Decommissioning Plan

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Decommissioning Plan

1.0 GENERAL INFORMATION

Sequoyah Fuels Corporation (SFC) conducted uranium conversion operations under NRC source materials license SUB-1010, Docket 40-8027. SFC ceased production in 1993 and submitted a Preliminary Plan for Completion of Decommissioning (PPCD). The PPCD indicated that decommissioning the facility would include construction of an on-site disposal cell to isolate some materials.

In July 1997, the U.S. Nuclear Regulatory Commission (NRC) adopted new regulations that establish radiological criteria for license termination. Under these criteria, a site will be considered acceptable for license termination if the residual activity is reduced to as low as reasonably achievable (ALARA) and the total effective dose equivalent (TEDE) to an average member of the critical group does not exceed 25 mrem/yr. If restrictions on site use are required to assure that the TEDE to an average member of the critical group does not exceed 25 mrem/yr, the licensee must make provisions for legally enforceable institutional controls that provide reasonable assurance that such restrictions will be effective. In addition, the licensee must demonstrate that if institutional controls fail the TEDE to an average member of the critical group would not exceed 100 mrem.

This Decommissioning Plan (DP), Revision 2, describes the decommissioning of to the Sequoyah Fuels Corporation (SFC) Facility located at US Interstate-40 and Oklahoma State Highway 10 (PO Box 610, Gore, OK 74435).

2.0 DESCRIPTION OF PLANNED DECOMMISSIONING ACTIVITIES

2.1 Decommissioning Objective, Activities, Tasks, and Schedules

2.1.1 Decommissioning Objective

The objective of this DP is to decontaminate and decommission the Sequoyah Facility in accordance with the provisions of 10 CFR Part 20, Subpart E, NRC's License Termination Rule, releasing portions of the facility for unrestricted use and releasing the remainder with legally enforceable institutional controls that provide reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 25 mrem (0.25 mSv) per year. In the unlikely event that institutional controls fail to restrict access to the site, the postulated dose would not exceed 100 mrem/yr. SFC's proposed approach would result in the dismantlement of facility equipment and structures, remediation of sludges, impoundments, buried wastes and some impacted soils, and placement of resulting waste materials in an onsite, engineered disposal cell.

The approach consists of the following elements:

- Construction of an above-grade, engineered disposal cell on the SFC site for permanent disposition of the SFC decommissioning wastes.
- Removal and treatment of raffinate sludge, calcium fluoride sludge, Pond 2 residue, and sediments from the Sanitary Lagoon, North Ditch and Emergency Basin followed by placement into the disposal cell. Excavation and treatment of buried low-level wastes, Pond 1 spoils and material from the Interim Soils Storage Cell.
- Dismantlement of process equipment, followed by recovery of gross quantities of contained uranium.
- Dismantlement/demolition of structures excepting the new SFC administrative office building and the storm water impoundment.
- Size reduction/compaction of process equipment, piping and structural materials (including scrap metal, empty drums, and packaged wastes that will accumulate prior to decommissioning) to satisfy disposal requirements for maximum void volume.
- Demolition of concrete floors, foundations and storage pads and asphalt or concrete paved roadways in the restricted areas.

Removal of contaminated soils and/or clay liners from under impoundments.

- Excavation and treatment of underground utilities, contaminated sand backfill from utility trenches and building foundation areas and more highly contaminated soils under the cell footprint.

- Excavation of contaminated soils lying outside the footprint of the disposal cell that exceed site-specific radiological criteria.

- Recovery and treatment of radiologically impacted terrace and perched groundwater.

- Placement of all SFC decommissioning wastes into the onsite disposal cell, followed by capping and closure of the cell.

- Backfilling of excavations to a finished grade, addition of clean soil cover and re-vegetation.

- Establishment of a fenced institutional control boundary around the cell, installation of additional monitoring wells as necessary, and initiation of a long-term site monitoring plan.

- Monitored natural attenuation of contaminants in the shallow bedrock groundwater system.

- Establishment of an agreement with an appropriate institution for long-term security, monitoring and maintenance of the disposal site, including the establishment of a trust fund for financing these activities.

- Termination of SFC's NRC license under the restricted release provisions of 10 CFR 20.1403.

2.1.2 Description of Activities and Tasks

Disposal Cell Design

The principle feature of SFC's proposed decommissioning approach is the on-site, engineered disposal cell. A location in the existing Process Area was selected for the disposal cell (see Figure 2-1).

The proposed cell is an above-grade unit built directly on prepared native soil without a synthetic base liner. Areas under the footprint of the cell that must be excavated for remediation purposes will be back-filled to the required base grade. The cell will be constructed by placement and compaction of the decommissioning wastes in pyramidal configuration with 5(H):1(V) side slopes and 4 percent top slope. The completed cell will be capped with a clay layer of adequate thickness to control radon emissions and limit water intrusion, and covered with a drain layer and riprap to control erosion and limit bio-intrusion and human access (see Figure 2-2).

The cell size will be adjusted proportionally to accommodate the actual decommissioning waste volume that is generated by adjusting the height and footprint. For the approach proposed here, the volume of the cell is estimated to be 5,122,340 cf (see Table 2-1) which would reduce the top elevation to about 590 ft. and the footprint to about 10 acres.

Table 2-1: SUMMARY OF MATERIAL VOLUME TO BE PLACED IN DISPOSAL CELL

Material	Volume[1] (cf)
Soils Outside Cell Footprint	434,000
Soils Under Cell Footprint	345,000
Buildings, Equipment, Structures and Concrete	1,080,455
Calcium Fluoride Sludge	625,280
CaF_2 Basin Clay Liners	9,530
Raffinate Sludge	1,000,000
Scrap Metal	100,000
Pond 2 Residual	749,000
Solid Waste Burials	51,100
Pond 1 Spoils Pile	437,400
Interim Soils Storage Cell	140,950
Ponds 3E and 4 Clay Liner	22,000
Clarifier Clay Liners	33,000
Drummed Contaminated Trash	6,250
Empty Drums (crushed)	2,000
Sanitary Lagoon Sludge	10,365
Sanitary Lagoon Soil	5,640
Chipped Pallets (3,000)	10,000
Emergency Basin Sediment	14,600
Emergency Basin Soil	16,250
North Ditch Sediment	20,770
North Ditch Soil	8,750
Totals	5,122,340

[1] Volumes estimated for Proposed Decommissioning Approach

Handling and Treatment of Sludges

Sludges (Raffinate and Calcium Fluoride (CaF_2)), sediments (Emergency Basin, North Ditch, and Sanitary Lagoon), and Pond 2 residue require treatment to improve their structural properties prior to being placed in the disposal cell. Approximately 1,000,000 cf (wet basis - 20% solids) of raffinate sludge containing an estimated 37.1 Ci U_{Nat}, 60.4 Ci thorium-230 and 0.7 Ci radium-226 is contained in Clarifier Basin A. A total of 625,280 cf of calcium fluoride sludge containing an estimated 4.6 Ci U_{Nat}, 0.039 Ci of thorium-230 and 0.006 Ci of radium-226 is located in several basins and burial pits at the facility. This sludge is estimated to contain about 45% solids. There is about 749,000 cf of Pond 2 residue containing an estimated 10.8 Ci U_{Nat}, 48 Ci of thorium-230, and 1.6 Ci radium-226. Sediments in the Emergency Basin, the North Ditch, the Sanitary Lagoon, and possibly, a small portion of the clay liner material from the Clarifier Basins and Pond 4 total 45,735 cf with about 2.6 Ci U_{Nat}, 5.3 Ci of thorium-230, and 0.16 Ci radium-226. In addition, greater than 95% of the thorium and radium on the site is in these materials. Solidification will limit the mobility of these materials and will inhibit radon emissions.

This material will be solidified with flyash and other additives to increase the compressive strength of the various materials to at least 50 PSI. Solidification of these materials will also aid in retarding radon emissions and potential leaching of the other contaminants by rainwater percolating through the cell.

Two forms of treated material may be produced; one a slurriable grout for use as void filler and backfill for structural components, the other a soil-like material that is compacted into the cell. In either case, fly ash and, if necessary, portland cement will be added to yield a mixture that will have adequate compressive strength for cell stability. Data on the candidate fly ash is provided in Appendix A.

The raffinate and calcium fluoride sludges will be transferred by slurry pump to feed tanks for blending and adjustment of the water content. This resulting mixture will be fed into a mixer where the fly ash and other additives are metered in. The slurriable mixture will then be pumped to the disposal cell area for placement as backfill around the components from equipment and building dismantlement.

The sediments and clay liner materials will be excavated with backhoes, front-end loaders and scrapers, de-watered if necessary, placed in feed hoppers and conveyed to the mixer for blending with flyash and additives. The finished product will then be transported to the disposal cell with conveyors and/or dump trucks and compacted into place.

Structure and Equipment Dismantlement, Size Reduction and Decontamination

A detailed volume estimate of the facility equipment and structural materials (after dismantlement and size reduction) was made and a disposal volume of 1,080,455 cf with 17.1 Ci U_{Nat} was determined. This estimate was based on a review of drawings and other data for the facility structures, equipment, utilities, and concrete in order to determine the location of contamination, to understand the construction of the facility, and to facilitate planning of dismantlement methods.

All equipment and structures will be dismantled and size reduced, as necessary. All contaminated materials will be placed in the cell following recovery of economically recyclable uranium. The dismantled equipment and structural components will be entombed with the slurriable grout produced by the treatment of the sludges and other materials. Concrete and asphalt will be broken into manageable pieces and placed in the cell. Only limited decontamination of materials for unconditional release is planned.

Soil Remediation

Soils outside the footprint of the disposal cell which contain uranium, radium and/or thorium in excess of the proposed site-specific cleanup criteria will be excavated and placed in the disposal cell. This volume is estimated to be about 434,000 cf. At a minimum, soils under the footprint of the disposal cell that exceed 440 pCi/g uranium (the concentration that would result in a 100 mrem dose in RESRAD calculations) will also be excavated, treated as necessary and placed in the cell. The volume of these soils is estimated to be on the order of 345,000 cf. A temporary staging area would be established for containing the "footprint" soils until the disposal cell is readied for use. The depth of excavation will be based initially on soils sampling data from characterization studies. Follow-up sampling will then be done to determine if additional excavation is required and to demonstrate that the cleanup criteria have been satisfied.

