committed dose equivalent to organs and tissues.

A computer should be utilized to perform the calculations and store the data for future retrieval. Flags at action levels should be included in the computer software package to help ensure that facility personnel are alerted to significant levels and exposures.

Health and Safety Technicians should be familiar with the action levels and the appropriate response. In many situations timely response to an event is required and should not wait for entry of data into the computer. The problem may need to be mitigated to prevent additional exposures of personnel. Bioassay samples may also need to collected shortly after the intake. For example, if an individual has been exposed to UF_6 or UO_2F_2 bioassay samples should be collected shortly after the intake since the elimination from the body occurs rapidly. Timely evaluation and reporting of evaluation and reporting of significant results to supervision and management is required.

Calculations of exposures to individuals must be based on air samples which are representative of the actual exposure conditions. Lapel air samples will represent the air concentrations to which an individual has been exposed. If air samples collected from the work area are used care must be taken to ensure that the appropriate airborne concentration is used. If a sampler is operating over a time period different from the actual exposure period, the concentration during the exposure period must be estimated. The following example is provided to illustrate how this estimation should be made:

- A sample has been collected from a small work area where a gooseneck air sampler has been set up. Decontamination work using a sand blaster is to be performed. The sampler runs from 10:00 until 16:00. An individual goes into the area for 20 minutes at 11:00.

- The air sample collected is analyzed and the concentration during the sampling period was $4X10^{-11}$ µCi/ml. The DAC for the isotope of concern is $5X10^{-10}$ µCi/ml.

- An estimation of the concentration during the time period in which the worker was present in the work area and performing the work activity is calculated as follows:

$$\frac{(4X10^{-11}\ \mu Ci/ml)(6\ hrs)(60\ min/hr)}{(20\ min)} = 7.2X10^{-10}\ \mu Ci/ml$$

- The DAC-hour exposure is calculated as follows:

$$\frac{(7.2X10^{-10}\ \mu C/ml)}{(5X10^{-10}\ \mu C/ml)} (20\ MIN) \frac{(1\ HOUR)}{(60\ MIN)} = 0.5\ DAC\text{-}HRS.$$

- This estimate assumes that the airborne activity present in the work area was generated while the worker was in the area performing the decontamination work.

- A better approach would be to collect a sample while the work activity is being conducted and

The following action levels have been established for stacks and vents:

LOCATION/UNITS		VALUE
DF1:	(F) µG/L	3
DS1:	µCi/ml	9×10^{-12}
DS2:	"	3×10^{-12}
DS3:	"	1.5×10^{-12}
DS4:	"	2.2×10^{-12}
E1:	"	4.5×10^{-14}
E2:	"	4.5×10^{-14}
E3:		4.5 X 10[illegible]
E4:	"	4.5×10^{-14}
S10:	"	1.2×10^{-12}
S11:	"	1.5×10^{-11}
S12:	"	2.5×10^{-12}
S4:	"	1×10^{-11}
S5:	"	1×10^{-11}
S6:	"	1.2×10^{-10}
S6:	(F) µG/L	5
S7:	µCi/ml	2.5×10^{-11}
S8:	"	1.2×10^{-12}

If any of the above concentrations exceed the action level, an investigation shall be performed and an attempt made to determine the cause.

c. Combination Steam - Outfall 001

The combination stream effluent shall be sampled continuously by an automatic sampling device. Treat samples removed from the combination stream sampling point in the following manner:

1. Every Monday, Wednesday and Friday, a Health and Safety Technician shall inspect the discharge sampler andremove the filled sample containers.

2. Remove the 8-hour samples from the refrigerator and complete a chain of custody form. Submit the samples and the chain of custody form to the Environmental Lab, for uranium, fluoride, total suspended solids (TSS) and nitrate analysis.

3. Once a week, usually on Wednesday, obtain an analysis for ammonia-nitrogen (as N) and Ra-226 (total).

On the last day of each month, submit one monthly composite sample to the Environmental Lab for analysis of The-230, Ra-226, gross alpha and gross beta activities, and for uranium, nitrate, and fluoride concentrations. In addition, submit the second monthly composite sample and request that the sample be preserved and retained for the Oklahoma State Department of Health.

On the last day of February, May, August, and November, submit the quality assurance sample with a chain of custody form for nitrate, fluoride, uranium, gross alpha, gross beta, Ra-226, and Th-230 analysis.

8.5.2 Controlled Areas

Control of effluents in controlled areas is by the use of containment devices including dikes, curbs, sumps, containers, absorbants, and "hot dog" (brand name) partitions.

the individual is in the area. Therefore, the sample collection time would be equal to worker exposure time. The air sample would be representative of the workers exposure and an estimate of the concentration during the work period using the method described above would not have to be performed.

5.3.3.2 Bioassay Requirements

Urinalysis may be used to detect an intake of transportable forms of natural and depleted uranium possessed at the Sequoyah Facility. Non-transportable uranium compounds are retained in the respiratory system for various periods of time, depending on physical and chemical properties of the material. The material clears the body by way of the ciliary mucus transport mechanism into the gastrointestinal tract, where a small fraction enters the blood. Excreted non-transportable compounds, depending on initial intake, may rapidly fall below the minimum sensitivity of analytical equipment.

Fecal analysis may be used to detect inhaled, non-transportable compounds of uranium, particularly material of large particle size. An appreciable fraction of the material that is cleared from the upper respiratory tract and swallowed is not absorbed in the gastrointestinal tract and will appear in the feces. Thus, fecal analysis is an excellent measure of exposure. With current analytical methods, minimum sensitivity of fecal analysis to radioactive material is quite low. As potential intakes of non-transportable material as identified by the air sampling program, fecal analysis may also be used to provide a check of the system.

In-vivo counting techniques may be used to directly measure X or gamma radiation from a radioactive deposit within the body. Typically, the primary mode of entry for radioactive material is inhalation; therefor, lung counting is more useful than whole body counting for exposure assessment at a uranium processing facility. Since transportable radioactive material clears the respiratory tract quickly, in-vivo counting is most beneficial for assessing an intake of non-transportable material.

Bioassay samples are collected routinely at the facility and following an apparent intake. These samples are referred to as routine and special, respectively. Routine urine bioassay samples are collected at a specified collection frequency and analyzed for uranium.

Individuals who work in or frequent restricted areas shall submit a urine sample for analysis on a biweekly basis. Other individuals who have less potential for exposure (supervisors,engineers, etc.) shall submit urine samples on a quarterly frequency. In-vivo counting and fecal analysis will not be used for routine bioassay monitoring; in-vivo counting and fecal sampling are special diagnostic tools employed following a known or suspected intake of non-transportable material.

Following an event of known or suspected intake by an individual enhanced bioassay monitoring will be conducted to assist in the exposure evaluation. Monitoring may include urinalysis, fecal analysis, in-vivo lung counts, or some combination of these at the discretion of the RPO. Frequency and duration of monitoring will be on a case by case basis, as required by the RPO.

Routine urine bioassay sample results greater than 10 µg/l should be immediately reported to the RPO. Two consecutive urine bioassay sample results greater than 20 µg/l, one sample greater than 100 µg/l or an exposure of more than 20 DAC-hours during one week or less require that the individual be placed on work restriction until released by the RPO. Special sampling shall be prescribed and as a minimum shall include at least one confirmatory sample. Special samples should be obtained and forwarded to the laboratory for analysis as soon as possible. The laboratory should be informed that these are special samples which require analysis on a priority basis. The Manager, Licensing and Health Physics shall review the results and initiate any additional actions, such as placing the individual or individuals on work restriction.

5.3.4 Medical Surveillance

5.3.4.1 Medical Examination

All employees or others who are required to wear respiratory protection must have a medical examination and evaluation in accordance with 10CFR20, Nuclear Regulatory Commission Regulatory Guide 8.15 and NRC NUREG-0041. This examination shall identify individuals who have significant attributes that prevent the effective wearing or proper functioning of respiratory protective equipment. The specific medical examination, evaluation and test results are to be kept confidential between the medical staff and the employee.

The physical examination shall include, but not be limited to, a medical history; an examination of eyes, nose, throat, heart, and lungs; a chest X-ray, if indicated; a pulmonary function test; CBC, differential, platelet count, and an audiogram. An electrocardiogram may be given if the need is indicated. The data in the questionnaire shall be elaborated on by the examiner whenever necessary to present a more complete picture of the individual's medical history.

Following the physical examination, if the individual is qualified to use respiratory protective equipment, the physician shall document the conclusion on a medical examination form. In the event of an unacceptable test result, the evaluating physician may specify restriction from respiratory use.

All records of the physical examination shall be considered confidential between the employee and the physician. However, records may be made available to others for legal or other such purposes with the permission of the President, Sequoyah Fuels Corporation. Records shall be retained by a designated company representative in accordance with the facility records retention policy and shall be destroyed only after written authorization is received from Sequoyah Fuels Corporation.

5.3.4.2 Injuries

Minor injuries occurring in an unrestricted area may be treated by routine first aid procedures. A record of very minor injuries is not required but should be maintained as good practice. Serious injuries must be treated by a physician. The phone numbers of physicians, hospital, and other emergency personnel shall be readily available to supervisory, health and safety and security personnel. The President, Sequoyah Fuels Corporation must be notified immediately of any serious injuries.

Accidents that occur within restricted areas must be handled to control complications from contamination and radiation. If no surface contamination is present the person should be removed from the restricted area as soon as possible. If contamination is present, decontamination is performed as necessary to limit the spread of contamination. In the event of a serious traumatic injury **DO NOT DELAY GETTING THE PERSON TO A MEDICAL FACILITY FOR MEDICAL TREATMENT.** A Health and Safety Technician can accompany or follow the ambulance to the medical facility and perform the necessary survey and decontamination after the person has been attended to. Medical personnel must be informed that the injured person may be contaminated. Treatment following removal from the restricted area depends on the seriousness of the injury. A survey report shall be prepared describing the incident. Wounds that occur in restricted areas must be checked for contamination. Decontamination and survey results shall be documented.

First aid shall be rendered by individuals who have been designated as first aid responders or by a physician or registered medical person. First aid includes one-time treatment of minor scratches, cuts, burns, splinters, etc., which do not ordinarily require medical care. First aid supplies and instructions will be kept available in the Health and Safety First Aid Room. A record of all first aid treatment will be kept in a first aid log.

Life saving first aid and rescue shall be provided immediately by those in the immediate vicinity. Contamination considerations are secondary to life saving efforts. A manager or supervisor shall assume control of subsequent actions including rescue, first aid, notification of medical personnel, physician, President SFC, etc.

5.3.4.3 <u>Medical Facilities</u>

First aid kits should be maintained in the facility in both the restricted and unrestricted areas. These kits should be stocked with medical supplies needed to treat minor injuries which may be sustained while work is being performed. Medical supplies, such as calcium gluconate gel, shall be approved by a consulting physician. These supplies must be inventoried periodically to ensure that adequate quantities are maintained and that expiration dates have not been exceeded.

Written agreements shall be made with local medical facilities to ensure that injured patients from the Sequoyah Facility will be accepted for treatment. Local medical facilities should be provided with information relating to the type of injuries which could be expected as a result of work being performed at the facility. Periodic training should also be provided for appropriate medical facility staff. An emergency kit should be provided to the primary local medical facility which contains contamination control materials and survey instrumentation needed for the treatment of contaminated injured people. This kit shall be inspected periodically and the instrumentation included maintained in calibration.

5.4 Effluent Monitoring

5.4.1 Airborne

The Sequoyah Facility has a number of stacks and vents which are airborne effluent sources from the facility. These sources include the main plant stack, main plant dust collection system, sampling plant dust collector, roof ventilation exhaust fans, laboratory hood exhausts, DUF_4 Plant dust collection system and the miscellaneous digestion dust collector.

Each airborne effluent which has a potential to release significant quantities of uranium is monitored using a sampling system which will obtain a representative sample. Typically an appropriately sized and shaped sampling probe is inserted into the stack. A sample collection system consisting of tubing, filters, pump, flow measuring device, etc. is provided. The specific components and configuration will depend upon the parameters being tested for and the effluent characteristics.

Samples are normally exchanged every 24 hours and analyzed for gross alpha activity. The analysis is performed after allowing for the decay of short lived radon decay products. Results are reviewed by the Health and Safety Supervisor daily and compiled into a monthly status report for review by facility management. The Health and Safety Supervisor shall evaluate any concentrations which are elevated above typical concentrations and report the findings of this investigation facility management and the RPO.

5.6 Environmental Monitoring

5.6.1 Air

Environmental air monitoring stations are provided around the perimeter of the facility at various locations. Each station is equipped with air sampling equipment including a pump, flow measuring device, filter media, associated tubing and an enclosure for the equipment. Samples are collected and analyzed in accordance with the facility environmental program.

Results from environmental air sampling are distributed to facility management personnel. Included in the evaluation is a comparison of the results with the regulatory requirements. Results which are significantly elevated above the normal values shall be evaluated and the findings documented in a report to facility management.

5.6.2 Penetrating Radiation

Penetrating radiation is monitored around the perimeter of the facility to ensure compliance with permissible levels for unrestricted areas as specified in 10CFR20.1302, "Compliance with dose limits for individual members of the public." This is accomplished by combining the external radiation dose measurements with the dose calculations performed in association with the release of airborne effluents. Occupancy times shall be used during the estimation of the doses received by member of the public.

The radiation levels are expected to be elevated at locations where uranium is stored (such as near the yellowcake storage pad) and where contamination is present in soils. Survey results and all calculations associated with demonstration of compliance with this section shall be documented by the individuals performing the survey or calculation and reviewed and approved by the RPO.

5.6.3 Restricted Area Perimeter

Radioactive materials and radiation levels in the restricted area must be maintained in accordance with the requirements specified in 10CFR20.1302, "Compliance with dose limits for individual members of the public." Internal and external dose information must be combined to demonstrate compliance with the regulatory requirement. Other areas away from the facility restricted area perimeter must also be considered since maximum ground level concentrations resulting from the release of airborne effluents may be some distance from the facility.

5.7 Ventilation

Ventilation at the Sequoyah Facility provides airflow through the facility to maintain a habitable work environment for the work force. This ventilation is provided by roof exhaust fans which move air from the buildings at the required air exchange rate. In addition, local ventilation is provided on process systems to aid in the containment of radioactive materials and hazardous chemicals. These effluents are directed through appropriate effluent treatment equipment prior to release. Treatment systems consist of baghouses, filtration and scrubber systems.

Airborne effluent discharge points are sampled and the results reviewed daily to identify unacceptable releases which may be occurring. Routine maintenance of the treatment systems is also required to ensure that they are operating effectively. Powder must be removed from the bag houses, bags need to be replaced periodically and other routine maintenance performed. Hose connections must be secured when temporary ventilation and vacuum systems are utilized at work areas to prevent the release of material. This is particularly important when setting up and connecting the hoses to knock-out drums. Failure of a hose connection can result in a significant contamination and airborne radioactive material release in the area. This will require additional cleanup and monitoring of workers, including bioassay and the associated follow up and dose calculations, and most importantly the unnecessary radiation exposure of facility personnel.

Ventilation for temporary enclosures may be provided utilizing the facility exhau_ systems or by portable vacuum equipment. Enclosures should .e constructed and maintained so that ventilation will work effectively in providing containment for the enclosure. After a containment has been installed, health physics personnel should be notified for their concurrence. Health physics approval is needed for any alt .tions that physically change the body/configuration of primary or special containments.