Additional soil will be excavated, most likely to the soil/bedrock interface, in those areas where terrace groundwater uranium concentrations are elevated in excess of 150 pCi/l (the SFC license action level, 225 µg/l). This would be done to facilitate the removal and treatment of the impacted terrace groundwater. It is likely that some of the soils in the areas of terrace groundwater impact contain uranium in the forms of uranyl nitrate and related compounds, which are much more soluble than the oxide forms. Treatability tests on soils from these areas suggests that solidification of these soils is necessary to adequately limit leaching.

Soils collected from prior cleanup activities that are presently located in the Interim Storage Cell and in the Pond 1 spoils pile will also be removed and placed in the disposal cell. These materials have a volume of about 578,350 cf. An additional 952,000 cf of potentially contaminated clay and soil lies beneath the facility ponds, basins and clarifiers. The fraction exceeding the applicable cleanup criteria is expected to be less than 10% of the above volume or 95,200 cf.

Soils from excavation areas will be transported to stockpiles or to the disposal cell by haul trucks for longer distances or loaders for shorter distances. Existing roads will be used as much as possible; new haul roads will be constructed only if necessary.

Soils that do not require treatment will be placed into the cell in 10-12 inch lifts and mechanically compacted according to design requirements. Placement of this material will be sequenced with other materials to assure stability of the cell, to minimize voids and settlement, to limit leaching and to further restrict the emanation of radon from the cell. Exact placement sequences and criteria will be developed during the disposal cell detailed design phase.

Other Materials

Scrap metal, drummed wastes, empty drums, used wooden pallets and other impacted materials that don't fall in the above categories will also be placed in the cell. Solid wastes which were buried on-site in the late 1970's and early 1980's will also be exhumed and placed in the cell. These materials are estimated to have a combined volume of about 170,000 cf.

Groundwater Remediation

SFC's proposed groundwater remediation approach is to remove and treat the more significantly uranium impacted Terrace Groundwater to minimize further impact to the Shallow Bedrock Groundwater and to rely on monitored natural attenuation for the remediation of the remaining uranium and/or chemical impacts in the Terrace, Shallow Bedrock and Alluvial Groundwater Systems. Monitored natural attenuation will assure adequate protection of human health and the environment over the planning period specified in the regulations, based on SFC's position that the drinking water pathway can be eliminated from dose and risk determinations.

Remediation of Terrace Groundwater

The primary uranium impacts in the Terrace Groundwater System are located under the west end and off of the northwest and southwest corners of the Main Process Building, under and north of the Solvent Extraction Building, and on the west side of the Emergency Basin. As previously stated, soils and backfill materials from these areas will be excavated to the bedrock interface to facilitate removal of the impacted groundwater. The groundwater will then be removed, treated to remove the uranium (and other contaminants as may be required by other regulatory agencies), and released to the Kerr Reservoir or land applied for nitrogen utilization. Treatment of the recovered Terrace Groundwater is anticipated to include precipitation, filtration and ion-exchange polishing. The goal of this activity will be to reduce uranium concentrations in the Terrace Groundwater System to 225 µg/l or less, thereby limiting further impacts to the underlying Shallow Bedrock Groundwater System.

Remediation of Bedrock Groundwater

SFC evaluated "monitored natural attenuation" (also referred to as "passive attenuation") as a bedrock groundwater remediation strategy for uranium impacts. Based on the limited amount of groundwater available under the facility and the results of the groundwater fate and transport modeling for the Shallow Bedrock Groundwater System, natural attenuation of the uranium appears to provide sufficient protection to human health and the environment.

Remediation of Alluvial Groundwater

The nitrate present in the Alluvial Groundwater System originated from leaks from the Fertilizer Storage Ponds south of the Industrial Area. The groundwater modeling performed to date indicates that the nitrate will flush from the groundwater and into the R.S. Kerr Reservoir. Concentrations are predicted to drop below the current drinking water standard of 10 mg/l in about 200 years. In the interim, restrictions on the installation of drinking water wells in this groundwater system will be imposed.

Alluvial groundwater entering the river will not result in measurable differences in the nitrate levels. The maximum in-stream concentration of nitrate as (N) resulting from this plume is estimated to be 0.003 mg/l, well below the normal background level in this body of water.

Conceptual Post-Remediation Groundwater Monitoring Plan

The conceptual post decommissioning groundwater monitoring program will be designed to confirm the predictions of uranium movement from the groundwater modeling. This monitoring program will consist of sampling wells in the Shallow Bedrock and Deep Bedrock Groundwater Systems. The Terrace Groundwater System will not be monitored since the remaining uranium impacted portions of this system will lie directly beneath the disposal cell. The monitoring program will use existing wells if they remain serviceable following decommissioning activities. All wells directly under the proposed foot print of the isolation cell (approximately 32 terrace system wells, 30 shallow bedrock system wells and 1 deep bedrock system well) will be plugged and abandoned in accordance with State and Federal guidance. The remaining wells will be left in place for future monitoring if necessary.

The conceptual post-remediation groundwater monitoring program will include the following wells:

- Five upgradient wells (two zones) - MW007A, MW007B, MW072A, MW072B, MW073A;
- Nine Industrial Control Boundary wells (one zone) - MW067A, MW049A, MW037A, MW040A, MW102A, MW065A, MW042A, MW066A, MW071A;
- Eleven perimeter boundary wells (two zones) - MW062A, MW062B, MW092A, MW095A, MW097A, MW098B, MW094A, MW099A, MW106, MW107, MW108;

Groundwater elevations will be collected each calendar quarter for two years following completion of decommissioning from all monitoring wells not affected by decommissioning activities. This will allow seasonal data to be gathered and provide time for the groundwater to stabilize after decommissioning activities have been completed. During the first five year period, sampling and analysis will be performed on a semi-annual basis. After five years, the frequency of monitoring activities will be determined from the previous monitoring results. During decommissioning, groundwater monitoring will be conducted on an annual basis. Existing wells not affected by decommissioning activities and not selected for long term monitoring will be left in place for future sampling if plume conditions change. (see Figure 2-3)

The parameters that will be monitored include uranium, arsenic and nitrate.

Site Restoration

Excavated areas, including the existing basins and impoundments, will be backfilled with on-site rock and soil, including the material in the impoundment dikes that meets the leave-in-place criteria. These areas will be graded with a slight slope to provide adequate drainage of storm water. A 6-inch layer of top soil will then be applied and seeded with grass to limit erosion.

Wastewater Management

A wastewater management system will be employed during decommissioning for the collection, storage and treatment of wastewater. Wastewater includes stormwater, process water and recovered groundwater from the decommissioning and decontamination process, which may include wastewater from soil washing, equipment washing, sludge de-watering, temporary storage area runoff, and dust suppression.

To the extent possible, the wastewater management system will employ existing facilities and basins for the storage and treatment of wastewater, and for the storage of treated wastewater. The proposed system would involve batch treatment of accumulated water in the 3A Clarifier to precipitate out uranium, thorium and radium. A combination of settling and filtration would then be used to remove the precipitated metals. Activated alumina and ion exchange resin may be used to remove arsenic and residual radionuclides if necessary. Since this waste water will most likely be impacted by nitrates, the treated water would then be land applied on the Ag-Land fields as fertilizer.

The 3A Clarifier and the wastewater treatment system would be among the last things remediated. The three Raffinate Holding Tanks would also be held back to be used for collection and storage of storm water from the 3A Clarifier as it is decommissioned. Once the remediation of the 3A Clarifier is completed, these tanks and the wastewater treatment system would also be dismantled and placed in the disposal cell. Alternate plans would be implemented for this system in the event that long-term groundwater recovery and treatment is required.

Long-Term Site Control

An Institutional Control Boundary (ICB) will be established as a permanent restricted-use zone around the disposal cell. It will be fenced to deter access by unauthorized persons and large animals. Security guards or surveillance inspections beyond those that would occur as a result of performing the planned maintenance and groundwater sampling are not considered necessary.

Approximately six times per year, the grass will be cut and any other required maintenance performed. A groundwater monitoring program will also be conducted as part of this activity.

Once the decommissioning is completed and SFC's NRC license is terminated, SFC will turn the disposal cell and the permanently restricted property over to a government entity for ownership/ custody of the land to ensure that required land use restrictions will be enforced. In the absence of government ownership/ custody, SFC will enlist a third party to be legally responsible for enforcing controls restricting the use of the site. A trust fund will be established to cover the anticipated cost of controlling the site as described below.

Cost of Proposed Approach

The costs associated with SFC's proposed decommissioning approach, as presented in Table 2-2, only reflect the "direct costs" for performing the various decommissioning activities. Costs that are included as "direct costs" include those associated with engineering, design and construction; excavation and handling of material; backfilling excavated areas; deconstruction of buildings, structures, and equipment; sludge and sediment treatment; cell filling; cell closure; wastewater handling and treatment; monitoring during remediation; and post-remediation monitoring, maintenance and security. General and Administrative costs such as SFC staff salaries and overhead, license and permit fees, taxes, routine environmental monitoring costs, etc., are not included. The basis for these cost estimates was provided in the Decommissioning Alternatives Study Report (DASR).

2.1.3 Cleanup Levels

Introduction

Currently, radiological criteria for termination of a license are provided in terms of dose to an average member of a group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances. In this case, the criteria will be satisfied with respect to radionuclides that are present in soils at the Facility. Specifically, derived concentration guideline levels (DCGL) have been developed as concentrations of residual radioactivity in soils that are equivalent to the radiological criteria.

Identification of Constituents of Concern (CoC)

The CoCs are the radionuclides that have the potential to contribute the dose against which the criteria is compared. The CoCs are specifically evaluated for the selection of acceptable site-specific DCGLs. The CoCs were chosen based on historical information and findings of site investigations, including this report. The CoCs were determined to be natural uranium and associated transformation products, thorium-230, and radium-226.

Table 2-2: ESTIMATED DIRECT COSTS FOR PROPOSED DECOMMISSIONING APPROACH

Activity	Direct Cost ($,000)
1. Contractor mobilization/ demobilization	650
2. Sludge, Sediment Solidification	4,357
3. Disposal Cell Construction/Closure	3,850
4. Soil Remediation	923
5. Building and Equip. Deconstruction	4,700
6. Ground Water Remediation	150
7. Site Restoration	2,226
8. Waste Water Management	500
9. EIS Support	1,600
10. Additional Site Characterization	500
11. Long-Term Site Control	1,062
12. Post-Closure Monitoring Program	20
13. Engineering/construction management	2,506
Total	23,044

Exposure Methodology

The acceptability of the dose from residual radioactivity was assessed by constructing a source term and exposure scenario, and using a computer model to simulate the release and transport of radionuclides and radiation in the environment. The assessment was performed, to the extent possible, on a site-specific basis. The assessment reflected the site-specific characteristics of the residual radioactivity (e.g. type, extent, concentration) and of the environment (e.g. soil, surface water, groundwater, and air) at the site. Exposure pathways relevant to the exposure scenario were chosen based on this information. The source term and exposure scenario are described in the following sections.

Source Term

The source term was assumed to be an uncovered contaminated soil zone of cylindrical shape. The radionuclide contaminants are assumed to be homogeneously distributed within the contaminated zone; this zone is modeled as a one meter layer of Terrace soil. The contaminated soil is known to be underlain by two uncontaminated unsaturated zones; these zones are modeled as a three meter layer of Terrace soil and a one meter layer of Unit 1 shale. The next layer is an uncontaminated saturated zone; this zone is modeled as a six meter layer of Unit 1 shale. The final layer is Unit 1 sandstone; this layer functions as an aquitard and is not included in the model. The relationship between Facility conditions and the source term parameters is also described in Appendix G. The physical characteristics (density, porosity, ...) of each layer are also described in Appendix G.

The starting point of radionuclide releases is the contaminated soil zone. Radionuclides are assumed to be released from the soil by erosion activities, plant uptake, direct ingestion, infiltration, and leaching. The scenario also includes exposure to direct gamma radiation emitted by the CoCs. The CoCs may also be transported to and/or by groundwater to eventually be released from soil.

Exposure Scenario

The exposure scenario modeled here is comprised of direct exposure to external radiation and inhalation and ingestion of radioactive material to an individual who lives on the site and ingests food grown on the site. The exposure scenario was modeled with respect to the previously described source term.

The scenario modeled here may be described as representing a residential farmer. The scenario is intended to represent the maximum reasonably exposed individual. The scenario is based on prudently conservative assumptions that tend to overestimate potential doses. The scenario assumes that an individual had access to the area within the ICB but would not disturb the disposal cell.

Application of the Scenario

The resident spends 66% of the time indoors on site, 12% outdoors on site, and 22% of the time away from the site. Gardening is assumed to occur in the contaminated area. A maximum of 50% of the resident's vegetable, grain, and fruit diet is assumed to be produced from the garden. The scenario also assumes that 100% of the resident's milk and

50% of the resident's meat diet are produced on site. Dust levels represent tilling, planting, harvesting, and other activities that may increase suspension of soil particles in air.

Vegetables, fruits, and grains are irrigated from overhead with water drawn from a pond at the site boundary, immediately downgradient of the contaminated area. The same water is also assumed to be used for watering livestock on site. A maximum of 50% of the resident's aquatic food diet is assumed to be taken from the pond.

The walls, foundation, and floor of the resident's house reduce external exposure by 55%. Indoor dust levels in air are assumed to be 50% of the outdoor dust level.

These and other parameters describing the exposure scenario are provided in Appendix G. Where available, site-specific values are used for parameters. Otherwise the parameter value was a model default and/or based on professional judgement.

The model used to assess the dose to the residential farmer was the RESRAD computer code version 5.82.

Drinking water was not considered as a pathway applicable to the exposure scenario. There are no existing drinking water wells near or down-gradient from the facility that could be impacted by migrating groundwater. The few active drinking water wells near the plant are either up-gradient from the facility or so far removed that future impact due to migration of contaminants is not possible.

Limited yield of groundwater wells is typical throughout this part of Oklahoma and has resulted in the construction of extensive potable water distribution systems that rely on surface water as their sources. The groundwater yields from the Terrace and Shallow Bedrock Groundwater Systems are consistent with other wells in the area of the facility. Yields from monitoring wells in these zones are generally very low, many yielding less than the EPA minimum quantity of 150 gallons per day. In addition, the highest yields occur in the terrace groundwater system which generally exists from the ground surface to a maximum depth of about 15 feet. It is unlikely that a well would be constructed in this zone due to potential contamination from septic systems or other near surface features.

Localized areas at the Facility which do produce higher yields of water have been affected by recharge from existing surface impoundments or man-made sub-surface reservoirs such as utility trenches and foundation backfill areas. Once these features are removed during decommissioning, the yields from the higher output wells are expected to decline significantly.

The Alluvial Groundwater System has been found to have a high water yield. This groundwater system is primarily supplied by in-flow from the R.S. Kerr Reservoir. This water is therefore of relatively low quality (elevated dissolved solids and salinity), is not currently used for drinking water, nor could it be in the future without expensive treatment.

Because of limited quantity or low quality and an abundance of inexpensive surface water, it is unlikely that a viable drinking water well would be established in the Shallow Bedrock Groundwater System. Therefore, the groundwater at the Facility is not considered a potential exposure pathway.

Selection of DCGLs

DCGLs have been derived for two areas at the Facility. Unrestricted release DCGLs have been established for areas outside the ICB. The unrestricted release DCGLs are based on a limiting dose of 25 mrem/yr to an individual member of the public (in this case a residential farmer), with a cleanup goal also specified. Restricted release DCGLs have been established for areas inside the ICB. The restricted release DCGLs are based on a limiting dose of 100 mrem/yr to the residential farmer, assuming that institutional controls fail, with an cleanup goal of 25 mrem/yr. Using RESRAD computer code, uranium, thorium-230 and radium-226 concentrations in soil were derived to satisfy the release (dose) criteria. The concentrations determined by RESRAD at 25 and 100 mrem/yr to the residential farmer were determined and are summarized in Table 2-3.

Table 2-3: FACILITY RELEASE CRITERIA
Derived Concentration Guideline Levels (DCGL)

Location	Condition	Uranium-Nat pCi/g	Thorium-230 pCi/g	Radium-226 pCi/g
Outside ICB	Unrestricted Release	110	12	1.8
	Cleanup Goal	35	5	1.0
Inside ICB	Restricted Release	440	48	7.2
	Cleanup Goal	110	12	1.8

The DCGLs for uranium presented in Table 2-3 were originally derived using the methodology described in "Decommissioning Cleanup Criteria. Sequoyah Fuels Corporation, Gore, Oklahoma," dated December 4, 1996. Roberts/Schornick & Associates, Inc. (RSA) and ENSR prepared this report for SFC. The report was previously submitted to NRC as Attachment J to the DASR. RESRAD version 5.621 and associated default values were used except for the contaminated zone surface area and thickness; a surface area of 25,000 m^2 and a thickness of 1.0 m were used.

Since that time, SFC has developed DCGLs for uranium, thorium-230, and radium-226 using a more recent version of RESRAD as well as some site-specific parameters. This resulted in a substantial increase in the soil concentration levels for uranium. However, as an element of conservatism and in the interest of continuity, the originally proposed soil concentration will not be changed for uranium but will be applied as the DCGL.

Regarding thorium-230 and radium-226, the limits originally proposed were not based on dose. In order to conform to regulatory requirement, the limits proposed here are based on dose.

In areas where radium and thorium are not currently present, the uranium DCGLs will be used. In areas where radium and thorium are currently present, uranium, thorium and radium will be considered in combination to ensure that the dose criteria is met; i.e. the sum of ratios of concentration to respective DCGL will not exceed one. Figure 4-1 depicts the areas identified where radium and thorium are present.

Cleanup goals have been selected for both unrestricted and restricted areas. Unrestricted area cleanup goals have been selected based on regulatory guidance and professional judgement. Restricted area cleanup goals have been set at concentrations which would result in a dose of 25 mrem/yr to an individual, assuming the residential farmer scenario.

2.1.4 Procedures

SFC will conduct decommissioning activities and tasks in accordance with written procedures approved by SFC. The written procedures have been or will be prepared, reviewed, revised, approved and implemented in accordance with the program for procedure use and control for decommissioning related activities specified in source materials license SUB-1010 section 2.7, Conduct of Operations.

2.1.5 Schedules

A proposed schedule for completion of decommissioning was submitted as part of the Preliminary Plan for Completion of Decommissioning (PPCD) dated February 16, 1993 and updated by letter dated February 7, 1995. The proposed schedule identifies the principal decommissioning tasks and the estimated time required for each task. This schedule was accepted by the NRC by letter dated July 21, 1995. Figure 2-4 is a modification to the July 21, 1995 schedule which incorporates the major elements of this proposed plan.

2.2 Decommissioning Organization and Responsibilities

SFC will continue to use the organization specified in source materials license SUB-1010, section 2.2, Organizational Responsibilities and Authorities, including the qualification statements provided in section 2.5, Personnel Education and Experience Requirements. This organization may be expanded to accommodate additional manpower required to complete the decommissioning project. The organization will be reviewed for adequacy during the project and necessary changes will be made.

2.3 Training

SFC will continue to use the training program described in source materials license SUB-1010, section 2.6, Training. SFC will also maintain the current system of training records described in license section 2.10, Records.