Containment tent inspections should include the following criteria:

- The containment tent is properly orientated and supported to hold its own weight and internal negative pressure;

- The containment floor is properly supported and protected from tears or punctures;

- All seams are complete, no holes or tears are present in the fabric;

- Air flow is in the direction of increasing potential for release or contamination;

- Air flow does not carry contamination across individuals;

- Service leads inside the tent are covered with sleeving, as required;

- External lighting is enough to illuminate the tent;

- Adequate negative ventilation within the containment;

- Sharp objects are properly covered to prevent tears or punctures to the tent;

- Change enclosures are provided;

- Piping and equipment near the exit are covered;

- Tent-to-component seal is properly made;

- All service sleeves enter the containment through connector boards or sleeves;

- The HEPA exhaust is installed opposite the inlet filters and the exhaust is near the floor of the containment;

- The ventilation system capacity is adequate (negative pressure);

- Radiological instructions are prominently posted at the entrance/exit;

- The work area and change area are separated by a barrier (i.e., zippered opening, wall, radiation ribbon, etc.)

- A portable air sampler is in close proximity;

- All velcro and/or zippered entrances are working properly.

Air flow measurements may be made at access points to the containment structure to evaluate the adequacy of the ventilation provided. Appropriate adjustments should be made.

5.8 Instrument Suitability and Use

5.8.1 Radiation Survey Instrumentation

Several types of radiation survey instruments are available at the Sequoyah Facility. The selection of a particular instrument depends upon the type of radiation being detected and the information desired.

Geiger counters are used principally as detectors for beta and gamma radiation. These instruments use G-M detectors to detect and measure radiation. They are generally pulse generators and should not be used to measure beta radiation dose. Gamma radiation can be measured provided the instrument has been calibrated properly since the response is not linear with dose for a mixture of nuclides. G-M instruments are used to measure very low to moderate count rates.

Ionization chamber instruments detect small current generated in an ion chamber when radiation passes through the chamber. This kind of instrument has been designed to measure the dose (exposure) produced by radiation in a given time. Because the currents generated at low dose rates are very small, the commonly used ion chamber instruments have limited sensitivity to low levels of radiation. These instruments may be used for the measurement of beta dose rates and are preferred for the measurement of gamma dose rates. Ion chambers are used for measuring radiation especially when mixed beta and gamma radiation fields are present. Ion chambers are sensitive devices and should be handled with care to prevent damage and to ensure that they remain operable. They are particularly sensitive to moisture or humidity and should be kept dry at all times.

Proportional detectors use gas amplification in the proportional region of the detector operating curve. Discrimination between radiations with differing specific ionization is possible with this type of detector. Proportional counters are frequently used for alpha and beta counting. Special counting gases are used and rather high voltages are required for proportional counters. Stable linear amplifiers with high sensitivity are necessary if discrimination is to be used.

Scintillation counters use light emitted by some crystalline materials or organic molecules to detect various kinds of radiation. Zinc sulfide (silver activated), or ZnS(Ag), is commonly used for detecting alpha radiation. Sodium iodide activated with thallium, or NaI(Tl), is the most common gamma scintillator.

Scintillators are frequently used to permit particle or energy discrimination. Photomultiplier (PM) tubes are used to amplify the light pulses emitted by the scintillation materials. PM tubes are sensitive to mechanical shock, temperature, and magnetic fields. They may be permanently damaged if the photocathode is exposed to light while high voltage is applied. Alpha scintillator survey meters are simple, sturdy instruments. Most other types, however, require care in the interpretation of the results. An understanding of detection principles and discriminator settings are necessary for proper evaluation of the readings.

There are, in addition to the types described above, a variety of instruments employing other detection schemes to provide special measurement capabilities. Examples of types available at SFC are solid state detectors for alpha and gamma spectroscopy, and moderating detectors for neutrons.

5.8.2 Air Sampling Equipment

Air sampling equipment of various types is used to obtain samples from work areas and the environment for analysis of radioactivity. Typical air sampling equipment consists of a pump, flow meter, sample collection medium and connecting tubing. In order to sample airborne particulates air is drawn through a particulate filter such as a glass fiber filter. Glass fiber filters have excellent collection efficiencies associated with low self absorption losses. The activity collected on the filter is then counted and air activity concentration calculated.

Lapel air samplers consist of a small battery powered pump, typically worn on the belt of the user, a flow rate measuring device (rotameter mounted on the pump), a sample filter holder connected to the users lapel, filter paper mounted in the sample filter holder and tygon tubing between the filter holder and pump. This type of sampler provides a representative sample of the air to which the individual has been exposed. The sampler flow rate is low (2 - 4 lpm) and may not provide a sufficient volume of air for an acceptable minimum detectable concentration. Sample collection times are a primary consideration in determining if a lapel sample will provide an acceptable sample.

Gooseneck air samplers consist of a pump with a flow rate of approximately 1 cfm (28.3 lpm) which is mounted on a cart. The sample holder and filter are mounted on a piece of rigid tubing which is positioned approximately one meter above the ground. Flexible tubing may also be used with this sampler to position the sample closer to the breathing zone of the worker. Care must be taken when using these sampling devices to ensure that representative air samples are obtained. Samples are generally collected during the entire work activity for an individual work crew. Samples should be exchanged if different individuals are coming and going from the work area, keeping in mind that each sample collected must be representative of the airborne radioactivity to which a worker has been exposed.

Hi-vol air samplers are used to obtain a grab sample over a short sample collection duration in order to evaluate the airborne radioactivity conditions in an area. The sample flow rates are high and an adequate sample can be obtained over a relatively short sample duration. The sample holder and filter is mounted directly on the pump. Hi-vol air samplers are typically used to collect air samples to evaluated the general airborne concentrations following a release or incident to determine if the controls established are adequate or may be reduced.

Stationary or fixed air sampling heads are provided throughout various areas of the facility to monitor the general work environment. These samples are not normally used to calculate intakes and DAC-hr assignments. A central vacuum system provides the source of vacuum for the samples. Rotameters are installed at each sample location.

5.8.3 Counting Equipment

Gas proportional counting equipment is used for the majority of sample counting at the facility. Some samples are submitted to the facility laboratory for analysis or to an outside vendor depending upon the type of analysis requested. Counters used for smears or air sample analysis are checked before use or daily, using a calibrated reference source (certified standard). The calibration shall be traceable to National Institute of Standards and Technology (NIST).

Care rust be taken during sample counting to ensure that samples are placed into the proper trays and that each sample is accounted for. Samples shall not be placed directly on top of each other since this may cross contaminate samples. Equipment may also be contaminated and increase the background for the system. Counting systems may be programmed to generate results in the format desired to facilitate data manipulation.

6.0 Data Management

6.1 Data Processing

Health physics related data should be processed as soon as possible after collection so that the results can be evaluated and the data stored. Sampling results should be stored in electronic format on computer disk with a backup hard copy placed in files. Computer program changes can be made after receiving authorization and must be verified prior to implementation. Changes must also be documented and filed with the computer program information.

6.2 Review

Personnel who process the data must receive instructions concerning the importance of maintaining accurate records and filing all information. These individuals should also be instructed in the type of data they are processing. Action levels should be established and the results reviewed to determine if any of the action levels have been exceeded. If any action levels are exceeded the Radiation Protection Officer (RPO) should be notified.

6.3 Reporting

6.3.1 NRC Requirements

Each Nuclear Regulatory Commission (NRC) licensee must maintain records in accordance with the requirements specified in 10CFR20.2101 - 20.2110. The types of records which must be maintained include records of surveys, determination of prior occupational dose, planned special exposures, individual monitoring results, dose to individual members of the public and waste disposal. Information which must be included in the records is specified along with the record retention requirements. Doses received by each individual must be recorded and reported to the individual annually.

Reporting requirements are specified in 10CFR 19.13 and 10CFR20.2201 - 20.2206 and include reports of theft or loss of licensed material; notification of incidents; reports of exposures, radiation levels, and concentrations of radioactive material exceeding the limits; reports of planned special exposures and reports of individual monitoring. Sequoyah Fuels Corporation is required to advise each worker annually of the worker's dose as shown in all records maintained on file.

6.3.2 State of Oklahoma Requirements

The State of Oklahoma has some special reporting requirements relating to airborne particulate emissions from the DUF_4 Plant. An air quality service permit issued by the Oklahoma Department of Health specifies a release rate limit of 0.002 pounds per hour for the DUF_4 Plant dust collector exhaust. If this limit is exceeded the Oklahoma Air Quality Service must be notified in accordance with the requirements specified in the permit. The person responsible for the environmental program at the facility will generally make this notification.

In addition to the requirements of the Nuclear Regulatory Commission, the combination stream is monitored in accordance with the requirements of the Department of Environmental Quality (DEQ) and the National Pollution Discharge Elimination System (NPDES) permits. Parameter and frequency requirements are specified in the permits. The person responsible for the environmental program has primary responsibility for reviewing the monitoring results and providing reports to the agencies. Routine reports are provided and include monitoring results and information relating to any permit exceedances.

6.3.3 Facility Requirements

6.3.3.1 Condition Reports

The condition reporting system is used at the Sequoyah Facility as a method to identify, document and respond to concerns or adverse conditions in a timely and effective way. Any employee or contractor can initiate a Condition Report to document a concern about some condition at the facility. Evaluations of the concern are performed to determine if the condition has met any reporting requirements. Causes are determined and corrective action assignments made to resolve the issue. Reports are tracked to ensure corrective actions are completed.

The RPO is responsible for tracking and closing out condition reports. Facility management shall be informed of the status of open condition reports and the schedule which has been established for closing them out. Employees will be encouraged to address condition reports in an effective and timely manner. When actions have been taken to close something out, the documentation must be completed and forwarded to appropriate personnel so that the condition report officially closed.

6.3.3.2 Action Levels

Action levels are established to inform facility personnel when a situation needs to be evaluated so that corrective actions can be taken. These levels are set below the regulatory limits so that corrective actions can be made before the limit is exceeded. Appropriate individuals should be designated to review data to determine if any of the action levels have been exceeded. Action levels are specified in Attachment A. The values have been set low enough to alert personnel to potential problem situations but not so low as to result in unnecessary work for those who will perform the evaluations.

Some action levels are specified in the source material license for the facility. For example, if the calculated quarterly dose to the nearest resident exceeds 6.5 mrem the NRC must be notified within thirty days of the determination. Action levels are also provided for environmental monitoring results, fence line sampling results, work area airborne concentrations and bioassay results.

6.4 Records

6.4.1 Personnel Monitoring

The radiation dose received by a worker from both external and internal sources must be measured and documented. External monitoring is conducted using either film badges or thermoluminescent dosimetry. Whole body monitoring is required for personnel entering restricted areas. The vendor used to process dosimetry for the facility shall hold a current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP). Estimates of intakes of radioactive material are made utilizing air sampling and bioassay data. After an intake estimate is made the doses received from that intake can be calculated and recorded.

Personnel monitoring results must be reviewed by the RPO or an individual specifically designated in approved procedures. The person performing this review shall initial and data each record reviewed. Any significant results above levels normally expected or above regulatory limits shall be investigated. Records shall be filed in a secure location and retained in accordance with regulatory and company retention requirements.

6.4.2 Radiation Monitoring and Surveys

Complete and accurate radiation monitoring and survey results must be documented. Each record should include the name of the surveyor, survey date, location, instrument(s) used, calibration date of instrument(s), type of measurement, measurement results, units, details of measurement location (ie. surface, 12 inches, etc.) and response/battery checks performed. Monitoring and survey results shall be reviewed and approved by the Health Physics Supervisor. Any significant results above levels normally expected or above regulatory limits shall be investigated. The results shall be filed in a secure location and retained in accordance with regulatory and company retention requirements.

6.4.3 Radioactive Material Shipments

Records which are required for the transport of radioactive materials include a bill of lading, radioactive materials shipment record (including shipper's certification), hazardous materials driver's instructions and radiation and contamination survey records. The shipper's certification must appear on the shipment record and be worded exactly as presented in 49CFR172.204. This states that the originator of the hazardous materials shipment certifies that all requirements for packaging and labelling have been met. The shippers certification states "This is to certify that the above named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation."

Each shipment of radioactive materials must include hazardous materials driver's instructions. The following information shall be included in these instructions:

- A layman's description of the materials in the shipment and their hazards under damaged conditions.
- A complete set of instructions that the driver may follow in case of an accident, if the material load is damaged, or if the shipment is delayed.
- An emergency call list of personnel to contact in any emergency or unanticipated situation.

- Instructions regarding exclusive use requirements prohibiting reloading or loading of additional packages, and other requirements.

All shipments of radioactive materials must have documentation that all required surveys have been made according to accepted procedures. Standard survey record forms are used when surveying packages or the shipping vehicle. These survey records are part of the shipment record.

6.4.4 Training

Records must be retained for all training conducted at the facility to document that the training has been completed. Tests shall be administered to demonstrate that the individuals have an understanding of the material presented during the training. The Training Coordinator is responsible for administering the training program and maintaining documentation of training completed. Lesson plans are required for training and shall be approved by the appropriate department manager and the RPO.

6.4.5 Medical and Injury

All injuries must be reported immediately to the injured persons supervisor. A supervisors investigation and injury report must be completed and forwarded to the Safety Engineer. The report should describe how the accident occurred, the extent of the injury, first aid or medical assistance provided and what can be done to prevent reoccurrence of a similar injury. Corrective actions indicated shall be documented and presented to the Management Safety Committee. The Safety Engineer shall record all OSHA related data and complete any related reports. If the injured individual was contaminated the RPO shall be notified immediately.

6.4.6 Air Sampling

Air sampling results are entered into a database which is utilized to summarize and report the results to appropriate facility personnel. DAC-hour and dose calculation results are maintained on file.

6.4.7 Environmental Sampling

The person responsible for the environmental program has primary responsibility for the maintenance of the environmental sampling related records.

6.4.8 Radioactive Waste

An individual should be designated with the responsibility for administering the radioactive waste program and generating the inventory and shipment records.

6.4.9 Respiratory Protection

Records relating to respiratory usage include fit testing results, physician approval statements, respirator use training, issuance records, inventory and maintenance records. The RPO is responsible for administering the respiratory protection program at the facility and maintaining the required program records. Records of annual physical exams are kept confidential between the individual and the physician performing the exam. The person responsible for the training program will maintain the respirator usage training records.

6.4.10 Release Surveys

Results of equipment and tool surveys are documented by the individual performing the survey. The Health Physics Supervisor shall review and approve all release survey results. Sufficient details should be included concerning the item(s) being surveyed so that facility personnel can associate the record of survey with the item. Results are maintained on file in the Health and Safety Department.

- Discussion of airborne radioactive and chemical hazards against which the wearer is to be protected.

- Discussion of operating principles and limitations of respiratory protection equipment.

- Reasons for using respirators and inadequacies of engineering controls.

- Instruction in donning and doffing respirators and checking fit.

- Instruction in proper use and care by the user.

- Discussion of the use of various cartridges for the air-purifying respirator.

- Instruction in emergency actions to be taken in the event of equipment malfunction or other situations that threaten the health or safety of personnel.

- Review of contamination hazards and proper control practices, including the use of other protective equipment which may be used with respirators.

Annual quantitative fit tests shall be administered by Health and Safety Department personnel to respirator users. Users must demonstrate a satisfactory fit prior to being issued a respirator. Any employee who has a potential need to wear a respirator in the performance of job duties must be clean shaven in the area between the sealing surface of the respirator and the face. Contact lens shall not be worn with respirators (or in the restricted areas).

7.1.4 <u>Selection of Respiratory Protection Equipment</u>

Respirator selection involves reviewing each operation to determine what hazards may be present (through hazard evaluation methods) and selecting the type or class of respirator which will offer adequate protection. Protection factors will be considered in the selection process. The selection considers not only the facepiece, but also the cartridge, where applicable.

7.1.5 <u>Issuance of Respiratory Protection Equipment</u>

Written procedures for issuing respiratory protection equipment shall be utilized. The Health and Safety Department shall be responsible for the issuance of respirators, and maintaining a list of qualified users.