2.4 Contractor Assistance

SFC has not determined the extent to which contractor assistance will be required. Any contractors employed in the completion of this project will be qualified to perform the assigned work, will be under the supervision of SFC staff and will be held to the same administrative controls and safety standards that would be applied if the work were to be conducted by SFC employees. The scope of work, contractor qualifications to perform work with radioactive materials, and administrative controls to be used to ensure adequate health and safety protection will be described in updates to this DP.

2.5 Safety Assessment for Decommissioning Activities

Occupational Safety

Occupational radiation doses presented here are based on experience gained at the SFC facility, and experience at a comparable facility that is now in the latter stages of completing a similar decommissioning activity. A summary of the occupational dose for SFC for the period 1995 through 1998 is provided in Table 1. Although the staffing level will increase during the final stages of decommissioning, activities completed during this period such as the removal of UF_6 cold traps, removal of process piping in support of asbestos abatement, removal of raffinate sludge from Pond 4 and decontamination of the pond liner, deconstruction of the Main Plant stack, and consolidation of contaminated soils are representative of the kinds of activities that will occur. This decommissioning plan does not call for any new or different activities that would significantly change the exposure history presented here. Thus, this assessment represents a reasonable forecast of exposure potential for occupationally exposed workers.

Table 2-4: SUMMARY OF OCCUPATION DOSE FOR SEQUOYAH FUELS CORPORATION

	Number of individuals in each range					
Year	Less than measurable	0 to 100 mrem[1]	100 to 250 mrem[1]	greater than 250 mrem[1]	Collective Dose (mrem)[1]	Average Dose[2] (mrem)[1]
1995	34	18	0	0	260	14
1996	7	3	0	1	475	119
1997	7	4	0	0	65	16
1998	8	17	1	0	26	27

[1] Total effective dose equivalent.
[2] Average of the Collective Dose among those whose received measurable exposure

Directly relevant experience is available from the decommissioning of the former uranium conversion facility at Weldon Spring, Missouri. The facility operated from 1957 into 1966 producing uranium metal from purified uranium ore (yellowcake). The Weldon Spring facility employed the same solvent extraction process as applied at SFC then reduced UF_4 to metal instead of further fluorination to UF_6. Operation of the facility resulted in impounded sludges and radiological impacts to soils comparable to that at SFC. The concentration ranges of some radioactive contaminants in the major waste streams at Weldon Spring are comparable to SFC materials and are summarized in Table 2-5.

At the time of decommissioning, bulk materials had been removed from the facility but structures, equipment, and impounded raffinate sludge remained.

The decommissioning of the Weldon Spring facility included:

(1) Removal and safe temporary storage of contaminated soil, sediment, sludges, rubble and debris. Dismantlement and safe temporary storage of contaminated structures.

(2) Treatment of selected contaminated wastes.

(3) Permanent disposal of treated and untreated contaminated waste in an on-site engineered earthen cell.

Table 2-5: CONCENTRATION RANGES OF RADIOACTIVE CONTAMINANTS AT WELDON SPRING[1]

Contaminant	Soil (pCi/g)	Raffinate Sludge (pCi/g)
Total Uranium	4600	3400
Th-230	97	34000
Ra-226	450	1700

[1] Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site, September 1993, Table 5-3

The Weldon Spring Site handled similar materials and was decommissioned in a manner very similar to the one proposed by SFC. The period 1994 through 1997 was the primary period of decommissioning when building dismantlement, slab excavation, sludge treatment, and cell construction occurred. Occupational doses recorded at the Weldon Spring facility during this period are summarized in Table 2-6.

Table 2-6: SUMMARY OF OCCUPATIONAL DOSE FOR THE WELDON SPRING SITE REMEDIAL ACTION PROJECT (WSSRAP)[1]

	Number of individuals in each range					
Year	Less than measurable	0 to 100 mrem[2]	100 to 250 mrem[2]	greater than 250 mrem[2]	Collective Dose (mrem)[2]	Average Dose[3] (mrem)[2]
1994	793	65	1	0	1314	20
1995	606	5	0	0	50	10
1996	184	8	3	0	673	61
1997	238	9	0	0	231	26

[1] Data from communication with WSSRAP personnel.
[2] Total effective dose equivalent.
[3] Average of the Collective Dose among those whose received measurable exposure

SFC expects that doses (both collective and average) will be similar to those presented here.

Public Safety

The potential radiological impacts of decommissioning on the safety of the public are principally related to the hazards associated with the atmospheric release of radioactive materials during decommissioning, both from planned tasks and from accidents. Dose calculations using results of air samples collected during ongoing decommissioning activities that are similar to those proposed in this plan provide a reasonable basis for predicting doses from planned activities. A summary of the doses calculated from data collected at the nearest residence air sampler for the period 1995 through 1998 is provided in Table 2-7. The calculations apply actual monitoring data collected during the performance of decommissioning activities to a hypothetical resident living near the Facility using the methodology in Appendix A of the NRC Environmental Assessment (NUREG-1157). SFC decommissioning plans do not include any new or novel approach that would significantly affect exposure scenarios represented here.

Table 2-7: SUMMARY OF DOSE AT THE NEAREST RESIDENT AIR MONITORING STATION OF SEQUOYAH FUELS CORPORATION

Committed Effective Dose Equivalent[1]	
Year	**(mrem)**
1995	0.5
1996	0.4
1997	0.3
1998[2]	0.3

[1] Assumes no contribution from external exposure or ingestion.
[2] Includes estimate for the fourth quarter

Dose assessments were performed in support of the Weldon Spring Site decommissioning effort to satisfy Clean Air Act requirements. The potential radiation dose from Weldon Spring Site to the maximally exposed individual member of the public for the period 1994 through 1997 is summarized in Table 2-8. The dose is derived from actual monitoring data collected during decommissioning work and applied to a hypothetical individual. This individual was assumed to reside continuously near the site. As stated earlier, the period 1994 through 1997 was the primary period of decommissioning at Weldon Spring Site and would be representative of the activities contemplated at the SFC site.

Table 2-8: SUMMARY OF NESHAPS DOSE ESTIMATES TO HYPOTHETICAL MAXIMALLY EXPOSED INDIVIDUAL MEMBER OF THE PUBLIC AT WELDON SPRING SITE REMEDIAL ACTION PROJECT[1]

Total Effective Dose Equivalent[1]	
Year	**(mrem)**
1994	0.2
1995	0.2
1996	0.9
1997	0.2

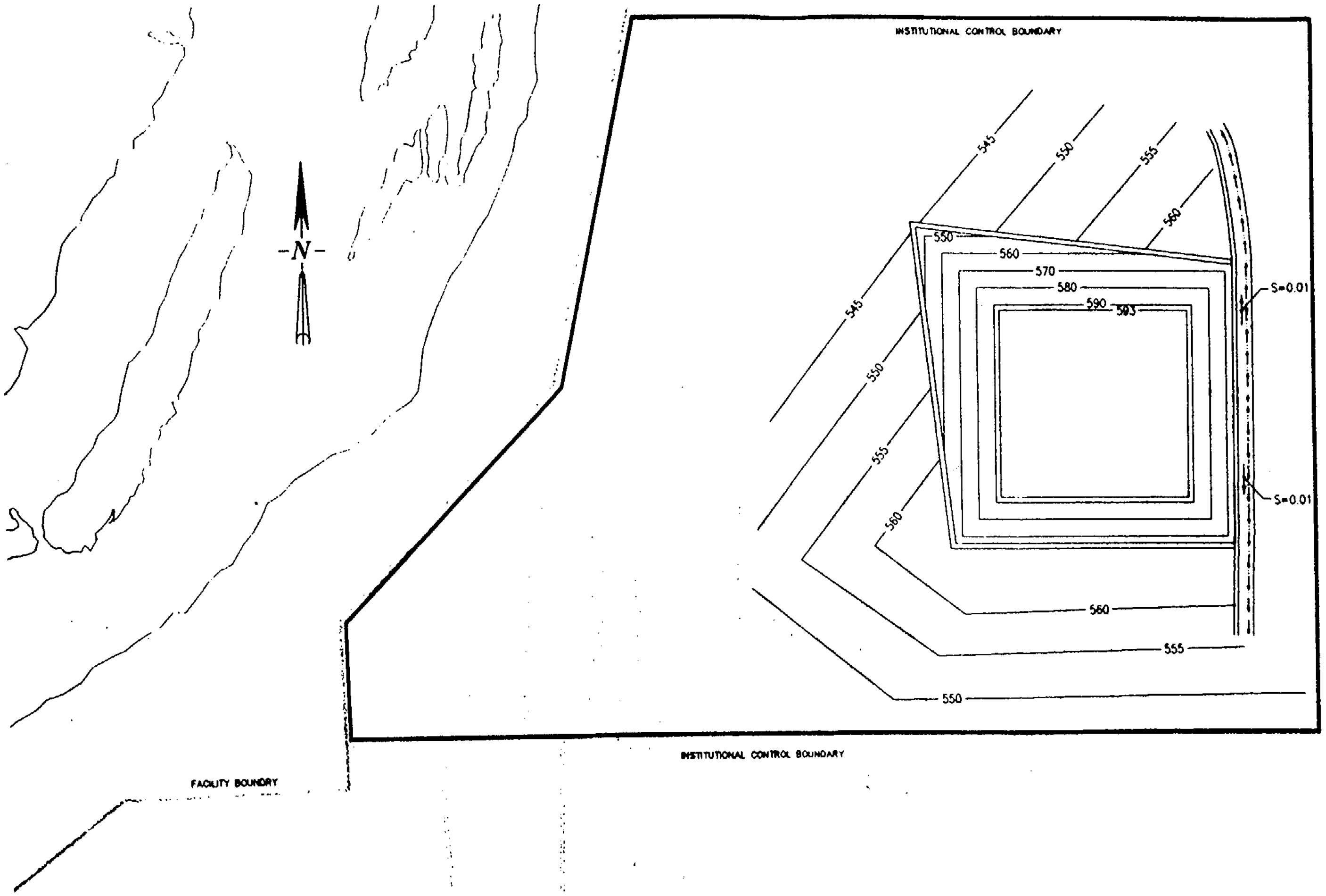
[1]Data from Weldon Spring Site Environmental Report for the respective calendar year.

SFC expects that the maximum potential dose to a member of the public will be < 1 mrem based upon relevant experience.

Accident Assessment

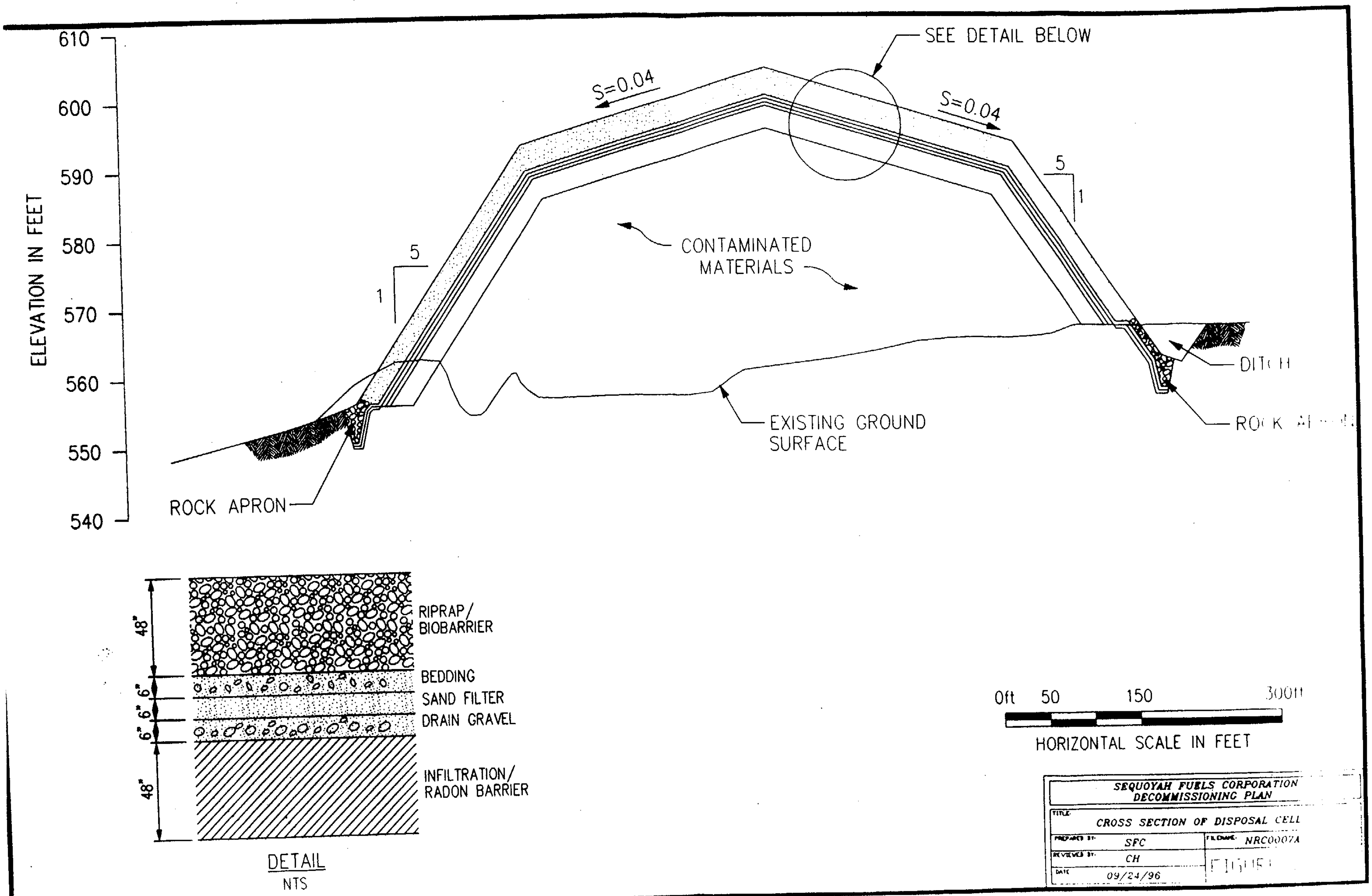
The residual radioactive contamination at the SFC facility is in quantities and forms such that any dispersal of the contaminants would likely be limited to within the Facility. Potential operational accidents relevant to decommissioning a UF_6 conversion facility that would result in release of radioactive material have been considered by the NRC in NUREG/CR-1757, Technology, Safety and Costs of Decommissioning a Reference Uranium Hexafluoride Conversion Plant. NUREG/CR-1757 analyzed the most significant potential accidents associated with decommissioning tasks such as those proposed by this plan. SFC has reviewed the major assumptions used in assessing these accidents relative to the conditions that exist at the SFC site, and determined that the analysis in NUREG-1757 is a reasonable accident assessment for the decommissioning of the SFC Facility. This plan does not introduce any new activities that would significantly affect the consequences of those accidents analyzed in NUREG/CR-1757.

Accidents associated with planned activities post-remediation would be typical of grounds maintenance. No radiological consequences were postulated from any of these accidents.

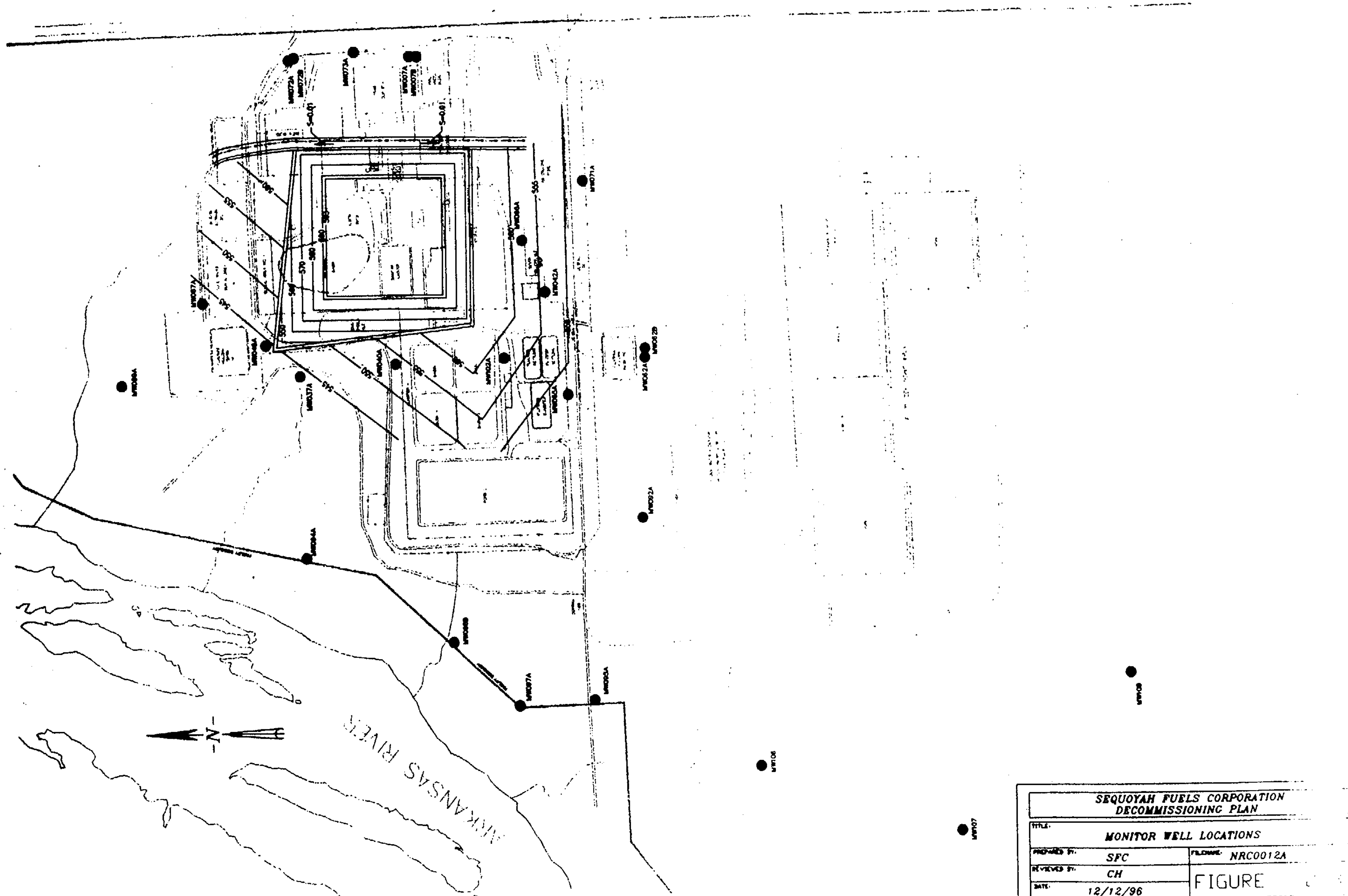


— Institutional Control Boundry (ICB)

SEQUOYAH FUELS CORPORATION DECOMMISSIONING PLAN	
TITLE: DISPOSAL CELL FOOTPRINT	
PREPARED BY: SFC	FILENAME: NRC0006A
REVIEWED BY: CH	
DATE: 12/11/96	



610
600
590
580
570
560
550
540
ELEVATION IN FEET
SEE DETAIL BELOW
S=0.04
S=0.04
5
1
5
1
CONTAMINATED MATERIALS
DITCH
EXISTING GROUND SURFACE
ROCK APRON
48"
RIPRAP/ BIOBARRIER
6"
BEDDING
6"
SAND FILTER
6"
DRAIN GRAVEL
48"
INFILTRATION/ RADON BARRIER
DETAIL
NTS
0ft
50
150
300ft
HORIZONTAL SCALE IN FEET
SEQUOYAH FUELS CORPORATION DECOMMISSIONING PLAN
TITLE: CROSS SECTION OF DISPOSAL CELL
PREPARED BY: SFC
FILENAME: NRC0007A
REVIEWED BY: CH
DATE: 09/24/96