Each respirator user shall be clean shaven. Health and Safety shall maintain a log of respiratory protection equipment issued. The qualified list shall reflect those users who have current medical approval, current training, and a current fit test. The Health and Safety Technician issuing the respirator must verify the users name is on the list prior to issuing each respirator. The Health and Safety Technician issuing respirators shall be given adequate training to ensure that the correct respirator is issued for each application.

7.1.6 Use of Respiratory Protection Equipment

The use of respiratory protection equipment shall be in accordance with written procedures established at Sequoyah Fuels. The procedures shall be developed following guidelines established in regulations and other guidance documents. Respiratory protection should not be used in lieu of proper engineering controls.

Each individual user shall perform a negative pressure test to verify fit each time a face-piece respirator is put on for use (negative pressure air-purifying only). Users who require prescription eyeglasses will be provided with special eyeglass inserts for use in the respirator. Contact lens shall not be worn with respiratory protective equipment.

7.1.7 Return of Respiratory Protection Equipment

Upon completion of work requiring respiratory equipment, the wearer shall place the respiratory protective equipment in a plastic bag and return it to the designated location. A Health and Safety Technician shall visually inspect the equipment to see that seals, straps, etc., are in proper working condition. The technician shall perform a smear survey of the face piece. If results of the survey are <100 dpm/100 cm² alpha or <500 dpm/100 cm² beta, no special actions are required. If the survey indicates contamination above the limits specified above, a review of air sample data should be made. The individual and his supervisor will be notified, and an investigation of the cause of the contamination initiated. The need for special bioassay samples should be considered and prescribed if appropriate.

7.1.8 Maintenance of Respiratory Protection Equipment

Replacement of parts or repairs shall be done only by qualified personnel in accordance with manufacturers recommendations. Maintenance and inspection of respiratory equipment shall be performed in accordance with written procedures. Guidance shall be included in facility procedures for the following:

- Clean, sanitize, survey, inspect, maintain and re-certify respirators for re-use.
- Conduct filter re-certification, prepare and maintain documentation of the inspection.
- Order and ensure availability of the necessary quantities of Respiratory Protection Equipment to ensure that the operational requirements of the respiratory protection program are met, including respiratory equipment for emergency preparedness.
- Inspection parameter to be used for new and re-used equipment is prior to being placed in service and after each use.
- Emergency equipment inspection requirements. (Monthly and after each use.)

7.1.9 Records

Respiratory protection training records, records of respirator fit tests and medical examination are maintained in accordance with written procedures. This information is supplied to the Health and Safety Department when needed to update the qualified respirator user list.

7.1.10 Quality Assurance

Audits of the respiratory protection program shall be performed by facility quality assurance personnel. Other routine inspections performed should include, if appropriate, evaluations of the respiratory protection program. Audit and inspection findings should be sent to management for corrective action.

7.2 Personal and Clothing Contamination

Contamination control practices and procedures shall be established to aid in the prevention of contamination.

7.2.1 Protective Clothing

The purpose of protective clothing is to pr[illegible]ide a barrier between contamination in the workplace a[illegible] to the personnel who work therein. The degree of protection is specified in procedures or on Hazardous Work Permits.

Protective clothing is laundered to remove loose contamination. Some fixed contamination may remain and be present on the clothing. Protective clothing requirements will depend on areas of work and the type of work to be accomplished. All personnel working with potentially contaminated tools or equipment must wear protective clothing as specified in facility procedures. Protective clothing requirements shall increase as the potential for contamination increases.

The HWP Guidance Document, a supplement to the procedure for Hazardous Work Permits, supplies information concerning hazards that may be encountered in different areas of the plant. This document can be consulted for guidance in selecting protective clothing.

The proper sequence is important for removal of protective clothing. The outer surfaces of the protective clothing may be contaminated. If these surfaces touch skin, the skin may become contaminated, and the whole purpose of the protective clothing is defeated.

Outer layers of protective clothing must be removed carefully. On jobs where significant amounts of loose powder are present, consideration should be given to obtaining assistance and health physics monitoring for removal of the outer layer of protective clothing.

General protective clothing (underwear, socks, coveralls, and lab coats) should be available in the change rooms. Special protective equipment may be stored in other areas, such as an equipment supply area. A supply of protective clothing ready for use should be maintained.

7.6.1 Laundry Operation

The Health and Safety Department is responsible for the operation of the laundry facility. A procedure describing the operation of the machines, survey methods, and maintenance schedules shall be provided.

A survey shall be performed of each load of laundry in accordance with facility procedures. Direct survey limits and actions required based on the degree of contamination shall be specified.

One washer may be designated for highly contaminated items only. Clothing with a potential for high levels of contamination should be segregated and washed using this machine.

Required protective measures for laundry service workers should also be addressed in procedures.

7.3 Facility and Equipment Design

Containment systems (except for pressure vessels) in the facility shall be designed to operate under negative pressure. The ventilation air flow shall be from areas of less potential for contamination to areas of greater potential. Building ventilation shall be provided to maintain airborne radioactivity at levels "as low as reasonably achievable".

Surveys of the velocity of air flows at the entrance of hoods shall be performed. If the measured face velocity is less than 100 linear feet per minute, a respirator shall be used when working in the area.

Suitable practices for dust suppression shall be used as necessary. Such measures may include enclosing and mechanically exhaust-ventilating sources of dust.

Local ventilation is a powerful tool to use for contamination control. It should be given consideration for all jobs where contamination control is needed.

7.4 Hazardous Work Permits

A Hazardous Work Permit (HWP) augments operating procedures and is used to provide special instructions related to radiological or hazards control, personnel protective equipment and clothing, protective actions taken to establish a safe work area and environment, sampling and survey requirements associated with work activities.

The purpose of the Hazardous Work Permit is to assure worker safety while performing work in the presence of actual or anticipated personnel hazards. The Hazardous Work Permit program performing hazard evaluations, identifying special safety precautions, and selecting worker personal protective equipment and or clothing.

When the need for a HWP is determined, the supervisor over the work activity obtains a blank HWP form and completes the appropriate sections, including a job safety analysis. Additional permits such as Tagout permits, digging permits, or Confined Space Entry permits may also be required and should be indicated on the HWP. The HWP is submitted to the Health and Safety department for classification of contamination conditions and Health and Safety requirements. Requirements to be considered include respiratory protection, dosimetry, monitoring and/or sampling (for radiological and chemical contaminants), follow-up surveys, and degree of job coverage.

Depending on the nature of the job, Health and Safety management approval may be required. Health and Safety requirements should be discussed with the department supervisor.

Prior to authorizing the beginning of work, the supervisor shall review the hazards of the job, required protective equipment, special instructions, requirements for enclosure or other containment, and instructions for actions to take in event of injury, personal contamination, and changing conditions with the workers assigned to the job. Prior to entering the work area, workers shall ensure a copy of the HWP is posted and that the area has been properly posted as required by the HWP. Requirements of an HWP must be met by all personnel working on the job. Health and Safety technicians shall monitor the job as required.

As soon as practical following completion of physical work, the supervisor shall ensure the work area is in a suitable condition - trash removed and all protective equipment appropriately handled - and the HWP forwarded for closure.

7.5 <u>ALARA Effort</u>

All SFC personnel shall be required to support the ALARA program.

7.6 <u>Access Control</u>

Requirements and guidelines for entering and exiting controlled areas of the Sequoyah Facility have been established to limit radiation exposure to personnel and prevent the spread of contamination.

Site access is controlled with a physical barrier and a security force. Entry to the site will normally be through a manned guard gate.

Picture identification badges should be issued to all permanent employees under the provisions of a Facility Administration Procedure. Each badge has a unique bar code and may be used for accountability purposes. Visitors are issued a temporary visitors identification badge. Security personnel shall contact the person the visitor is to see before allowing the visitor access to the site. The visitor badge has the same bar code system as employee badges. Upon exiting the site, security personnel collect identification badges.

Access to restricted areas is also controlled by physical barriers and administrative controls. No one under the age of 18 years shall be permitted to enter the restricted area.

Visitors must be escorted unless training requirements have been met and approval has been given to access the area unescorted. When entering the main process area, identification badges are scanned on a card reader. This is done again upon exiting the main process area.

All items being removed from a restricted area must be surveyed and meet the release criteria for unrestricted use. Unauthorized removal is controlled by physical barriers of fences and locked gates.

7.7 Postings and Barriers

Individuals entering areas containing potential radiation hazards shall be informed of the presence of these hazards so that they can take measures to minimize their exposure. Individuals entering such areas are made aware of the potential for exposure to radioactive materials through conspicuous postings. These postings alert the individual to the potential hazard(s) and what controls are required for entry.

7.7.1 General Posting Requirements

Title 10 of the Code of Federal Regulations requires that the standard radiation symbol (conventional three bladed design) of magenta, black or purple on yellow background be used on postings where required.

In addition to the contents of signs and labels prescribed, additional information may be provided on or near such signs and labels which may be appropriate in aiding individuals to minimize exposure to radiation or to radioactive material.

7.7.2 Radioactive Material Posting and Labels

Containers of licensed material meeting conditions in 10CFR20.1904 shall bear a durable clearly visible label identifying the contents. The container shall have a conspicuous sign bearing the words "CAUTION (OR DANGER) RADIOACTIVE MATERIAL" and bear the radiation symbol. Labeling is not required for containers when they are in transport and packaged and labeled in accordance with regulations of the Department of Transportation. Labeling is not required for containers which are accessible only to individuals authorized to handle or use them, or to work in the vicinity thereof, provided that the contents are identified to such individuals by a readily available written record.

Radioactive sources and material stored in the warehouse shall be stored in a segregated area and posted "CAUTION (OR DANGER) RADIOACTIVE MATERIALS". Each area or room in which there is used or stored an amount of licensed material exceeding 10 times the quantity of such material specified in Appendix C to 10 CFR 20.1001 to 20.2401 shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIALS" OR "DANGER, RADIOACTIVE MATERIAL(S)."

7.7.3 Radiation Area

A Radiation Area is defined as any area accessible to personnel, in which there exists radiation, originating in whole or in part within licensed materials, at such levels that a major portion of the body could receive in any one hour in excess of 5 millirem, or in any 5 consecutive days a dose in excess of 100 millirems.

Such areas shall be posted with a conspicuous sign bearing the words "CAUTION (OR DANGER) RADIATION AREA" and bear the radiation symbol. This applies to penetrating radiation (gamma at SFC).

7.7.4 High Radiation Area

A High Radiation Area is defined as an area, accessible to personnel, in which there exists radiation, originating in whole or in part within licensed materials, at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem. Unless materials are being processed onsite, there should be no high radiation areas at the Sequoyah Facility.

Such an area shall be posted with a conspicuous sign bearing the words "CAUTION (OR DANGER) HIGH RADIATION AREA" and bear the radiation symbol. This applies to penetrating radiation (gamma at SFC).

High Radiation Areas shall be locked except during periods when access to the area is required, with positive control over each individual entry. For a short time, control of a High Radiation Area may be by observation instead of locking.

7.7.5 Airborne Radioactivity Areas

Access to any area meeting any one of the following criteria shall be posted with a sign bearing the words "CAUTION (OR DANGER) AIRBORNE RADIOACTIVITY AREA". This sign must bear the radiation symbol.

Airborne Radioactivity Area posting is required by 10CFR20 and when:

- Deemed necessary by Health and Safety personnel to protect individuals from airborne radioactivity.
- Opening a primary uranium-bearing system involving high potential for airborne contamination under a Hazardous Work Permit.
- Areas determined to have chronic potential to meet the criteria for an Airborne Radioactivity Area.

7.7.6 Controlled Access Area

A Controlled Access Area is defined as an established area which is clearly marked, access to which is controlled, and which affords isolation of the material within it. These are uranium process areas where greater potential for contamination of surfaces exists due to process leaks, etc.

Each controlled access area is posted with a sign bearing the words: "CAUTION - CONTROLLED ACCESS AREA". Posting shall state entry instructions.

Inside the restricted area, controlled access areas have loose contamination levels consistently greater than 2,000 dpm/100 cm^2 alpha or greater than 20,000 dpm/100 cm^2 beta/gamma, despite contamination efforts.

Outside the restricted area, controlled access areas are established for an area having contamination loose surface contamination levels greater than 500 dpm/100 cm^2 alpha or 1,000 dpm/100 cm^2 beta/gamma.

7.7.7 Restricted Areas

A Restricted Area is any area to which access is controlled for the purpose of protection of individuals from exposure to radiation and radioactive materials. At the Sequoyah Facility those areas have been designated to be all areas within the Restricted Area fence lines and on the process building side of the changerooms, excluding the warehouse. See Attachment 1 for a map of the Restricted Areas.

Each Restricted Area shall be posted "CAUTION - ANY AREA OR ROOM WITHIN THIS PLANT MAY CONTAIN RADIOACTIVE MATERIAL". This sign must bear the radiation symbol.

7.8 Work Restriction and Limits

Work Restriction means a person cannot work in an area where the potential for exposure to radiation exists. Work Restriction may be imposed based on bioassay program requirements when:

- Failure to submit routine bioassay samples as requested.

- A single bioassay sample (urine) greater than 100 micrograms per liter or two consecutive bioassay samples (urine) greater than 20 micrograms per liter.

- Work restriction will be lifted when 2 consecutive results of less that 20 micrograms per liter are obtained.

- Work restrictions may be improved based on program requirements when the calculated DAC-hour exposure for an individual is greater than 30 DAC-hours in a week.

Work restriction will be lifted when the cumulative exposure drops below 10 DAC-hrs in 7 consecutive days or a urine sample is less than 20 micrograms per liter.

7.9 Declared Pregnant Worker Limits

Sequoyah Fuels Management shall provide instructions on established radiation protection standards, procedures and exposure limits to all employees and other persons potentially subject to occupational radiation exposure at company operations. These instruction should include estimates of the extent to which workers will be exposed to radiation or radioactive material and the possible effect such exposure may have on their health, as well as the health of an unborn child.

Sequoyah Fuel's policy on prenatal exposure is based on NRC Regulatory Guide 8.13 entitled "Instruction Concerning Prenatal Radiation Exposure", and 10 CFR 20.1208. 10 CFR 20.1208 requires that the dose equivalent to the unborn child from occupational exposure of the expectant mother be limited to 500 millirems for the entire pregnancy. The pregnancy must be declared in writing by the mother. Sequoyah Fuels shall furnish a copy of Regulatory Guide 8.13 to all new female employees. Sequoyah Fuels encourages any female employee to notify their supervisor or the Radiation Protection Officer (RPO) as soon as she knows or thinks she is pregnant. Action pursuant to the standard on Prenatal Radiation Exposure will be initiated.

7.10 External and Internal Exposure Evaluation

10CFR Part 20, "Standard for Protection Against Radiation", established radiation dose limits for occupationally exposed adults. These limits apply to the sum of the dose received from external exposure and the dose from internally deposited radioactive material. In 10CFR20.1201(a)(1), the annual limits for adults are (i) 5 rems total effective dose equivalent or (ii) 50 rems total organ dose equivalent to any single organ or tissue (other than the lens of the eye), whichever is more limiting. The annual dose limit for the lens of the eye is 15 rem. The occupational dose limits for minors in 10CFR20.1207 are 10% of the dose limit for adults, and 10CFR20.1208 establishes a dose limit for the embryo/fetus of 0.5 rem during the entire pregnancy.

The "total effective dose equivalent" is defined as the sum of the "deep-dose equivalent" (for external exposures) and the "committed effective dose equivalent" (for internal exposures). The total organ dose equivalent limit of 50 rems specified in 10CFR10.1201(a)(1)(ii) applies to the sum of the "deep-dose equivalent" and the "committed dose equivalent" to any individual organ or tissue. The requirements in 10CFR20.1202 are for summing external and internal doses to demonstrate compliance with the dose limits of 10CFR20.1201.