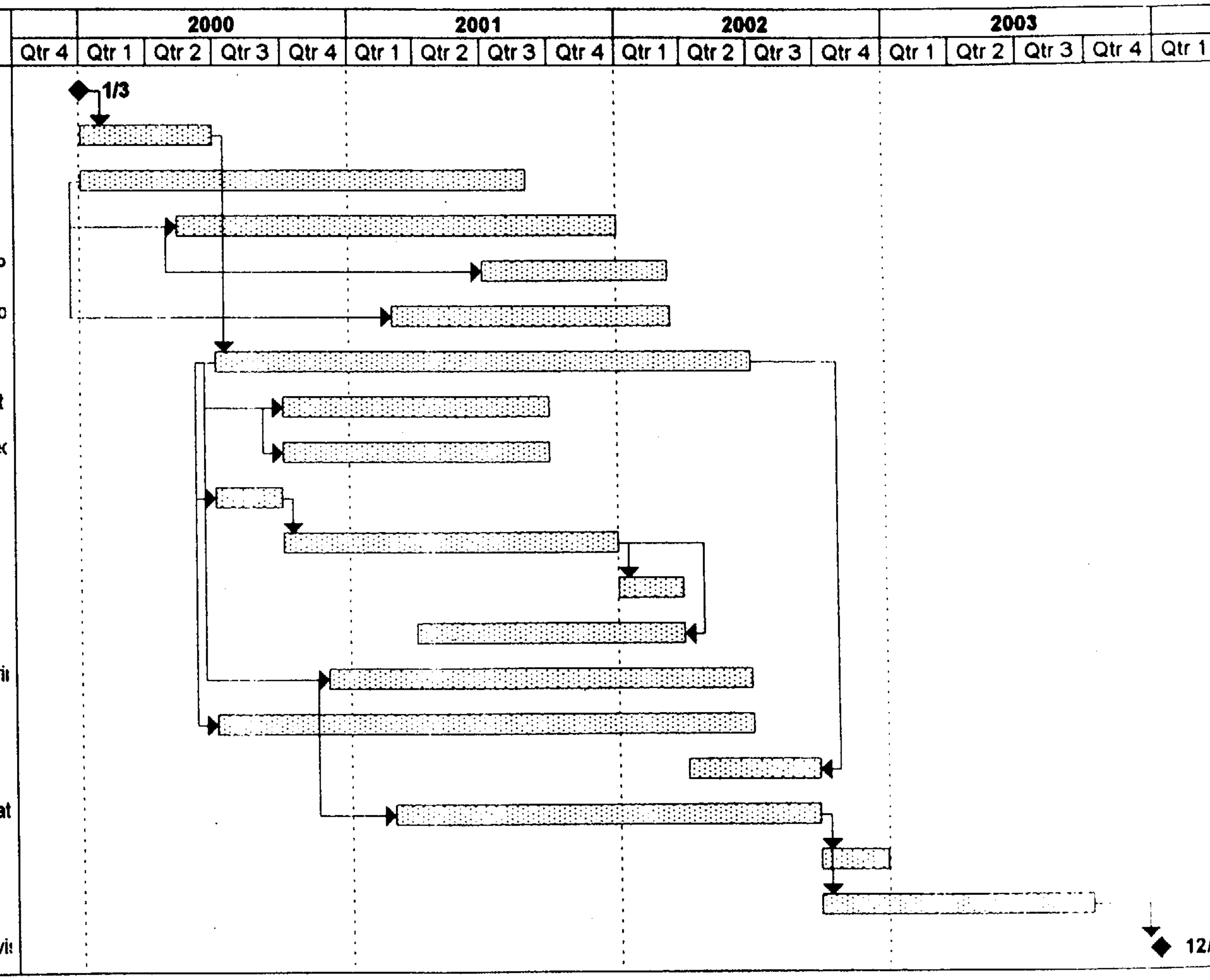
SEQUOYAH FUELS CORPORATION
DECOMMISSIONING PLAN

TITLE: **MONITOR WELL LOCATIONS**

PREPARED BY:	SFC	FILENAME:	NRC0012A
REVIEWED BY:	CH	FIGURE	
DATE:	12/12/96		

Figure 2-4
Conceptual Decommissioning Schedule

ID	Task Name
1	NRC Approval of Decommissioning Plan
2	Preparation of North Site for Cell Construction
3	Dismantlement of Process Equipment
4	Dismantlement/Demolition of Structures
5	Demolition of Concrete Floors, Foundations and Storage P
6	Size reduction/Compaction of Structures, Systems and Co
7	Construction of Disposal Cell Base and Dike
8	Excavation and Treatment of Material Under Cell Footprint
9	Recovery and Treatment of Impacted Terrace and Perchec
10	Construction of Solidification Plant
11	Removal and Treatment of Sludges and Sediments
12	Deconstruction of Solidification Plant
13	Removal of Clay Liners/Soils Under Impoundments
14	Excavation of Contaminated Soils Outside the Cell Footpri
15	Collection and Treatment of Stormwater
16	Complete Capping and Closure of Cell
17	Backfilling Excavations to a Finished Grade and Revegetat
18	Establishment of Fenced Institutional Control Boundary
19	Final Survey for License Termination
20	Termination of SUB-1010 Under Restricted Release Provi



Project: Sequoyah Facility Decommissioning | Task | Milestone ◆

3.0 DESCRIPTION OF METHODS USED FOR PROTECTION OF OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY

3.1 Facility Radiological History Information

SFC submitted a Draft Site Characterization Plan to the NRC in January, 1994. The NRC provided comments on that plan by letter dated November 3, 1994. By letter dated February 5, 1995, the NRC advised SFC that it need not submit a revised plan responding to the NRC comments and could proceed with site characterization activities provided that SFC considered NRC comments during the characterization activities and preparation of the Draft SCR. SFC considered the NRC comments and made appropriate adjustments to its characterization activities, as reflected in the Draft SCR.

The current radiological conditions of the Sequoyah Facility are described in the final Site Characterization Report (SCR). Detailed historical information about the facility is provided in the documents listed in section 2.2.4 of the SCR. This historical information was considered in the planning of the site characterization.

Summary of Radiological Conditions

SFC has characterized the site through a series of environmental investigations. In the vicinity of the process buildings, process impoundments and uranium handling areas, concentrations of uranium in the soils exceed background and in many areas exceed the proposed soil cleanup criterion. Uranium in soil at concentrations above 35 pCi/g is found to a maximum depth of about 31 feet beneath the Process Area. In addition, a few areas of limited extent are impacted by thorium-230 and/or radium-226. Soils containing thorium or radium in excess of the proposed limits are confined to areas where raffinate sludge was managed.

Groundwater beneath portions of the SFC site is impacted by uranium from past leaks and spills. The vertical extent of the groundwater impact is limited by an almost impervious sandstone layer, referred to as the "Unit 4 Sandstone", that underlies the majority of the site. Monitoring wells in the groundwater zone immediately beneath Unit 4 Sandstone confirm that there is no significant impact below that level.

Groundwater flow on the site is generally to the southwest, conforming to the tilt of the bedrock strata in the area. Some localized areas of groundwater flow to the south and northwest have been measured, however these flows appear to be influenced by erosional features and location for future development. A rip rap cover will prevent erosion and discourage human intrusion into the cell.

The ability of the disposal cell to effectively contain the radioactive materials in the decommissioning wastes is a function of the design and construction of the cell and of the leachability of the radionuclides from these wastes after treatment and placement in the cell. A series of studies have been conducted, using the cell conceptual design and representative samples of selected waste materials to quantify the expected long-term performance of the cell. Earth Sciences Consultants, a company with experience in disposal cell design and in solidifying and stabilizing radioactive and heavy metal contaminated soils and other waste materials, was retained to evaluate the performance of the SFC disposal cell design and planned waste treatment.

Treatment of Waste Materials

A treatability study was conducted on selected SFC decommissioning materials (specifically raffinate sludge, calcium fluoride sludge, depleted uranium tetrafluoride (DUF4), and highly impacted soils and backfill sands). The objectives of the treatability study were to:

- Characterize the physical properties of selected decommissioning materials;
- Establish metals and radiological baseline levels in decommissioning materials before and after solidification/stabilization (S/S) processing;
- Determine the unconfined compressive strength of S/S processed decommissioning materials;
- Evaluate leachability of radionuclides and metals from S/S processed decommissioning materials;
- Develop leach rate input for use in groundwater transport modeling; and
- Provide information for use in the disposal cell design.

Portland cement and flyash from a local power plant were used in various ratios to solidify/stabilize test specimens of the decommissioning materials. Leach rates from the test specimens were determined for radionuclides (uranium, thorium-230 and radium-226) and selected heavy metals (arsenic, lead and thallium) in accordance with *ANSI/ANS-16.1-*

1986. Measurement of the Leachability of Solidified Low-Level Radioactive Wastes By a Short-Term Test Procedure.

Details on the performance of the treatability test and the results are contained in Appendix B in a report entitled *Treatability Study Report.* The study results indicate that, with the exception of the DUF4, the materials tested can be successfully solidified and stabilized using either portland cement or flyash in sufficient ratios to hydrate all the water in the materials. (SFC's decommissioning plan does not include on-site disposal of the DUF4, however, the data collected will be useful in evaluating other options.) Unconfined compressive strengths of greater than the minimum 50 psi were achieved and leachability indexes exceeded the minimum L value of 6. Leachate concentrations were measured for uranium, thorium-230 and radium-226 for the various test mixtures.

Radon Release Analysis

The RADON computer program was used to assess the rate of radon release from the cell. The results of this assessment are contained in Appendix C, entitled *Calculation Brief - RADON Analysis Case I and Case II Scenarios.* In the Case I scenario, raffinate sludge and Pond 2 residues which contain the bulk of the radium and thorium inventories for the site, were excluded from the cell. In the Case II scenario these materials were included. To simplify the calculations, the total uranium, thorium-230 and radium-226 quantities contained in the various waste materials were assumed to be uniformly distributed throughout the materials, i.e. the concentrations were averaged. This approach yields a conservative result since SFC plans to put the materials containing the bulk of the radium and thorium in the bottom of the cell covered with a thick layer of low impacted soils. The actual radon release rate will to be even lower than this model predicted because the added soil cover will further attenuate the movement of the radon.

Varying thicknesses of clay cover were evaluated (from 0 to 48 inches). The analysis indicated that as little as 1 cm of clay would reduce the maximum radon release (Case II) to less than the maximum flux of 20 pCi/m^2-sec. At 18 inches of clay, which is the minimum required to control rainwater infiltration, the radon emission rate is estimated by interpolation to be less than 0.5 pCi $/m^2$-sec (see Appendix C).

Infiltration Analysis

The HELP computer program (Hydrological Evaluation of Landfill Performance) was used to predict the amount of rainwater that would infiltrate the cover and the waste materials in the cell. Two clay cap

3.6.3 Residual Radioactivity

Residual radioactivity will remain in two general areas following completion of decommissioning at the Facility. The majority of the site will be remediated to levels that permit unrestricted use. The remainder of the site will be inside the Institutional Control Boundary (ICB). The remediation of both areas will utilize criteria for permissible levels of residual contamination that assure that the potential dose to an average member of the critical group will not exceed the applicable limit established in the NRC regulations. An analysis has been conducted to verify that the potential dose to an average member of the critical group will meet the applicable limits. Soil release criteria that have been derived for these areas are presented in Section 2.1.3, Cleanup Criteria.

SFC has evaluated a range of potential exposure scenarios and determined that the residential farmer scenario is the most conservative. Potential doses to a resident farmer in the unrestricted area would be less than 25 mrem/y, and to an intruder who establishes a residence and farm inside the ICB would be less than 100 mrem/y if the maximum individual radionuclide concentrations in Table 2-3 were applied. SFC has also evaluated the potential exposure to an industrial worker who performs routine maintenance activities within the ICB. The estimated maximum dose to this worker is 2.9 mrem/y. Specific parameter assumptions are provided in Appendix G.

Concentrations in soil remaining after completion of decommissioning will likely be much lower than the levels calculated for the residential farmer and industrial worker assessments due to application of the cleanup goals described in section 2.1.3. In addition, areas which will be excavated to remove contaminated soils will be backfilled with clean soil further reducing the extent and concentration of residual source materials. Thus, these assessments provide an upper bound for doses in each case.

An intruder dose which assumes application of cleanup goals in Table 2-3 would be 41 mrem/y. This is a conservative estimate of the potential dose because no credit was taken for reduction in permissible residual concentration values that will be applied where multiple radionuclides are present. Specific parameter assumptions for this analysis are found in Appendix G.

4.0 FINAL STATUS SURVEYS

4.1 Introduction

This section presents the final status surveys for the Facility. The surveys will be designed from the guidance contained in NUREG-1575 "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM). The surveys will demonstrate that the residual radioactivity in each survey unit satisfies the applicable criteria described in Section 2.1.3; i.e. release for unrestricted use or use with designated limitations, as appropriate. The surveys will provide data to demonstrate that all radiological parameters do not exceed the established derived concentration guideline values (DCGLs).

4.2 Survey Design

The survey designs will begin with the development of data quality objectives (DQOs). The DQOs will be developed using guidance provided on the DQO Process in Appendix D of MARSSIM. On the basis of these objectives and the known or anticipated radiological conditions at the site, the numbers and locations of measurement and sampling points used to demonstrate compliance with the release criterion will be determined. Finally, survey techniques appropriate for development of adequate data will be selected and implemented.

4.2.1 Radionuclides of Concern

The SCR identified the primary radionuclide of concern as natural uranium (U-nat). The SCR also established areas where thorium-230 (Th-230) and radium-226 (Ra-226) must be considered as contaminants.

4.2.2 Derived Concentration Guideline Levels (DCGL)

Section 2.1.3 of this report provides the DCGLs used to design the surveys. For the purpose of the final status surveys, the DCGLs of Section 2.1.3 represent contamination conditions that are approximately uniform across the survey unit and will be specifically referred to as $DCGL_W$. A separate DCGL will be derived for small areas of elevated activity and will be specifically referred to as $DCGL_{EMC}$ (elevated measurement comparison).

4.2.3 Investigation Levels

Radionuclide-specific investigation levels will be used to indicate when additional investigations may be necessary. The investigation levels will also serve as a quality control check for the measurement process. The investigation levels to be used at the Facility are provided in Table 4-1.

Table 4-1: FINAL STATUS SURVEY INVESTIGATION LEVELS

Survey Unit Classification	Investigate When Sample Result:	Investigate When Scanning Measurement:
Class 1	> $DCGL_{EMC}$	> $DCGL_{EMC}$
Class 2	> $DCGL_W$	> $DCGL_W$
Class 3	> fraction of $DCGL_W$	> MDC

4.2.4 Classification of Areas based on Contamination

All areas of the Facility do not have the same potential for contamination and, accordingly, do not need the same level of survey coverage to demonstrate that residual radioactivity in the area satisfies the applicable criteria. The surveys were designed so that areas with higher potential for contamination receive a higher degree of survey effort.

The survey designs fall into one of two categories, non-impacted and impacted. Areas that have no reasonable potential for residual contamination are designated as non-impacted areas and are not provided any level of survey coverage. Areas that have some potential for containing contaminated material are designated as impacted areas. Impacted areas are subdivided into five classes according to known or suspected levels of contamination and with regard to the classification guidance of MARSSIM. Specific and thorough consideration was given to site operating history and/or known contamination based on site characterization efforts:

- Class 1 areas: These areas are known to not have thorium-230 or radium-226 as a significant contaminant. These areas are known or suspected to have contamination in excess of the $DCGL_W$ for U-nat.

- Class 1-Th areas: These areas are known have thorium-230 and radium-226 as significant contaminants. These areas are known or suspected to have contamination in excess of the $DCGL_W$ for U-nat, thorium-230, and radium-226.

- Class 2 areas: These areas are known to not have thorium-230 or radium-226 as contaminants. These areas are known or suspected to have contamination less than the $DCGL_W$ for U-nat.

- Class 2-Th areas: These areas are known have thorium-230 and radium-226 as contaminants. These areas are known or suspected to have contamination less than the $DCGL_W$ for U-nat, thorium-230, and radium-226.

- Class 3 areas: Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGL for U-nat, based on site operating history and previous radiological surveys. These are areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification. These areas are known to not have thorium-230 or radium-226 as contaminants.

Class 1 areas have the greatest potential for contamination and, therefore, receive the highest degree of survey effort, followed by Class 2, and then Class 3 areas. Areas may be further subdivided into units in accordance with the guidance in MARSSIM or to better facilitate assessment of the area. Figure 4-1 shows the boundaries of the different areas with the specific survey design descriptions.

4.2.5 Survey Techniques

Measurement methods used to generate data during the surveys can be classified into three categories commonly known as scanning surveys, direct measurements, and sampling. These survey techniques will be combined in an integrated survey design.

Scanning Surveys

Scanning will be performed to identify areas of elevated activity that may not be detected by other measurement methods. Scanning will be performed of structure surfaces and land areas. Structure surfaces will be scanned for both alpha and beta/gamma radiations. Land areas will be scanned for gross gamma radiations. The types of instruments used for scanning and their typical performance characteristics are provided in Table 4-2.

Table 4-2: IDENTIFICATION OF RADIATION DETECTION INSTRUMENTS FOR THE FINAL STATUS SURVEYS OF THE SEQUOYAH FACILITY

Measurement	Instrumentation Detector	Instrumentation Meter	Background[1] (cpm)	4 π[1] Efficiency (%)	Detection Sensitivity[2, 3]
Scan alpha Direct alpha	Large area gas prop., Ludlum Meas., Inc., Model 239-1F.	Count rate meter and digital scaler, Ludlum Meas.,Inc., Model 2221.	16	20	56 dpm/100cm² 37 dpm/100cm²
Scan beta/gamma Direct beta/gamma	Large area gas prop., Ludlum Meas., Inc., Model 239-1F.	Count rate meter and digital scaler, Ludlum Meas.,Inc., Model 2221.	1220	20	2200 dpm/100cm² 280 dpm/100cm²
Removable	Gas proportional, 80 μg/cm² window	Tennelec, Model LB5100	α ß/Γ 1 3	α ß/Γ 30 30	67 α 110 ß/Γ
Scan Soil	NaI scintillation Ludlum Meas., Inc., Model 44-10	Countrate meter, Ludlum Meas., Inc., Model 2221.	10000	n/a	80 pCi/g[4] as natural uranium

[1]Nominal values.
[2]Monitoring audible signal during scanning.
[3]One-half minute integrated count for direct measurements, 0.3 minute count for removable measurements.
[4]MARSSIM Table 6.7
n/a - not applicable

Direct and Removable Measurements

Direct and removable measurements will be made to determine average activity in a survey area or unit. Direct and removable measurements will only be made of structural surfaces. Direct and removable measurements will be limited to alpha and beta/gamma measurements. The types of instruments used for direct and removable measurements and their typical performance characteristics are provided in Table 4-2.

Sampling

Sampling will be limited to land areas. Samples of soil will be collected and analyzed for the radionuclides of concern, as applicable. The analysis technique and typical detection limit for each radionuclide of concern is provided in Table 4-3.

Table 4-3: IDENTIFICATION OF RADIOANALYTICAL METHODS FOR FINAL STATUS SURVEYS OF THE SEQUOYAH FACILITY

Radionuclide	Analytical Method	Detection Limit[1] (pCi/g)
Total Uranium	kinetic phosphorescence analysis	0.7
Thorium-230	alpha spectrometry	0.5
Radium-226	co-precipitation, gross alpha and gross beta	0.1

[1] nominal values

4.2.6 Reference (Background) Areas

The reference areas used for the conduct of the final status surveys for land areas will be as described in the SCR. The reference for structural surfaces will be determined at the time of the survey as part of instrument calibration.