The Part 20 requirements for recording individual monitoring results are contained in 10CFR20.2106. When monitoring is required under 10CFR20.1502, the monitoring results must be recorded on NRC Form 5 or equivalent.

Additional information and guidance concerning external and internal exposure evaluations may be found in Regulatory Guide 8.34, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses".

1

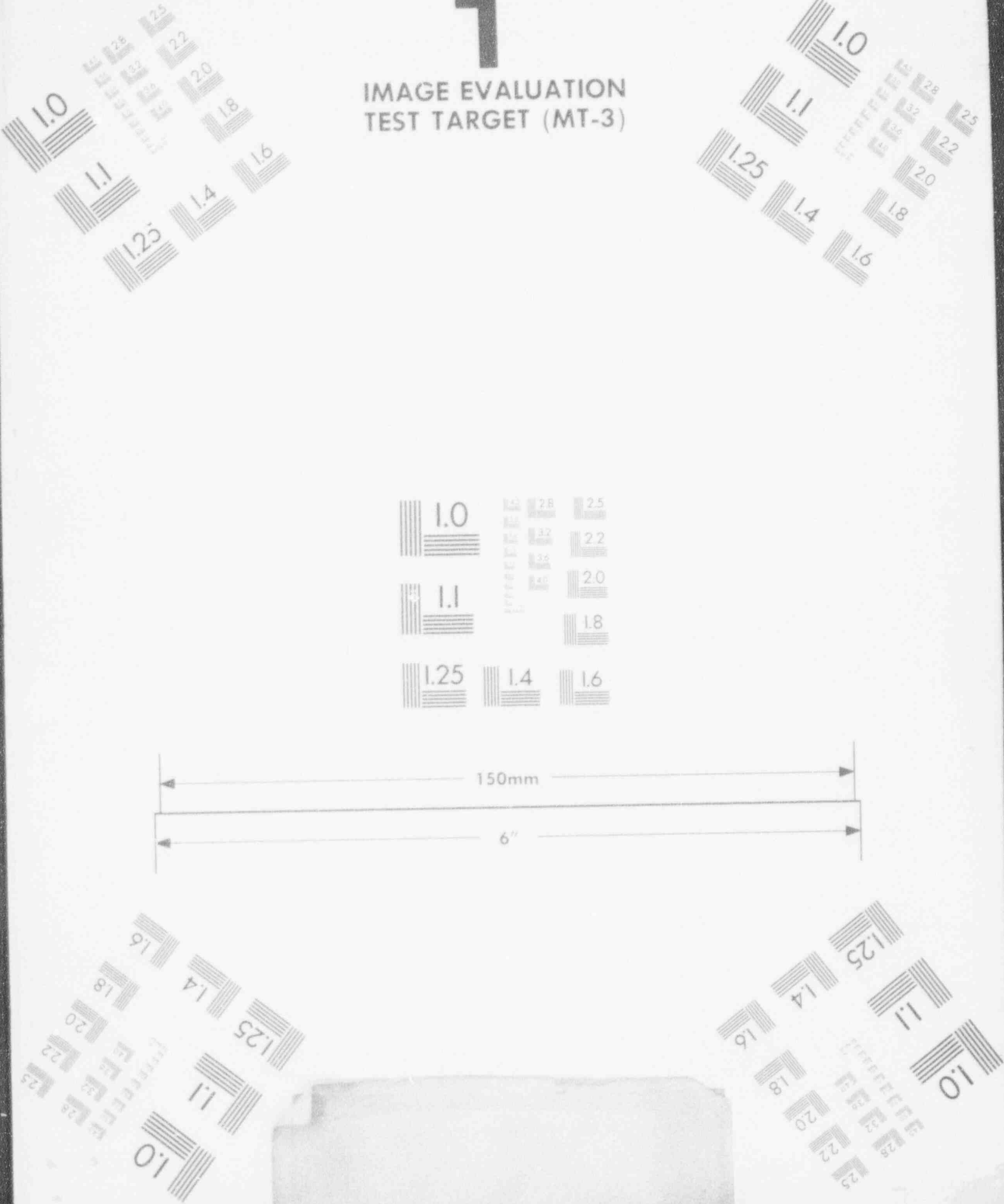
IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION
TEST TARGET (MT-3)



1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

1.0 2.8 2.5
3.2 2.2
3.6
4.0 2.0
1.1
1.8
1.25 1.4 1.6

150mm

6"

8.0 Radioactive Material Control

8.1 Control of Radioactive Material Shipments

Radioactive material controls have been established at SFC for the transportation of Low Specific Activity (LSA) radioactive material. Materials shipped include yellowcake, yellowcake slurry, drummed source materials, UF6 cylinders, depleted UF6 cylinders, raffinate sludge, depleted UF4, limited quantity radioactive material, radioactive waste, and sealed radioactive sources.

8.1.1 Receipt

a. Incoming LSA vehicle shipments (including yellowcake, yellowcake slurry, drummed LSA material, UF6 cylinders, and depleted UF6 cylinders) are weighed, surveyed for radiation / contamination, and admitted to the Facility restricted area through a controlled access gate.

b. Empty raffinate sludge tankers are also admitted to the facility through a controlled access gate.

c. Limited quantity radioactive material and sealed radioactive sources are received in the materials warehouse. A radiation / contamination survey is performed externally on the shipping package. If survey results are acceptable, the package is opened and a visual inspection is performed. A survey is then conducted upon the package contents. A leak test is performed on sealed radioactive sources. The Manager of Health and Safety shall be informed immediately upon receipt of packages labeled as containing radioactive material or packages which are crushed, wet or damaged (not labeled as radioactive material but known to contain radioactive material). A Health and Safety Technician shall survey a package within 3 hours after receipt during normal working hours, or not later than 3 hours from the beginning of the next working day if during non-working hours. Sealed sources shall only be moved, installed or removed from service under a sealed source work permit.

8.1.2 Accountability and Control

a. LSA materials (including yellowcake, yellowcake slurry, drummed LSA material, UF6 cylinders, and depleted UF6 cylinders) are accounted for by using DOE / NRC Form 741 "Nuclear Material Transaction Report". A monthly report is submitted to management by the accountability section of the accounting department as a running inventory of the amount of uranium held on site as source material. An annual physical inventory is conducted on these source materials.

b. A physical inventory of sealed sources is conducted and documented at no greater than six month intervals. A source leak test is performed and documented on sealed sources at six month or 3 year intervals, as required by the byproduct material license.

8.1.3 Shipment and/or Release

a. Outgoing LSA vehicles (empty or loaded) are surveyed for radiation and contamination and a visual inspection is conducted. Vehicle contents are accounted for with a NRC DOE Form 741 "Nuclear Material Transaction Report".

b. Outgoing raffinate sludge trucks are surveyed for radiation and contamination. The contents of these vehicles are a radioactive waste by-product shipped for processing and/or burial and accounted for by sampling and documented on the shipping manifest.

c. Limited quantities of radioactive material is shipped via common carrier. These materials are packaged in a strong tight package that will not leak during conditions normally incident to travel. The contents of these packages are surveyed for radiation and contamination. The maximum allowable dose rate on contact with the package is 0.5 millirem per hour.

d. Radioactive waste is shipped in accordance with Department of Transportation (DOT) requirements.

e. Sealed radioactive sources are removed and disposed of by licensed vendors and returned to the manufacturer or another individual licensed to receive them.

8.2 Control of Radiative Material

8.2.1 Marking, Labeling and Storage

All entrances to the restricted area are posted with a sign containing the word "CAUTION", the three bladed radiation symbol, and the statement "Any Area or Room

Within this Plant May Contain Radioactive Material". All radioactive material storage areas are posted with a sign containing the word "CAUTION", the three bladed radiation symbol, and the statement "Radioactive Material". Radioactive sources are clearly identified as to their contents and stored under lock and key. Access to radioactive sources is limited to H&S Technicians for key control purposes. Lockers containing radioactive sources are labeled the same as radioactive material storage areas.

8.2.2 Administrative Controls

Access into Radiation and High Radiation areas shall be controlled to limit personnel exposure to As Low As Reasonably Achievable (ALARA). All personnel, including employees, contractors, and visitors entering a restricted area shall wear as a minimum a personal dosimeter (film badge or TLD). Visitors and contractors must review the visitor training video prior to receiving personal dosimetry and must be escorted at all times while in a restricted area. Health and Safety shall assign and issue a permanent dosimeter, with a unique dosimetry tracking number to each person who is granted unescorted access to restricted areas or frequent site visitors who may require access to restricted areas.

No one under the age of 18 shall be permitted to enter the restricted area.

Possession and / or use of tobacco products and food is prohibited in any restricted area. Drinking is prohibited except at specified locations.

Radiation areas are posted with a sign stating the word "CAUTION", the three bladed radiation symbol, and the statement "Radiation Area".

High radiation areas are locked or guarded. They are posted with a sign stating the words "CAUTION", "High Radiation Area", and the three bladed radiation symbol. Further entry requirements are addressed in written facility procedures. Exposure rate surveys are conducted as required by written facility procedures inside the restricted area.

8.2.3 Engineering Controls

Engineered access controls at the facility consist of locks, chain-link fencing, doors, gates, partitions, buildings, enclosures, and surveillance cameras.

8.3 Control of Surface Contamination

8.3.1 Controlled Access Areas

a. Semi-Controlled Access Areas

All areas within the physical barriers of the restricted area that are not posted controlled access areas are considered to be semi-controlled areas.

b. Temporary Controlled Access Areas

This is any area in the semi-controlled access area or unrestricted area that is bounded and posted as controlled access area to restrict access to protect personnel from radiation or radioactive materials while work is in progress or actions are being taken to clean up uncontained source materials.

c. Controlled Access Areas

An established area which is clearly marked, access to which is controlled, and which affords isolation of the materials within it. These are uranium process areas where greater potential for contamination of surfaces exists due to process leaks, etc. Each controlled access area is posted with a sign bearing the words "CAUTION - Controlled Access Area", and the three bladed radiation symbol.

8.3.2 Use of Step-Off-Pads

To minimize the spread of contamination, the exit and entrance to controlled access areas shall be at designated points only. These egress points are to be provided with step-off-pads and shoe cover stands. Proper methods for use of step-off-pads are delineated in written facility procedures.

8.3.3 Protecting Surfaces

The use of herculite, visqueen and polyethylene bags will be maximized to prevent the unwanted spread of contamination to clean equipment surfaces.

8.3.4 Contamination Control

Personnel authorized unescorted access to the restricted area are trained as Radiation Workers. Personnel entering the restricted area are required to wear a smock over street clothing. Personnel handling radioactive materials and / or systems are required to wear process clothing / coveralls, and are required to shower prior to exiting the facility. Prior to exiting the restricted area personnel are required to monitor for contamination with a personal contamination monitor (PCM-1B) or by frisker.

All material or equipment exiting restricted areas shall be surveyed and meet the requirements for release for unrestricted use in accordance with facility procedures.

The primary health risk posed by uranium and associated decay products is related to the intake of these radioactive materials into the body. In order to minimize this risk, we must contain and control the material to keep it out of the air, water and food we consume and off skin surfaces.

Contamination can be spread by tracking on shoes and transfer on clothing. It may also be spread by the movement of vehicles, tools, and other equipment from one location to another within the facility, as well as, by maintenance and upset conditions.

Control of radioactive contamination is most readily accomplished by the following:

a. Identifying sources of contamination.

b. Containing contamination at the source.

c. Isolating any uncontained material through contamination control boundaries (e.g., rope or banner guards).

d. Establishing limits for radioactive contamination.

e. Planning and performing work in a manner which minimizes the spread of contamination.

f. Cleaning up spills of radioactive materials as quickly as possible.

g. Applying anti-contamination steps where identified and recommending ways to improve the facility's contamination control program.

h. Recognizing that contamination control is everyone's responsibility.

8.3.5 Safety Precautions

The primary focus of the SFC radiation protection program is to prevent or minimize the intake of radioactive materials.

Care shall be used when handling or cleaning up liquids encountered in the facility. The chemical nature shall be understood prior to proceeding and appropriate protective clothing and equipment shall be used.

Signs and barriers enclosing special areas within the facility must be recognized, read, and their instructions understood fully before entering the area.

No eating, drinking or use of any form of tobacco product is permitted within any Restricted Area at this facility except as noted below:

a. Company supplied and approved drinks are permitted within the in-plant Reading Room. Entry is permitted only after washing hands and surveying hands and face as a minimum prior to entry. Protective clothing should be free of visible uranium material.

b. At designated drinking fountains which must be kept free of dust or powder.

c. Bottled water stations in the DUF4 plant motor control center where only drinking bottled water is permitted. Drinking is permitted only after washing hands and surveying hands and face at a minimum prior to entry. Protective clothing should be free of visible uranium material.

Always wash hands thoroughly prior to using restroom facilities located within the restricted area.

8.3.6 Confinement of Contaminants

When radioactive materials have not been effectively contained, it becomes important to ensure that they not be dispersed to other parts of the facility. The following sections describe actions to be taken to ensure effective confinement of uncontained radioactive materials.

In the event of a large spill, evacuate the area and notify the Senior Shift Supervisor and Health and Safety.

The source should be isolated in accordance with the following guidance:

a. Excess contamination in any form should be cleaned up as soon as practicable. When prompt cleanup is not practicable, measures shall be taken to isolate the material close to its source.

b. Use buckets, drain systems, catchpans, or other suitable method to contain liquid leaks and spills as close to the source as possible. Containers must be large enough to hold the amount of material expected or be maintained in such a manner as to prevent overflow.

c. Take prompt corrective action to repair or replace leaking containers which hold contaminated materials.

d. Form temporary dikes or curbing to prevent liquids from spreading to other areas. Permanent dikes or curbing should also be used in areas where large volume liquid spills are more likely, such as around tanks, handling areas and loading docks.

e. Report and repair or replace leaking valves, joints, bearings, seals, or other components in uranium bearing process systems.

f. Clean up leaks and spills in a timely manner whenever they are identified.

g. Perform routine maintenance on uranium bearing process systems and components so as to prevent future leaks.

h. Temporary Controlled Access Areas may be established for work which is likely to create significantly higher levels of contamination than is present in surrounding areas. The intent of the Temporary Controlled Access Area is to limit the spread of contamination by controlling access to the area.

8.3.7 Protective Clothing Requirements

All personnel entering radiologically controlled areas are required to wear protective clothing as specified by facility procedures, hazardous work permits, and by Health and Safety personnel. Protective clothing requirements are based on actual or potential levels of contamination in the work area and the work to be performed. Minimum protective clothing requirements for personnel entering Restricted Area through a Change Room are specified in operating procedure G-114, Change Room Procedure.

Contact Health and Safety prior to entering any restricted area other than Restricted Area 1 (Main Process Area). Health and Safety will review current survey results and specify protective clothing requirements.

Personnel entering Restricted Area 1 for the purpose of making a delivery shall enter through the motor-operated truck gate. These persons must wear lab coat, shoe covers, hard hat and safety glasses any time they leave their vehicle.

Security personnel must wear shoe covers whenever they leave their vehicle inside the Restricted Area. Security vehicles must be surveyed and released by Health and Safety prior to leaving the Restricted Area. All personnel must monitor themselves prior to exiting the restricted area.

Personnel entering Restricted Areas may be required to wear additional protective clothing and exposure monitoring equipment, at the discretion of Health and Safety personnel. Additional protective clothing may be required based on survey data, work to be performed, other work in nearby areas, and similar conditions which are subject to change.

Personnel wearing shoe covers over street shoes in the Restricted Area may enter Controlled Access Areas without changing shoe covers. Shoe covers must be changed at the Control Point when leaving the Controlled Access Area.

All personnel performing work under a HWP shall comply with the protective clothing requirements of the HWP.

Protective clothing shall not be worn outside the Restricted Area except as directed by the Manager or a Supervisor in the Health and Safety Department.

Where liquids that may contain radioactive material are present in a work area and shoe covers are unlikely to protect shoes from contamination, wear rubber boots.

Gloves shall be worn when handling any potentially contaminated item, including bags, which may be contaminated on the outside.

Protective clothing such as lab coats and coveralls should have long sleeves and the sleeves should not be rolled up.

8.3.8 Monitoring for Control of Contamination

It is every individual's responsibility to be attentive to conditions which could result in the spread of radioactive contamination, and to report these conditions to Health and Safety and supervision when they are observed.

Health and Safety personnel are responsible for routine monitoring of the work place for alpha and beta/gamma contamination. This monitoring includes process areas, areas outside the facility, equipment, materials, vehicles and personnel.

Each individual shall:

a. Be familiar and comply with all requirements established to minimize the spread of contamination.

b. Strive to keep the job site clean and orderly at all times.

c. Vacuum, or otherwise, contain all loose radioactive material before it has a chance to spread and create a hazard or costly clean up effort.

d. Bag and label all potentially contaminated materials prior to removing from a Controlled Access Area. Transport materials to the Decon or Solid Waste Area as directed by Health and Safety personnel.

e. Report spills and clean them up as soon as possible to prevent the spread of contamination.

8.3.9 Decontamination

8.3.9.1 Personnel

Radioactive contamination must be detected and removed from the skin and clothing of personnel before they leave a Restricted Area or change room to protect them and maintain control of radioactive contamination. Contamination incidents must be documented so that effective measures can be taken to prevent additional contamination. Furthermore, regulatory requirements make it necessary to document and evaluate contamination so that exposure records for workerr can be maintained in compliance with federal law.

Although skin contamination is to be take seriously, the nature of the radioactive materials commonly encountered at the Sequoyah Facility make them more of an internal rather than an external hazard. For this reason, exceptional care shall be exercised to prevent ingestion or inhalation of radioactive material.

Personnel decontamination will be carried out in accordance with facility procedures.

8.3.9.2 Tools and Equipment

When removing equipment, components, tools or other items from controlled access areas which are potentially contaminated with uranium, the following actions shall be taken (potentially contaminated items include equipment and components which have been in direct contact with uranium process equipment and other items which are known or suspected of being contaminated). This does not apply to hand carried items under continuous control such as pens, papers, hand held instruments, items bagged to prevent contamination, items in pockets, and radios.

After a respirator or a lapel air sampler has been used, it may be bagged and returned by the user to the Health and Safety in-plant office without being surveyed at the controlled access area control point.

Remove as much loose radioactive contamination from the item as possible.

Notify a Health and Safety Technician for survey of items. All items must be released by Health and Safety prior to removal.

Health and Safety may, after survey, authorize equipment, components, tools, or other items to be placed in a tightly sealed plastic liner (bag), labeled, and transferred to another controlled access area.

Bagged items removed from a controlled access area shall be labeled with the following minimum information:

1. Description of Material
2. Responsible Department / Group
3. Contamination Levels
4. H&S Technician Signature and Date

Large items, with suspected contamination, which cannot be placed into plastic bags should be decontaminated prior to removal from the area. If it cannot be decontaminated prior to removal, contact a Health and Safety Supervisor for guidance.

8.3.10 Surveys

Routine contamination surveys of floors and equipment surfaces are performed at certain frequencies in plant facilities and other areas to control the levels of radioactive contamination to within license specifications, detect off-standard trends, identify malfunctioning equipment, and prevent the spread of radioactive contamination from or within the facility. The objective of such controls is to reduce the exposure of personnel to radioactive materials to As Low As is Reasonably Achievable (ALARA).

Surveys conducted in the restricted and unrestricted areas shall be performed at random locations. Particular attention shall be given to traffic areas of high probability for contamination. The status of plant layup and decommissioning shall determine the extend of these surveys.

The following actions and limits apply to routine and special surveys performed at the facility on surfaces normally accessible to personnel working in the areas. This includes surfaces of equipment pieces that personnel might come in contact with in the performance of their normal work, as well as accessible floors, walls, etc. It is not intended to apply these limits and actions to inaccessible areas or to surfaces on equipment that would normally only be contacted during maintenance or repair. Furthermore, contamination detected during preparation for or conduct of maintenance work shall not be subject to these limits and actions. Appropriate contamination control and personnel protection requirements will be established for each job to prevent unnecessary exposure of personnel or spread of contamination. Following completion of maintenance or repair work, followup surveys will be conducted and the applicable limits and actions applied. In addition, visible contamination shall be cleaned from normally inaccessible exterior surfaces upon completion of maintenance or repair work or when observed during visual contamination inspections.

1. Smear results greater than 500 dpm/100 cm^2 (alpha or beta/gamma) in areas where drinks are provided shall require cleanup and posting as a temporary controlled access area. A follow-up survey shall be done to ensure an effective cleanup has been completed.

2. Any smear result greater than 2,000 dpm/100 cm^2 (alpha) in the controlled access areas or greater that 1,000 dpm/100 cm^2 (alpha) in semi-controlled access areas shall be reported to the area supervisor upon survey completion.

3. Any smear result greater that 20,000 dpm/100 cm^2 (beta/gamma) in controlled access areas or greater than 10,000 dpm/100 cm^2 (beta/gamma) in semi-controlled access areas shall be reported to the supervisor responsible for decontamination upon survey completion.

A visual inspection for surface contamination shall be performed as delineated by written facility procedure by a Health and Safety Technician for all uranium handling process areas.

Any visual contamination, such as yellowcake, shall be reported to the area supervisor. The supervisor responsible for decongamination shall initial the Routine Contamination Survey report and ensure the affected area is cleaned up.

Cleanup shall be initiated by the end of the following shift.

Set up a temporary controlled access area if needed to prevent the spread of contamination.

Each visual inspection tour and findings will be documented on the standard report form. Recommendations are also documented on this form.

The supervisor responsible for decontamination shall notify the Health and Safety Technician when the clean-up is complete. The H&S Technician will then log the time and actions taken in the shift log.

The Health and Safety Technician shall verify that the required clean-up has been completed.

8.4 Control of Airborne Contamination

8.4.1 Source Control

The mainstay to prevention of airborne contamination is the use of containment and / or ventilation to provide a negative pressure in the desired area.

Containment - A physical barrier used in conjunction with a ventilation system designed to prevent the release of radioactive material into the work area. Containment refers to the barrier that is or can be directly exposed to radioactive material. The containment should prevent the release of radioactive material through either sealed construction, negative pressure differential, or a combination of both.

a. Permanent Containment - Includes the tanks, containers, pipes, vessels, and other enclosures which contain radioactive material. They have been engineered into the facility design and construction.

b. Temporary Containment - The form of containment which is typically used for short periods of time. Temporary containments are usually constructed or utilized during the performance of a non-routine operation. They are most often prescribed and used during jobs which require a Hazardous Work Permit (HWP).

8.4.2 Local Ventilation

The ventilation systems provide multiple functions, depending on the specific process area:

a. Ventilation may be used for controlling concentrations of airborne radioactive material.

b. Ventilation may be used to maintain the quality of breathing air and for the reduction of flammable gases, fume and vapors, in process areas.

c. Ventilation may be the primary method of ensuring that releases within an area are controlled.

Personnel should not enter or remain in an area or building if there is any doubt about the quality of the breathing air. When in doubt, call Health and Safety.

If operation of a ventilation system required by NRC license, state or federal regulatory commitment becomes non-functional, an evaluation shall be performed and the responsible agency informed of the condition.

Adequate ventilation can be achieved through the use of natural draft or forced ventilation. The Misc. Digest Building and the ADU Slurry Building are examples of where natural draft ventilation is used. Ventilation fans or exhausters are examples of forced ventilation.

In order for any ventilation system to work, an air flow path must be established. This flow path can be accomplished by the use of louvers, roof hatches, doors or exhausters.

Forced ventilation and natural draft ventilation systems require an established air flow path. Air must be able to flow into and out of the area being ventilated.

8.5 Control of Radioactive Materials in Effluents

8.5.1 Restricted Area

Gaseous effluent sources include the main plant stack, lab sample preparation room hood exhaust, HF off-gas scrubber, main plant dust collector exhaust, sampling plant dust collector exhaust, miscellaneous digestor dust collector exhaust, lab hood exhausts, roof vent fans, depleted UF4 dust collector exhaust, depleted UF4 reactor cooling exhaust, the depleted UF4 drum dryer exhaust, and the depleted UF4 plant roof vent fans. Other effluent sources include the cooling air exhaust from the hydrofluorination lines, decon-room oxylate and nitric acid tank exhausts, laundry room dryer exhaust, the plant's ambient air sampling system exhaust, and solid waste compactor exhaust.

All liquid effluents excluding the storm water runoff are discharged into the combination stream, which includes the sanitary lagoon discharge.

Airborne Effluent Monitoring

a. Main Plant Stack

The main plant stack gasses shall be sampled continuously at a nominal sampling rate specified in facility procedures.

A Health and Safety technician shall change the sample filter daily and analyze it for gross alpha activity using a gas proportional counting system.

Air samples should be held for at least four hours prior to analysis to allow the short-lived radon daughter products to decay.

Determine the stack effluent gross alpha concentration (excluding short-lived radon decay products) and express the results in uCi/ml.

b. Building Vents and Other Stacks

1. HF Off-Gas Scrubber Stack

The HF off-gas scrubber shall be sampled continuously during blower operation at a sampling rate specified in facility procedures. The sample flow is through a potassium hydroxide (KOH) scrubber solution, a moisture trap, and two particulate filters - all in a series.

2. Other Release Points

Each airborne effluent release location listed shall be sampled continuously if the source's release rate exceeds 10 g-U/month. Sampling is required only when the associated exhaust fan is running.

The filter shall be changed daily and analyzed for gross alpha activity. These results are used to derive the corresponding uranium concentrations in the stack or vent exhaust.

If the measured or estimated airborne activity from stationary air sampling locations in the restricted area is $\geq$0.5 DAC, the Manager, Licensing and Health Physics shall investigate the cause of the activity. The manager shall compare air sample results from site fence air samplers and review past releases. Additional reporting requirements shall be evaluated as part of the evaluation.

Monthly, the release rate from each effluent release point or stack is summed with all other release points. The resulting release rate is then compared to the plant's limit of 30,000 uCi/qtr. The release rate is computed and compliance is evaluated.

If the DUF4 Plant Dust Collector exhaust exceeds 5 uCi/day (0.002 lbs/hr) UF4, the Manager, Environmental, shall be immediately notified. The Manager, Environmental, shall make notification to the Oklahoma Air Quality Service.

9.0 Equipment and Instrument Control

9.1 Specification

9.1.1 Health Physics Instrumentation - Portable

Health physics instrumentation provides direct readout of or readout relatable to dose or dose equivalent, or activity per unit area. Included are portable rate and integrating devices for alpha, beta and photon.

9.1.2 Particulate Radioactivity Monitors

Particulate radioactivity monitors measure only the radioactivity present in or on particulates suspended in the ambient air, ordinarily by filtering the particulates from a measured volume of air and continuously or periodically measuring the radioactivity in the material removed.

9.2 Inventory

9.2.1 Portable Health Physics Instruments

Instruments in use will be inventoried daily to ensure that the instrument is in working condition and stored at it's proper location when not in use. This will include a field check (or equivalent field verification). A semi-annual inventory should be performed of all instrumentation, including instruments which are in storage.

9.2.2 Particulate Radioactivity Monitors

All installed air monitors will be checked on a weekly basis to ensure proper operation in accordance with approved procedures.

All portable air monitors will be inventoried and inspected monthly to ensure that the instrument is in working condition and stored at it's proper location when not in use.

9.3 Calibration

This section covers all health physics instrumentation and monitors including portable instruments, laboratory counters, installed air monitors, and portable air monitors.

9.3.1 Calibration Frequency

Instruments and monitors in use shall be calibrated semi-annually and after any maintenance or repair that could affect the calibration.

9.3.2 Calibration for Special Conditions

If the instrument is to be used under conditions which vary significantly from those for which the instrument is designed, the instrument should be adjusted, calibrated, and used only for the special condition. When an instrument is calibrated for special conditions, a special identification label shall be attached to indicate its applicability for its special use.

9.3.4 Radiation Energy

Calibration shall be performed with a standard source or sources providing radiation fields similar to those in which the instrument will be used. Where instruments will be used in radiation fields of widely differing energies, the response of the instrument at several energies over the expected energy range shall be determined.

9.3.5 Calibration Records

A record shall be maintained of all calibration, maintenance, repair, and modification data for each instrument and air monitor. The record shall be dated and shall identify the individual performing the work. The record shall be filed with previous records on the same instrument or air monitor. Each instrument or air monitor shall be labeled with the following information:

a. Date of the most recent calibration.

b. Initials or specific identifying mark of calibrator.

c. Energy correction factors, where required.

d. Graph or table of calibration factors, where necessary, for each type of radiation for with the instrument may be used; this should relate the scale reading to units required if units are not provided on the scale.

e. Instrument response to an identified check source.

f. Unusual or special use conditions or limitations.

g. Date that calibration is again required.

h. Special condition identification label, if applicable.

9.3.6 Calibration Standards

Instruments and air monitors should be calibrated either against National Standards or with Derived Standards.

9.3.7 Calibration Facility

Free-space geometry should be achieved for photon instrument calibration. The distance to scattering objects from the source and from the detector should be at least twice the distance between the detector and the source. The radiation background at the calibration facility shall be low, known, and stable and shall be accounted for during calibration.

9.4 Use of Instruments and Monitors

Any individual who uses an instrument or air monitor shall have formal classroom training in the performance and operation of the instrument or air monitor. After successful completion of the classroom training the individual shall receive on the job training in the use of each item and demonstrate satisfactory knowledge and operation prior to unsupervised use or operation.

10. Tool and Equipment Control

10.1 General Requirements

Good "housekeeping" practices shall be followed in order to minimize the amount of material that becomes contaminated and has to be decontaminated or disposed of as radioactive waste.

Only those tools, equipment, and material actually required for work shall be taken into Restricted Areas. Anything taken into Restricted Areas may become contaminated and will, at the very least, require monitoring for contamination before it can be released from the Restricted Area for unrestricted use. If an item becomes contaminated in a Restricted Area it must remain within the Restricted Area, or be decontaminated or disposed of as contaminated waste unless released for conditional use. Conditional use must be approved on a case by case basis by the Radiation Protection Officer (RPO).

Packing associated with an item or other disposable outer containers should not be taken into Restricted Areas. Because of the increased levels of contamination found inside of Controlled Access Areas extra care must be taken to minimize the amount of equipment and materials taken into these areas.

Once tools are taken into a Controlled Access Area, they should be left in the area until the work which requires those tools is completed. However, contaminated tools may be transferred through a clean area to another Controlled Access Area if they are bagged and tagged to control contamination and if Health and Safety personnel approve the transfer.

Personal items are taken into Restricted Areas at the owner's risk. While in the Restricted Area, individuals should not unnecessarily touch a contaminated surface or allow clothing, tools, or other equipment to do so.

10.2 Contamination Control and Decontamination

Tools and equipment which will be released from a Restricted Area should be kept as clean as possible. If possible cover the item with a protective cover such as a poly sleeve or bag to prevent contamination, or apply a removable cover such as tape or strip coat that can be removed to aid in decontamination. As practical, place all contaminated equipment such as tools and sampling bottles on disposable surfaces (e.g. sheet plastic).

Tools and equipment that will be needed within a Restricted Area on a routine basis should be kept in the Restricted Area to reduce number of items which may become contaminated and require decontamination. These items should be maintained at low levels of contamination to prevent personnel contamination and cross contamination with other tools and equipment. Decontamination should begin at the earliest practical opportunity after the contamination has occurred.

Prior to starting decontamination a survey shall be done to identify the location and level of contamination so that a plan for decontamination can be formulated and carried out. The decontamination should be performed in a manner which efficiently utilizes available resources and prevents the spread of contamination.

Surveys shall be performed at different stages of the decontamination process to check the efficiency of the decontamination technique.

11.0 Emergency Plan

11.1 Scope

The Sequoyah Facility Emergency Plan (SFEP) is used by facility personnel to respond to emergency conditions at the facility. Since the facility has discontinued operations, process chemicals and the bulk of the uranium contained in the systems at the facility have been removed from the process equipment. The primary hazards that are present at the facility are related to industrial safety hazards encountered during performance of decommissioning activities and radiological concerns due to exposure to the residual uranium and associated decay products left inside and on the process systems. Although the probability of an accident is low, this plan will be maintained to provide for the health and safety of the facility employees. Off-site consequences resulting from an incident or accident on-site will not result in an individual member of the public receiving a significant intake of uranium or hazardous chemicals. Potential hazards to the health and safety of members of the general public in the vicinity of the Sequoyah Facility will be negligible and response efforts from the off-site public or public agencies will not be required.

Emergency response measures specific to a task or decommissioning activity should be included in the procedure describing the activity. This will include the use of fire watch, fire extinguishers, removal of combustible materials, barricades, evacuation routes, pre-job evaluations and other job specific considerations which will enhance personnel safety. Procedure guidance shall be consistent with the SFEP.

11.2 Responsibilities

An Emergency Plan Coordinator shall be designated by the President, Sequoyah Fuels Corporation, and shall be responsible for the Sequoyah Facility Emergency Plan and maintenance of emergency facilities, equipment and supplies in a state of readiness. The Emergency Plan Coordinator will schedule training for facility employees and employees with emergency response positions. Employees with emergency response responsibilities shall be trained. Documentation of training shall be maintained.

Sequoyah Fuels Corporation shall implement, maintain and execute the response measures of the SFEP. Changes shall not be made in the plan or facility procedures that would decrease facility emergency response effectiveness. The distribution of all copies shall be maintained and controlled to ensure that copies of the plan are kept up to date.

11.3 Plan Description

The Sequoyah Facility Emergency Plan will be approved by facility management and be provided to appropriate facility personnel. The following program elements will be considered for inclusion in the plan:

- On-site Emergency Response Organization
- Sequoyah Facility Emergency Plan Training Program
- Drill Program
- Emergency Equipment and Supplies
- Plan Maintenance
- Recognition and Classification of Emergencies
- Types of Event Classifications
- Activation of Assembly and Support Center
- Emergency Procedures
- Hazard Assessment and Projection
- On-site Emergency Monitoring
- Emergency Exposure Control and Respiratory Protection
- Emergency Contamination Control and Decontamination
- Emergency Monitoring of Personnel
- Personnel Accountability
- Rescue
- Traffic and Access Control
- Ventilation Operation During a Radiological or Hazardous Material Release
- Fire Protection
- Severe Weather
- Handling of Injured Personnel
- Emergency Response for Highway Accidents Involving Hazardous or Radioactive Material
- On-site Emergency Response for a Spill Involving Hazardous or Radioactive Material
- Emergency Communication During an Emergency
- Record Keeping and Documentation During an Emergency
- Reporting Requirements

The plan must provide sufficient detail so that the regulatory and facility requirements are conveyed to personnel who will use the plan during an emergency. Information should be presented in a concise and easily understood format that can be quickly referenced and used.

APPENDIX J

Sequoyah Fuels Facility

ALARA Policy

SEQUOYAH FUELS
A GENERAL ATOMICS COMPANY

POLICY/PROCEDURE

TITLE: ALARA

I. POLICY

It is the policy of SFC to protect its employees, the public, and the environment by maintaining radiation exposures and releases of radioactive materials to the environment as low as is reasonably achievable (ALARA).

II. REQUIREMENTS

The Nuclear Regulatory Commission's radiation protection regulations require that licensees "make every reasonable effort to maintain radiation exposures, and releases of radioactive materials in effluents to unrestricted areas, as low as is reasonably achievable" (ALARA). ALARA is an approach to occupational, public, and environmental protection by which exposures to radioactivity and releases of radioactive materials are managed and controlled to levels below regulatory limits. It must be understood that ALARA practices involve the balancing of costs and benefits, not dose minimization. In other words, ALARA is a commitment to go beyond regulatory limits to the lowest practical exposure or contamination level, taking into account social, technical, and economic considerations. SFC is committed to the concept of ALARA.

ALARA is everyone's responsibility. It requires the involvement and cooperation of all departments and all personnel

SFC is committed to and responsible for a successful ALARA program. SFC management will establish ALARA goals and foster a strong ALARA climate, will support efforts to maintain exposures/contamination levels ALARA, and ensure that the facility has the necessary resources to operate a successful ALARA program.

The principal means of maintaining radiation exposures ALARA are through application of design and engineering controls, administrative policies, personal protective equipment and training. In that regard, implementation of SFC's ALARA policy will include the following basic aspects.

* The ALARA concept will be considered in all phases of activities involving potential exposure to or releases of radioactive materials including plant operations, planning of jobs, development of procedures, plant modifications, equipment selection, maintenance activities, effluent releases, etc.

* Administrative procedures will be instrumental in setting program goals and objectives; method for job planning, monitoring, and review; methods for evaluating, monitoring, and reviewing releases of radioactive materials; measurement of success of ALARA efforts; and measure to effect corrective actions as required.

* Instruction will be provided for all personnel to assure their understanding and support of the ALARA program, including job-related training for workers, incorporation of ALARA philosophy in basic radiation protection training and ALARA awareness training for managers, supervisors, and professionals.

* Exposure data and release data will be collected, analyzed, and evaluated to ascertain achievement of ALARA program goals and objectives and to identify trends requiring corrective action.

* Channels of communication will be open to all management levels of SFC for employee's suggestions regarding the ALARA program and for resolution of ALARA issues and concerns.

* An ALARA Committee has been established at SFC to aid in incorporating SFC's ALARA commitment into SFC's operations and practices. The Committee is comprised of managers and executives from SFC and SFC's parent company. The role and function of the ALARA Committee is explained in SFC's license.

Prepared by:
Health & Safety

Approved by: ____________________
President

APPENDIX K

Sequoyah Fuels Facility

Respiratory Protection Program Policy Statement

POLICY/PROCEDURE

TITLE: RESPIRATORY PROTECTION PROGRAM POLICY STATEMENT

I. POLICY

The management of Sequoyah Fuels Corporation and the Health and Safety Staff remain dedicated to maintaining occupational exposure to radioactive materials As Low As Is Reasonably Achievable (ALARA). The company has developed and maintains a comprehensive Respiratory Protection Program to achieve this end.

The primary objective of the respiratory protection program is to limit the inhalation of airborne radioactive materials and other chemical hazards at SFC by its employees, contractors, or visitors. This will be achieved by the application of engineering controls, including process, containment, and ventilation equipment whenever practical. When such controls are not feasible or cannot be applied, the use of respiratory protection equipment (RPE) may be utilized.

II. REQUIREMENTS

Sequoyah Managers and Supervisors will exercise sound judgement by providing and using engineering controls where feasible to avoid unwarranted use of RPE according to the following guidelines:

A. Routine operations are planned activities that are generally repetitive and occur with various frequencies. For such operations respiratory protection should be accomplished by the use of engineering controls. The use of RPE as a substitute for practicable engineering controls in routine operations is inappropriate. RPE may be considered for use, however, in cases where engineering controls are determined to be impractical, or while engineering controls are being instituted or evaluated.

B. Nonroutine operations are activities that are either nonrepetitive or else occur so infrequently that adequate limitation of exposure by engineering controls is impractical. To the extent that engineering controls are not reasonably feasible in nonroutine operations, the use of RPE to avoid excessive exposure to airborne hazardous materials is appropriate.

C. Emergencies are unplanned events characterized by risks sufficient to require immediate action to avoid or mitigate an abrupt or rapidly deteriorating situation. Sufficient RPE is provided to meet the needs for emergency respiratory protection and to minimize the respiratory hazards from any potential emergency.

D. Respirator users will be provided adequate relief from wearing RPE by providing breaks at reasonable intervals. Both the period of time where RPE is worn continuously, and the overall duration of use where RPE is worn several times in succession should each be kept to a minimum. In cases of equipment malfunction, undue physical or psychological distress, procedural or communication failure, significant deterioration of operational conditions, or any other condition that might require relief, RPE users should exit the areas where RPE use is required and remove the equipment.

The respiratory protection program and Sequoyah operating procedures shall be followed by all personnel.

Prepared by:
Health & Safety

Approved by: John H. Ellis
President

APPENDIX L

Sequoyah Fuels Facility

Employee Safety Handbook

SEQUOYAH FACILITY

EMPLOYEE

SAFETY

HANDBOOK

SAFETY FIRST

SEQUOYAH FUELS CORPORATION

Issued to ______________________________

SEQUOYAH FUELS CORPORATION

SEQUOYAH FACILITY

EMPLOYEE SAFETY HANDBOOK

Issued &
Explainedby: ______________________________

Title: ______________________________

Date: ____________________

Dear Fellow Employee:

Safety is an important part of every employee's job. We are all expected to give safety primary consideration. **Safe** workers will develop their skills in order to do their best job the best way possible by carefully following instructions, understanding the hazards involved, and keeping physically and mentally fit. A good attitude towards **safety** is essential.

The information in this guide is published to help you become a **safer** worker. Read it again and again and keep it handy for future reference. Rules mentioned in this guide are mandatory. Employee **safety** is so important that infraction of **safety** rules will result in employee corrective action up to and including discharge.

Safety is a line function. Every employee is responsible for his or her own **safety**, as well as the **safety** of fellow employees who may be affected by the employee's actions. Supervisors and managers are responsible for the **safety** of employees reporting to them.

In addition to the general **safety** rules in this guide, Sequoyah Fuels has specific **safety** precautions covering operations. The specific **safety** precautions may appear in written procedures or may be part of instructions received from supervisors. Read all written instructions and ask questions if any instruction is not clear to you. Communicate clearly with your supervisor regarding **safety** procedures. Never start a job without first knowing the **safe** way to do it.

If you notice an improper or unsafe condition or procedure, promptly notify your supervisor.

Under no circumstances will you be allowed, persuaded or compelled to execute any unsafe act, or use unsafe materials or equipment.

The Company's policy of insuring primary attention to accident prevention, fire protection, and health preservation is positive and continuous. It is a day in day out program which takes precedence over all other aspects of our activities. Remember - even when there is no written rule, accident prevention is the first duty of every employee. Your active help will be most appreciated by your fellow workers and your company.

Sincerely,

President

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A. CORPORATE SAFETY POLICY

The safety and health of company employees will be given prime consideration in all company operations and activities.

In order to protect employees from the suffering and hardship caused by injuries it is the policy of the company to promote safe work practices and maintain a safe working environment through effective accident prevention programs.

It is necessary that:

- All employees accept the responsibility to work safely and to extend this concern for personal safety to other employees.
- All accidents, injuries, unsafe conditions and practices be reported to supervision immediately.
- All employees appreciate the need for safety awareness both on and off the job.

The basic objectives of our safety program are:

1. Provide a safe place of employment, institute controls against property loss, and reduce production interruptions caused by accidents.
2. Promote safe work practices through employee education, job training, and the establishment and enforcement of safety rules.
3. Plan safety as an integral part of each operation and manufacturing process.
4. Comply with applicable federal, state and local safety regulations and codes, and acceptable industry practices.

B. SAFETY RESPONSIBILITIES

In general, all employees are expected to report to work in good condition for work; to perform any assigned work promptly, safely and efficiently; to use company time, tools and equipment carefully.

Supplements to the safety rules may be posted or issued as necessary.

The facts concerning any alleged violation of safety rules will be investigated thoroughly and extenuating circumstances will be given full consideration. You are subject to all company rules while you are in any part of the facility, or in any other place where you are engaged in performing your job assignment.

Corrective actions up to and including discharge may be given for violations of the safety rules. Refer to the Employee Information Guide for details.

C. ACCIDENTS

1. Know the location of safety showers, eye wash fountains, emergency escape respirators, first aid stations, fire fighting equipment and other emergency equipment in your work areas. Learn how to use this equipment and know the Emergency Procedures. If you have a question, ask your supervisor.

2. Know how and when to turn in an emergency alarm, and how to safely evacuate your area in case of an emergency requiring evacuation.

3. If you are injured, notify your supervisor as soon as possible. All on-the-job injuries, however minor, must be reported, and treated at the first aid station or by a company designated physician. If the injury is such that it is not practical to report to your supervisor before getting first aid, get the first aid immediately and then promptly report the injury to your supervisor.

4. Non-injury or near-miss accidents must also be reported because the next time someone may be hurt severely. We need to know where and why accidents happen so the required steps to prevent them from happening again may be taken.

5. Immediately wash off any acid, caustic, or other harmful chemical should it splash on you. Remove any contaminated clothing and use plenty of water flooding the affected area for at least 15 minutes (5 minutes for HF exposures). This action is very important because it can greatly reduce the seriousness of a chemical burn. Seconds count - don't wait! Report the incident and get first aid promptly.

6. Your supervisor and management have a responsibility to investigate each accident to determine the cause and, where appropriate, to recommend corrective action. The corrective action may include revising procedures, modifying equipment or taking employee corrective action which may include discipline up to and including discharge.

An accident investigation requires complete cooperation of everyone involved in order to learn the real cause of the occurrence and to prevent a recurrence. Your safety and that of other employees is ensured by honest and complete cooperation in an accident investigation.

D. SAFETY EQUIPMENT AND CLOTHING

1. **Safety Glasses** must be worn at all times by all persons in the operating areas of the plant, laboratories, and grounds. Contact lenses are strictly forbidden in the operating areas and laboratories.

2. **Special Additional Eye Protection** is required for certain jobs where the hazards to eyes are high. Proper goggles, or full face shields, must be worn as appropriate when grinding, chipping, cutting or welding, and when handling chemicals where a potential for splash or spray of hazardous chemical exists. Any work subject to flying particles, sparks, or hazardous fumes also requires the use of special eye protection. Refer to operating procedures for additional safety requirements.

3. **Safety Shoes** are required for all employees who work in the operating areas of the plant. Regular street shoes, slippers, boots, sandals, open toed shoes, etc., are not to be worn in the operating areas. Safety shoes may also be required for certain jobs outside the operating areas , i.e., grounds keeping, fertilizer program. Shoe covers **are to be worn** as described in applicable procedures.

4. Your plant has special procedures for the issue, inspection, care and use of respiratory protective equipment. Know these procedures and follow them faithfully. Only trained and physically qualified persons are to wear respirators.

   Respirators appropriate to the job and exposure must be worn as the circumstances may dictate. Obey all signs and instructions requiring respirator use.

   Respirators with appropriate canisters or filters must be worn when handling dusty radioactive material, and whenever it is determined that airborne radioactivity requires their use. Respirators should also be worn when handling certain non-radioactive chemicals.

   CHEMICAL RESPIRATORS and GAS MASKS are NOT to be used in areas containing a major concentration of acid gas or other toxic gases or where a deficiency of oxygen exists.

   Self Contained Breathing Apparatus (SCBA) is to be used where high concentrations of toxic gas or oxygen deficiency is present or in any Immediately Dangerous to Life or Health (IDLH) atmosphere.

   Evacuation of unprotected personnel from an area affected by acid or toxic gases is the first priority. Re-entry by only trained personnel using SCBA for emergency repair or rescue. Emergency procedures must be followed for rescue work.

5. **Safety (Hard) Hats** must be worn by all persons in all areas so designated.

6. **Suitable impervious gloves** must be worn when handling hazardous, corrosive or radioactive materials. Various other types of gloves are available, and as appropriate, must be used whenever handling sharp, rough, or hot materials.

7. **Protective clothing** (coveralls or smocks) is furnished and must be worn in all operating areas of the plant and laboratories where radioactive or hazardous materials are present.

8. **Plastic suits** in combination with other safety apparel offer protection from hazardous chemical situations and emergencies. Trained persons can safely perform hazardous tasks using proper equipment and work procedures.

9. Other special personal protective equipment and clothing is provided for specific jobs. Wear these when specified. Be sure you know when, where, and how to use all personal protective equipement.

10. Before using any protective device make sure that it is in good operating condition and that you thoroughly understand its use.

11. **Hearing Protection** devices shall be worn in all posted high noise areas or when operating equipment such as pneumatic powered tools, saws, portable grinders, and cut-off saws. As a rule, if the noise level is such that normal conversation can not be understood, hearing protection should be worn.

E. **PLANT EQUIPMENT**

1. **NEVER** attempt to operate any equipment or machinery unless you are trained in its use and authorized to operate it.

2. **Machine Guards** are installed around moving machine parts to keep you from injury. Leave them there to protect yourself. Never remove guards without authorization. If you must remove a guard to service a machine, have the machine shut down and locked out first. Replace the guard before starting it up again.

3. Conveyors, bucket elevators, belt conveyors, material hoists, and other material handling equipment are not to be used for passenger service. Employees must stay off such equipment except when maintaining or repairing it.

4. **Hand tools** must be kept in good order. The use of defective tools, or improper use of good tools is prohibited. Promptly repair or replace defective tools. "Mushroom" heads on chisels, punches, etc. are prohibited. Keep them ground off.

5. Ladders must be in sound condition and securely placed if they are to be used safely. Inspect ladders before you use them. Do not use ladders with cracked or split side rails, cracked or broken rungs, missing or defective safety feet. Tag broken or defective ladders so they will not be used by anyone else until they are repaired or discarded if unrepairable.

Use only ladders that are labeled to indicate they meet OSHA requirements.

Do not use metal ladders in electrical service or in close proximity to an electrical exposure.

Stepladders are not to be used as straight ladders. Always open a stepladder to its fullest extent and latch the spreaders before using. **Never** stand on the top, or the top step, of a stepladder.

Remember, a ladder is not intended to replace a platform or a scaffold. Any work done from a ladder should be within easy reach. If you can't reach the work without overextending yourself, move the ladder closer to the work. **When climbing a ladder, both hands must be free for climbing.** Don't carry heavy or bulky materials or tools up a ladder. If you must get load aloft, use a handline or other means. Straight ladders must be equipped with safety feet. Whenever possible tie off the top of a straight ladder after it is positioned or have a co-worker steady it.

The foot of a straight ladder should be placed one quarter of the ladder's length away from the wall or other vertical support.

Be sure the object supporting the top of the ladder is strong enough to bear your weight.

6. **Scaffolds** are used for work that cannot be reached from the ground or existing walkways. They must be adequately strong and so located as to provide safe access to the work. All latches, holding pins and other fasteners provided to hold the scaffold structure together must be in good condition and properly used. Sturdy handrails and toeboards must be provided. Do not store any material on a scaffold except that currently in use. Use both hands for climbing a scaffold. Bulky or heavy materials should be taken aloft by use of a handline or other mechanical means.

7. **Abrasive Blasting (Sandblasting)**

   a. Only abrasive blasting respirators shall be worn while conducting abrasive blasting.

   b. A constant pressure (deadman) control valve shall be used and in good condition when abrasive blasting.

   c. Bench grinders - Tool rests on bench grinders shall be kept adjusted to within 1/8 inch of the grinding wheel.

F. PLANT CONDITIONS

1. Hazardous materials are to be handled only by trained workers who follow specific procedures and use adequate personal protection. The hazardous materials we handle in our plant include radioactive materials, various gases, and other chemicals and substances. These materials are described in Section J of this booklet.

2. Materials not normally hazardous can be dangerous under certain conditions. Oil spilled on the floor is an example of a slip hazard. Dust in the air is a condition which can be annoying and harmful, and may produce skin irritation if personal cleanliness precautions are not used.

   Follow these simple rules faithfully:

   A. Wear your personal protective equipment and any clothing you have been furnished where policy, procedure or conditions require their use.

B. Set the most rigid standards for your personal cleanliness:

1. Wash your hands frequently, particularly before eating or smoking.

2. Bathe or wash thoroughly after your work shift to remove any dust or chemicals from your body.

3. **Housekeeping** - It is the duty of each employee to keep his work area orderly and clean so that he can work safely and efficiently. Put things away when you are through with them. Clean up all types of spillage **at once. We do care** about our housekeeping. Good housekeeping and safety go hand in hand.

   Keep passageways clear. Equipment and materials must not be placed in walkways, door ways, stairways, or in front of emergency equipment. Enough passageway is needed for both efficiency and safety. Safe exit from work stations must be maintained.

4. You must put in place the proper warning signs or barricades whenever you find a chemical leak dripping where it may harm someone. Report the leak to your supervisor promptly.

   Warning signs, precautionary tags, barricades, and safety ropes are placed for your safety. Observe them. When equipment controls bear "Do Not Operate" tags, the equipment **must not be operated.** You should place a warning tag on the controls of any equipment you find defective and unsafe to operate. Notify your supervisor of the problem. Never remove any warning notice or device without proper authorization from your supervisor.

5. **Unsafe Working Conditions** - Inspect your work area for unsafe conditions at the start of the shift. Never tolerate unsafe working conditions. Report them to your supervisor at once. Be careful where conditions are unfavorable, using all precautions necessary to avoid injury to yourself, your fellow workers and the equipment.

6. Some work areas are quite warm during the summer season. In hot weather, drink plenty of fluids, normal diet usually provides enough salt to replace that lost with perspiration.

   Ice vests and other cooling devices are provided to help prevent heat stress in high temperature areas.

7. **Stairs are walkways,** not runways. They are provided with handrails. Hold the handrail and watch your step. Keep steps clean and clear.

8. **Lighting** is important to efficiency and safety. Report burned out lights to your supervisor.

9. **Ventilation** in many areas is controlled by forced air circulators. Do not prop open doors marked "Keep Closed". To do so may unbalance or short-circuit the building's ventilation control systems making exhaust hoods and dust collectors ineffective.

10. **Fire Prevention and Control**

    A. Learn the location of fire extinguishers and other fire fighting equipment in your work area. Do not use water on electrical, oil or flammable liquid fires.

    B. Use only approved cleaning solvents. Never use gasoline for cleaning.

    C. Flammable liquids shall be stored in approved and properly labeled safety cans.

    D. Class 1 liquids shall not be dispensed into containers unless the nozzle and container are electrically connected. (Class 1 liquids have a flash point of 100° F or less).

11. **Fire Prevention for Hot Work** operations such as, but not limited to, cutting, welding and open flame heating.

A. Remove all flammable/combustible material within 35 feet. If flammables/combustibles cannot be moved, guards shall be used to confine sparks and slag. If it is impractical to move all combustible material, cover it with flame proof material.

B. Have a fire extinguisher available in the immediate area. Do not remove fire extinguishers from designated stations. Obtain extinguisher from storage.

C. A fire watch is to be posted and remain in the area for at least 30 minutes after the HOT WORK activity has ended if a serious fire could develop. This applies to areas where there is an appreciable amount of combustible material within 35 feet or combustible building material opposite walls, beams, floors and ceilings.

G. VEHICLE AND PEDESTRIAN SAFETY

Certain new employees shall receive basic fork lift training and on-the-job instruction. When the supervisor and the employee agree that the employee is capable of operating the fork lift in a safe manner, the fork lift operation authorization form shall be completed and retained in the employee's training file.

The speed limit on facility roadways outside the restricted area is 15 MPH. Speed limits are 5 MPH inside the restricted area and parking lots.

Drive no faster than weather conditions permit. Reduce speed during time of inclement weather such as rain, snow, fog and when frozen roadways exist.

Powered Industrial Truck Operation

1. Check out your truck before using it every time. Be sure to observe position of rear (steering) wheels prior to mounting the truck.

2. After engine has started and warmed up, check the instrument panel.

3. Come to a complete stop before reversing direction of travel.

4. Make gradual turns to prevent turnover.

5. Every lift truck must have a rating-capacity plate. This limit should never be exceeded.

6. Approach loads straight on with forks close to floor or ground.

7. Center forks under each load.

8. Position loads against the carriage and backrest.

9. Start in low gear or low range if automatic transmission.

10. Avoid fast starts and stops.

11. Avoid running over obstructions.

12. Always look in the direction of travel, never operate blindly.

13. Watch out for overhead obstructions.

14. Special care should be taken when operating on ramps and inclines.

15. Do not park on an incline unless absolutely necessary, and then take precautions against vehicle rolling (e.g., chock wheels, apply safety brake).

16. Never drive into a truck or trailer until sure the load wheels are blocked.

17. Before entering a trailer from which the tractor has been removed, assure that jack is positioned under front of trailer.

18. Before entering a trailer, inspect floor to make sure truck will not break through.

19. Check dock plates to make sure they are secured and strong enough to carry truck and load.

20. Avoid driving along the edge of loading dock. If too close to edge, lower the forks, set brake and turn off motor, get off and figure how to maneuver the truck away from the edge. Keep in mind the rear wheels of the truck swing wide, and a wrong turn could cause wheels to drop over the edge.

21. Extreme care must be taken when the mast and load are raised high. The high lift acts as a lever when tilted forward, and can cause the truck to tip over.

22. Do not stack loads in aisles or roadways.

23. Never use reverse as a brake.

24. Never leave a powered industrial truck with its motor running.

25. Always lower forks to floor or ground when parking trucks.

26. NO PASSENGERS ARE PERMITTED.

27. A safety cage, properly secured to the forks, shall be provided if used to elevate a person. The operator must remain at the controls whenever persons are elevated on the work platform.

28. Gasoline or diesel trucks shall be refueled in specified areas only.

29. A ground wire shall be connected to the truck, when filling with LP gas.

30. Clean up all fuel spills before starting trucks.

31. The horn is a warning device and should be used for that purpose only. Sound horn when rounding blind corners.

32. Always observe the rules of courtesy when operating a truck. The same safe rules used when operating any automobile should prevail when operating a fork truck.

33. Do not dangle arms or legs outside of the cab.

34. When descending an incline or ramp with a load, drive in reverse.

35. When going down an incline, use low gear.

36. Trucks should be driven with extra caution during adverse weather conditions.

37. Do not operate the lift from outside the cab.

38. Make sure loads are stable before moving.

A lift truck is an efficient piece of equipment when used to do the work for which it was designed. It is a safe truck, when handled correctly and when all safety rules and practices are observed by the operator. The pedestrian who is in the operating area must look for the truck, and the operator must be vigilant to prevent accidents. Pedestrians must use walkways where provided. If pedestrians must use roadways, they must walk on the left side, facing traffic.

H. WORK METHODS

1. The supervisor in charge of the job carries the responsibility of seeing to it that safe work procedure instructions are given before a job starts. Be sure that you understand the instructions. Let your supervisor know that you understand. If you are not sure, ask him. He wants you to. If you feel that a procedure is not safe, check with your supervisor before you start the job.

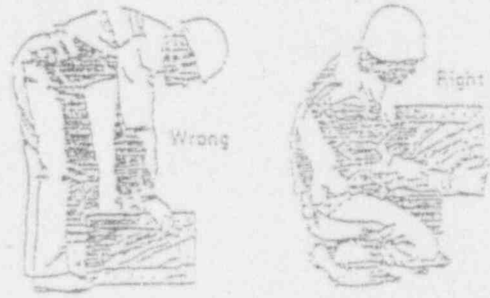
   Before starting the work and while working, consider the job from the safety standpoint so as to eliminate or reduce any hazards that might be present.

2. **Hazardous Work Permits** are safety procedures which have been established to reduce to a minimum the hazards associated with the maintenance of potentially hazardous equipment or equipment containing hazardous or source material. Precautions to be taken include locking switches and valves, removing fuses, blind flanging pipelines, washing and/or purging tanks before entry, wearing special personal protective equipment and other precautions depending on the job.

   In the event you are called upon to work on any job requiring confined space entry, chemical pipeline repair, or any maintenance job involving equipment containing hazardous material, follow the applicable special work permits and procedures.

3. **Lifting** shall be done properly to avoid injury. Don't over estimate your strength. If a load is too heavy or bulky for you to handle get help or use mechanical means for lifting.

When lifting manually, you will avoid injury to the back if you use the leg muscles to carry the brunt of the strain. **Keep your back straight - lift with your legs.** When setting a load down - keep your back straight - lower with your legs.



4. **Carry tools safely** - in a tool box, tool bag or bucket as needed. Do not overload your pockets. Do not carry sharp edged tools in pockets or where they can scratch and cut you or anyone else.

5. **Take tools aloft safely.** Use both hands to climb a ladder and pull tools up in a container with a handline. Keep them secure from falling. When the job is finished, lower the tools using the handline. Should tools or materials need to be aloft on a platform, scaffold or other place where they might fall off, be sure they are securely contained and cannot fall of the edge.

6. **Working aloft requires other special precautions.** Before you go aloft, be sure you have a safe way to get up and down again. When using a lift type mechanical platform be sure to position it properly, lock the wheels, and use the handrails and safety chains provided.

   Never throw anything up to a person who is working aloft. Material shall not be thrown down unless the landing area is securely barricaded and posted, or workers are safely stationed below to keep every one else out of the danger zone.

   Post "Men Working Above" signs to warn others not to walk beneath the job aloft. Remove warning signs and barricades as soon as the need for them has passed.

Working aloft where there is danger of falling requires the use of a life belt and life line. The line must be securely fastened and use the shortest length that will permit the work to be performed.

7. **Scaffolding**

A. Erect scaffolds only on sound, rigid footing.

B. Guard rails and toe boards shall be installed on all open sides and ends of platforms more than 10 feet high. Scaffolds 4 to 10 feet high and less than 45 inches deep or wide shall have standard guardrails installed on all open sides and ends.

C. Cross braces are required on tubular scaffolding.

D. Tie off scaffolding to structures when possible.

8. **Cranes and Hoists** of various types and capacities are used throughout the plant to raise or lower materials and equipment. Only personnel who have been trained and authorized to operate this equipment may do so. These devices are marked to indicate their loading capacity. This limit must not be exceeded at any time. If in doubt as to the weight of any load, check with your supervisor. Make sure the safety latch on the hook and all cables, chains, slings, etc., are in good condition before using any hoist or crane.

Never walk or stand under the loaded hook of a hoist or crane. Warning lights, safety gates or portable barricades are provided to prevent personnel form walking under suspended loads and must be used whenever this possibility exists. Never walk into a barricaded area or move portable barricades - they are there to protect you.

Where barricades cannot be used and a hazard exists, personnel must be posted to warn others to stay out of the area.

Riding on the cable hook or on a suspended load is strictly forbidden and like other safety related misconduct, is subject to disciplinary action.

Use of a crane suspended work platform is not allowed except when **any** alternate means of getting to the work site would be more hazardous or would not be possible because of structural design.

If it is determined that the crane suspended work platform must be used, the applicable safe work practices and procedures shall be followed.

9. **Electric Welding** - The bright light given off by electric arc welding is dangerous to the eyes and skin. Whenever possible, the welder must shield the arc from other workers. Avoid looking at the arc and try to stay at least 20 feet from it. Welders and others who must work close to an electric arc must wear special eye and face protection and other protective equipment appropriate to the job.

   Inspect arc welding equipment thoroughly. Defective cables are dangerous. Be sure defective equipment is properly repaired **before it is used.**

10. **Gas welding and cutting** - Gas cylinders, when not in use, must be stored in a well ventilated area, away from sources of heat, secured firmly so they cannot be tipped over, and the valve caps fully screwed down hand tight. Empty cylinders should have their valves closed, caps in place and marked "M.T." and stored away from full cylinders. Gas cylinders must be secured to prevent them from falling over. If cylinders which are not on a handcart must be moved, the cylinder valves must first be closed, regulators removed, and valve caps put in place.

    Keep cylinders far enough away from the welding or cutting operation so that sparks, slag or flame will not reach them. Be careful not to put cylinders where they might become part of an electrical circuit. Never use a gas cylinder for any purpose other than that for which it was intended; they are not rollers or supports. Defective or leaking cylinders shall be removed to an isolated outdoor area, tagged, and the supplier notified. Keep oxygen cylinders, valves, hose, couplings, and apparatus away from oily or greasy substances. Oil and grease can ignite violently on exposure to oxygen.

Oxygen and fuel gas cylinders in storage must be separated by a distance of at least 20 feet or by a noncombustible barrier at least 5 feet high, with a one-half hour fire rating.

Handle all compressed gas cylinders carefully. A cylinder with its valve knocked off can act much like a high powered rocket.

Special eye and face protection is required for **all** welding, cutting or burning operations.

11. **Switch Boxes**, junction boxes and electrical panels are for electrical gear exclusively. They are not cabinets to store lunch, tools, notes, etc. Keep all box covers and cabinet doors closed except when necessary to open to renew fuses or to make necessary repairs. Replace covers at once!

    ONLY AUTHORIZED PERSONS WITH PROPER TOOLS SHALL CHANGE FUSES OR MAKE ELECTRICAL REPAIRS. When operating a breaker switch stand well to the right of the switch box and operate the handle quickly to avoid arcing within the box. Never operate a switch handle while standing on a wet floor or while holding onto a grounded object.

12. Some portable electric tools meet "shock proof" standards and use a two wire cord. These are known as DOUBLE INSULATED. Most portable electric tools are provided with 3-wire cords and plugs. The third wire is the ground wire on 115 Volt equipment. Be sure and use three wire extension cords when an extension is needed. Inspect this equipment for defective wiring before using it. Where a "pig tail" grounding wire is provided, be sure and use it properly. Do not use any frayed or damaged extension cord. Defective extension cords must be removed from service.

    Cords shall be used only in continuous lengths without splice or tape. Number 12 or larger cords may be spliced for repair.

13. Compressed air or compressed gases must never be used for blowing dust from clothing or the body. Serious eye injuries and skin injuries have resulted from this practice. Compressed air used for cleaning must not exceed 30 psig. **NEVER DIRECT COMPRESSED AIR AT A PERSON.**

Compressed air shall not be used to transfer material from drums. Drums are not pressure vessels.

The connections on air hoses 3/4 inch in diameter or larger must be secured with clips or safety ties.

14. **Valving Operations** must be done carefully.

A. Never operate any valve unless you are authorized to do so.

B. Never operate any valve unless you know what is contained in the line and where the line goes.

C. Valve wrenches are available in the plant for valves that are hard to operate. When using a valve wrench make sure it is engaged properly so that it doesn't slip. Never leave wrenches in aisles or extending into passage ways.

D. If a valve is stuck or difficult to turn after reasonable effort, inform your supervisor so that he may have the valve serviced.

E. Always report promptly any valve that leaks or functions improperly.

15. **Hoses** - The proper hose in good condition is a safe tool. The wrong hose for the job, or a hose in poor condition, represents a safety hazard.

A. Be sure to use the proper hose for the job. You wouldn't want to use a garden hose to carry high pressure steam.

B. When you finish using a hose, return it to the hanger provided.

C. Don't leave hoses strung across walkways where they will cause tripping hazards.

D. Steam or hot water hoses must be attended or firmly secured when they are on.

E. Protect hoses from vehicular traffic or other abuse.

F. Hoses that are defective must be repaired or replaced immediately.

16. **SHORT CUTS MUST BE AVOIDED UNTIL PROPER APPROVALS ARE OBTAINED.** We appreciate your suggestions which may make your jobs safer or easier. Contact your supervisor whenever you feel you have a better method to accomplish your job. Your supervisor can obtain proper approvals for changes in operating procedures.

I. RADIATION AND RADIOACTIVE MATERIALS

Radioactivity is nothing new. It has been present in nature since the beginning of time. Man has always been exposed to radioactivity. Exposure to too much radioactivity can be harmful to man. Our radiation protection program is designed to minimize your exposure to radiation to levels well below any amount considered to be harmful. Exposure limits are set by law.

You will be trained to handle radioactive materials safely. **You or your fellow workers may be harmed if you do not handle radioactive materials safely.** Infractions of radiation safety rules are cause for disciplinary action up to and including discharge.

1. **Specific procedures** are provided covering radiation safety and the various uses of radioactive materials and hazardous chemicals. These procedures include special safety precautions to be taken. **Be certain** you completely understand the entire operating procedure before you begin the job. **Follow the procedures exactly!** Your supervisor will instruct you in using the procedure. If you have any questions or doubts - ask your supervisor.

2. Area Designation for Radiation Control

For information and specific instructions regarding the radiation control areas, refer to the applicable procedure-Access to Restricted Areas and Controlled Access Areas.

J. GENERAL RULES FOR CHEMICALS

1. **Under no circumstances** should you work with any chemical for the first time before checking it out with your supervisor. **READ THE MATERIAL SAFETY DATA SHEET.** Know where the eye wash fountains and safety showers in your area are located.

2. **Hazardous chemicals** are safely handled in our operations because we insist on strict adherence to the safety rules and procedures that have been established for the handling of such materials.

   Our safety rules and procedures have been developed from years of experience and it is only common sense for you to take advantage of this experience to avoid injury to yourself.

3. **Hazardous Work Permits** must be used and followed when:

   A. Disconnecting pipelines containing hazardous chemicals.

   B. Entering tanks, vessels, or other enclosed spaces used for chemical processing or storage. **In addition, a confined space entry permit is required in accordance with the Confined Space/Vessel Entry Procedure.**

   C. Welding or cutting on chemical pipelines or tanks.

   D. Opening equipment and systems containing loose radioactive materials.

   E. Performing other hazardous tasks determined to require special work permits.

   F. Welding or cutting in the process areas. Refer to the Hazardous Work Permit Procedure for details.

4. Hazardous chemicals which may be used or may be present in our operations include:

   A. Acids, such as nitric (HNO_3), hydrofluoric (HF), sulfuric (H_2SO_4), and small quantities of others.

   B. Alkaline substances such as caustic soda or sodium hydroxide (NaOH), ammonium hydroxide (NH_4OH) and lime ($Ca(OH)_2$).

   C. Gases such as hydrogen (H_2), ammonia (NH_3), natural gas, oxygen (O_2), acetylene (C_2H), hydrogen sulfide (H_2S), and others.

   D. Solvents such as hexane, and paint thinner.

   E. Many chemical compounds such as "dry chlorine", uranium fluorides, various nitrates, and many others can be hazardous.

5. Below is a description of the properties of hazardous substances which may be used in our plant in quantity. It is well to understand the nature of the chemicals even though you may not be expected to handle them. Read the Material Safety Data Sheets of the chemicals you work with.

   A. **Acids** may be shipped to us in tank car quantities or in drums or bottles. Acids may react with metal in the presence of moisture to generate hydrogen, a highly flammable and potentially explosive gas. Acids can cause severe chemical burns to the eyes, skin and lungs.

   Avoid striking a spark in the immediate area of acid cars, tanks, drums and equipment. Repair of tanks, pipelines, valves, etc., is done under work permit by persons specially trained for such work.

Wear all necessary personal protective equipment as described earlier. Avoid contact with acid, especially to the eyes. In the event acid comes in contact with the body, **immediately** wash it off with large quantities of water. Preferably use a safety shower, but any source of water will do. Remove contaminated clothing after you are under a running shower, not before. After the acid has been thoroughly washed away, get medical/first aid attention and notify your supervisor.

Hydrofluoric acid (HF) skin burns can be especially deep and severe. Following removal of all HF from the skin by washing with water, obtain prompt first aid treatment.

If the eyes have been exposed, wash immediately with large quantities of water for at least five (5) minutes. Hold eyelids open so water may get to the eyes. What you do in the first few seconds is critical. Use an eye wash fountain if available, otherwise use any source of water. Obtain medical attention after the eyes have been thoroughly washed with water. Notify you supervisor. **DO NOT USE ANYTHING BUT WATER IN THE EYES!** Trained first aid personnel are available to administer proper treatment. Detailed and specific procedures have been established for handling acids and most other chemicals. The procedures are **MANDATORY AND MUST BE OBSERVED IF YOU ARE TO AVOID INJURY.**

Acid vapors can also be dangerous. Volatile acids are to be handled under a hood. The use of a respirator may be required when handling certain acids.

B. **Caustic soda** (sodium hydroxide - "Caustic") causes severe burns to skin and eyes. Avoid any contact by using proper protective equipment and following safe procedures.

Mists and dust of caustic soda can cause damage to the upper respiratory tract and to lung tissue. If any form of the chemical comes in contact with the eyes or body, immediately wash with large quantities of water for at least fifteen (15) minutes, call for help, and then seek medical attention and notify your supervisor.

C. **Ammonia** - Anhydrous ammonia is a gas. Aqueous ammonia is a liquid. Ammonia is a strong irritant to the eyes, skin and respiratory tract. Anhydrous ammonia gas is capable of forming flammable mixtures with air.

Gas tight chemical goggles and an ammonia gas respirator should be worn in addition to the other protective equipment mentioned earlier whenever handling ammonia where spills or leaks may occur. Should a leak occur, evacuate the area immediately as respirator canister breakthrough can occur quickly when exposed to more than small amounts of ammonia. Do not smoke where ammonia is used or stored. Again, water and plenty of it promptly is the first and most important thing to use should ammonia contact your skin or eyes.

D. **Flammable gases** such as hydrogen, natural gas, and others are fire and explosion hazards. These flammable gases are lighter than air, and will rise in a normal atmosphere. They may collect under unvented roofs and ceilings if a leakage of gas develops.

E. **Corrosive gases**, such as chlorine and fluorine, are highly irritating to the eyes, skin and respiratory tract. High concentrations of either gas can cause pulmonary edema, while lower concentrations may cause coughing, smarting of the eyes, a general feeling of discomfort in the chest, nausea and vomiting. Both chlorine and fluorine are oxidizing agents, and can support combustion. Fluorine is the most powerful oxidizing element, and will react explosively with most organic compounds.

Gas tight chemical goggles and an acid gas respirator, or full-face canister mask should be worn in addition to other protective equipment mentioned earlier whenever a leak potential exists. If a leak should occur, it will be detectable at low concentration. Evacuate the area immediately, and do not reenter the area unless full protective gear, including impervious suit and self-contained breathing apparatus (SCBA) is worn.

If chlorine or fluorine is inhaled, call for assistance immediately. The victim should be immediately removed from the contaminated area and given first aid treatment.

Exposure to the skin or eyes should be treated by immediate flushing with copious amounts of water. Remove contaminated clothing and seek first aid treatment.

F. **Flammable solvents** such as hexane, and many paint thinners are fire hazards. Gasoline is another familiar substance similar to these. Flame, sparks, smoking and welding are not permitted where these materials are used or stored. In addition, many solvents give off vapors which are harmful to breathe. Such materials must be used under exhaust hoods or in well-ventilated areas.

Methylene chloride, although not flammable, should also be used with care. Solvents should not be permitted to get onto the skin, in the eyes or swallowed into the body. Poisoning may result. **IMPERVIOUS GLOVES MUST BE WORN WHEN USING SOLVENTS.**

G. **Hydrogen sulfide (H_2S)** is a flammable, poisonous gas which has the odor of rotten eggs. The characteristic odor is not a reliable warning since H_2S has a paralyzing effect on the sense of smell, and the presence of this gas cannot be detected by odor after prolonged exposure. Symptoms of over exposure include headache, dizziness, nausea and fatigue. If an employee is overcome by hydrogen sulfide, remove him to fresh air but do not expose yourself to the gas. Don a self-contained breathing apparatus (SCBA) before attempting rescue <u>after</u> calling for assistance.

When the affected employee is in fresh air, start artificial respiration immediately and administer cardio-pulmonary resuscitation (CPR) if necessary. Have someone call for emergency assistance.

Personnel working in the NOX scrubber area must be aware of the danger of H_2S and be aware of the alarm system which warns of unusual conditions. **LEAVE THE AREA IMMEDIATELY IF THE ALARM SOUNDS.**

H. **OTHER CHEMICALS AND RADIOACTIVE MATERIALS**, though not specifically mentioned in this section, must be handled safely. Refer to appropriate procedures for further guidance. Again, if you don't know the hazards involved and precautions to be taken, consult your supervisor before attempting to handle any chemical substance.

I. Consult Material Safety Data Sheets, read labels and follow all instructions and procedures when handling chemicals. Contact the Hazard Communications Coordinator when assistance is required.

DO IT SAFELY

If you don't know how to do it safely, ask and find out. If you don't understand the first time, ask again.

Don't be ashamed to ask questions. We all ask questions because this is one way to learn.

Ask your supervisor if there is any doubt about the safe way to do a job.

No general set of rules can guarantee safety since safety results from a mental attitude and depends on the individual.

The cooperation, active interest, and participation of each employee is vital to the success of our safety program.

FOLLOW ALL WRITTEN OR ORAL SAFETY ORDERS

The success of our safety program rests with **YOU!**

"Safety is a way of life in which a person has the quality to keep himself and others free from danger or harm."

SEQUOYAH FUELS CORPORATION

SEQUOYAH FACILITY

These pages of General Safety Rules and Safe Procedures are issued to you to help you prevent accidents on the job. Your signature below indicates that you have received, read, and understand the contents of the booklet.

After you have read the booklet, sign this sheet, detach and personally return it to your instructor. It will then be placed in your training file.

______________________________ (Signature)

__________________ (Date)

When lifting manually, you will avoid injury to the back if you use the leg muscles to carry the brunt of the strain. **Keep your back straight - lift with your legs.** When setting a load down - keep your back straight - lower with your legs.

4. **Carry tools safely** - in a bag or bucket as need -y overload your pockets. Do ere sharp edged tools in pocke yone your can scratch and cut you else.

5. **Take tools aloft safely.** Use both hands to climb a ladder and pull tools up in a container with a handline. Keep them secure from falling. When the job is finished, lower the tools using the handline. Should tools or materials need to be aloft on a platform, scaffold or other place where they might fall off, be sure they are securely contained and cannot fall off the edge.

6. Working **aloft** requires other special precautions. Before you go aloft, be sure you have a safe way to get up and down again. When using a l type mechanical platform be sure to ition it properly, lock the wheels, and use the handrails and safety chains provided.

   Never throw anything up to a person who is working aloft. Material shall not be thrown down unless the landing area is securely barricaded and posted, or workers are safely stationed below to keep everyone out of the danger zone.

   Post "Men Working Above" signs to warn others not to walk beneath the job aloft. Remove warning signs and barricades as soon as the need for them has passed.

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APPENDIX M

Sequoyah Fuels Facility

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