4.2.7 Reference Coordinate System

Reference coordinates systems will be used to facilitate selection of measurement and sampling locations, and to provide a mechanism for relocating a survey point. Land area scanning surveys and soil sample locations will be referenced to the Oklahoma State Plane. Scanning surveys and direct measurements of structural surfaces will be referenced to prominent building features.

4.2.8 Measurement Evaluation

Measurements from a survey unit will be compared to equivalent measurements from the reference areas. In general, the comparison will be whether the survey unit exceeds the reference area by more than the $DCGL_W$. The Wilcoxen Rank Sum (WRS) statistical test will be used to evaluate the data from the final status surveys.

In addition, an elevated measurement comparison (EMC) will be performed against each measurement in a Class 1 unit to ensure that the measurement result does not exceed the specified investigation level; i.e. the $DCGL_{EMC}$. If any measurement exceeds the $DCGL_{EMC}$, then additional investigation will be completed regardless of the outcome of the WRS test.

4.2.9 Area Factor

The method for determining values for the $DCGL_{EMC}$ will be to modify the $DCGL_W$ by a correction factor that accounts for the difference in area and the resulting change in dose. The area factor is the magnitude by which the concentration within a small area of elevated activity can exceed the $DCGL_W$ while maintaining compliance with the release criterion. (If the $DCGL_W$ is multiplied by the area factor, the resulting concentration distributed over the specified smaller area delivers the same calculated dose.

Table 4-4 provides the area factors to be used at the Facility. The area factors were developed from RESRAD. Other than changing the area (i.e. 1.0, 2.0, 2.5, 3.0, ... or 10000 m^2), the RESRAD values used to develop the $DCGL_W$ were not changed. The area factors were then computed by taking the ration of the dose per unit concentration generated by RESRAD for 25000 m^2 to that generated for the other areas listed.

Table 4-4: OUTDOOR AREA FACTORS

	Area Factor										
Radionuclide	1m²	2m²	3m²	10m²	30m²	100m²	300m²	1000m²	3000m²	10000m²	25000m²
U-Nat	7.6	5.7	4.8	3.1	2.3	1.9	1.6	1.1	1.1	1.0	1.0

4.3 Survey Descriptions

The following sections describe the final status surveys to be completed for each of the area classifications previously described. As necessary, the following sections are further subdivided to provide description of the survey for a particular unit of an area.

4.3.1 Class 1

Survey Units

This area is described as the entirety of the current main restricted area at the Facility excluding the portions contaminated with thorium-230 and radium-226, and the area that will be occupied by the disposal cell. This area may otherwise be described as Restricted Area No. 1 except for Pond 2, Clarifier A Basin, and the disposal cell footprint. The final status survey will be applied independently to each 2000 m^2 unit of this area.

Estimated Number of Data Points

The estimated number of sample locations was derived in accordance with Section 5.5.2.2 of MARSSIM. Surface soil sample results for the area were used to provide an estimate of the standard deviation (σ_s) for uranium in this area.

Calculate Relative Shift

The relative shift (Δ/σ_s) was calculated using an upper bound of the gray region (UBGR) equal to the DCGL = 440 pCi/g, a lower bound of the gray region (LBGR) of ½DCGL = 220 pCi/g, and σ_s = 18 pCi/g: Δ/σ_s = 12. This number is rounded down to 4.

Decision Error Percentiles

The null hypothesis for this Class 1 survey is that each survey unit does not meet the release criteria. Acceptable decision error probabilities for testing the hypothesis were arbitrarily chosen as $\alpha = \beta = 0.05$.

Number of Data Points for WRS test

The number of data points was obtained directly from MARSSIM Table 5.3. For $\alpha = \beta = 0.05$, and $\Delta/\sigma_s = 4$ a value of 9 is obtained for the number of data points (N/2).

Determining the Number of Data Points for Small Areas of Elevated Activity

The concern for detection of small areas of elevated activity was addressed in accordance with MARSSIM Section 5.5.2.4. For nine data points, a survey unit size of 2000 m^2, the calculated triangular grid size is 16 m. Using the scanning sensitivity in Table 4-2, the Area Factor in Table 4-4, the required scan minimum detectable concentration (MDC) is determined to be 750 pCi/g. Since the required scan MDC is greater than the actual scan MDC, no adjustment of grid size is necessary to account for small areas of elevated activity.

Determining Survey Locations

Units will be surveyed on a random-start triangular grid pattern. The spacing of the grid will be 16 m.

Integrated Survey Strategy

Sampling will be completed on the previously described grid. Scanning will be completed for 100% of each unit. Biased samples will be collected based on elevated scanning results.

4.3.2 Class 1-Th

Survey Units

This area will be considered as two subareas; the footprint of Pond 2 (~20000 m^2) and the footprint of Clarifier A Basin (8800 m^2). The final status survey will be applied independently to each 2000 m^2 and 2200 m^2 units of these subareas, respectively.

Estimated Number of Data Points

The estimated number of sample locations was derived in accordance with Section 5.5.2.2 of MARSSIM. The standard deviations (σ_s) used in the following calculations were derived from surface soil samples in the respective subarea.

Calculate Relative Shift

Footprint Pond 2

In order to obtain a manageable sample requirement, σ_s was derived from 31 uranium sample results.

The relative shift (Δ/σ_s) was calculated using an upper bound of the gray region (UBGR) equal to the DCGL = 440 pCi/g, a lower bound of the gray region (LBGR) of ½DCGL = 220 pCi/g, and σ_s = 541 pCi/g: Δ/σ_s = 0.4.

Footprint Clarifier A Basin

Clarifier A Basin is similar to Pond 4 in construction and contents. The σ_s was derived from the thorium-230 sample results for the bottom of Pond 4 excluding the minimum and maximum results.

The Δ/σ_s was calculated using an upper UBGR equal to the DCGL = 76 pCi/g, a LBGR of ½DCGL = 38 pCi/g, and σ_s = 18 pCi/g: Δ/σ_s = 2.1 rounded down to 2.

Decision Error Percentiles

The null hypothesis for this Class 1-Th survey is that each survey unit does not meet the release criteria. Acceptable decision error probabilities for testing the hypothesis were arbitrarily chosen as α = 0.05 and β = 0.25.

Number of Data Points for WRS test

The number of data points were obtained directly from MARSSIM Table 5.3. For α = 0.05, β = 0.25 and Δ/σ_s = 1.0, then values of 87 and 7 are obtained for the number of data points (N/2) for the each unit of Pond 2 and Clarifier A, respectively.

Determining the Number of Data Points for Small Areas of Elevated Activity

The concern for detection of small areas of elevated activity was addressed in accordance with MARSSIM Section 5.5.2.4. The calculated triangular grid size for each unit of the Footprint of Pond 2 is 5m and for each unit of the Footprint of Clarifier A Basin is 19m. Using the scanning sensitivity in Table 4-2, the Area Factor in Table 4-4, and an assumed ratio of U-nat, thorium-230, and radium-226, the required scan minimum detectable concentration (MDC) is determined to be less than the actual scan MDC. Adjustment of the grid size based on the required scan MDC results in approximately 860 samples per unit for each subarea. It is anticipated that the contaminant variability will drop considerably after remediation. It is also anticipated that during remediation, an *a posteriori* estimate of scan MDC will be developed and will be lower than the scan MDC used here. The sample frequency requirement will be revisited at that time.

Determining Survey Locations

Units will be surveyed on a random-start triangular grid pattern.

Integrated Survey Strategy

Sampling will be completed on the previously described grid. Scanning will be completed for 100% of each unit. Biased samples will be collected based on elevated scanning results.

4.3.3 Class 2

Survey Units

This area is comprised of four units and one subarea. The four units are: the tail of drainage south of the South Guard House, former 001 drainage, Initial Lime neutralization Area, and the former Sod Storage Area. The subarea is the front lawn; it will be divided into 10000m² units.

Estimated Number of Data Points

The estimated number of sample locations was derived in accordance with Section 5.5.2.2 of MARSSIM. Surface soil sample results for the unit or subarea were used to provide an estimate of the standard deviation (σ_s) for uranium.

Calculate Relative Shift

Drainage south of South Guard House

The σ_s was developed from five sediment samples near this area.

The relative shift (Δ/σ_s) was calculated using an upper bound of the gray region (UBGR) equal to the DCGL = 110 pCi/g, a lower bound of the gray region (LBGR) of ½DCGL = 55 pCi/g, and σ_s = 24 pCi/g: Δ/σ_s = 2.3 rounded down to 2.25.

Former 001 Drainage

The standard deviation was developed from nine sediment samples from this drainage.

The Δ/σ_s was calculated using an UBGR equal to the DCGL = 110 pCi/g, a LBGR of ½DCGL = 55 pCi/g, and σ_s = 22 pCi/g: Δ/σ_s = 2.5.

Initial Lime Neutralization

The standard deviation was developed from 105 surface soil samples from this unit.

The Δ/σ_s was calculated using an UBGR equal to the DCGL = 110 pCi/g, a LBGR of ½DCGL = 55 pCi/g, and σ_s = 59 pCi/g: Δ/σ_s = 0.9

Former Sod Storage

The standard deviation was developed from 29 surface soil samples from this unit.

The Δ/σ_s was calculated using an UBGR equal to the DCGL = 110 pCi/g, a LBGR of ½DCGL = 55 pCi/g, and σ_s = 6.5 pCi/g: Δ/σ_s = 8.5 rounded down to 4.

Front Lawn

The standard deviation was developed from 24 surface soil samples from this unit.

The Δ/σ_s was calculated using an UBGR equal to the DCGL = 110 pCi/g, a LBGR of ½DCGL = 55 pCi/g, and σ_s = 24 pCi/g: Δ/σ_s = 2.3 rounded down to 2.25.

Decision Error Percentiles

The null hypothesis for this Class 1 survey is that each survey unit does not meet the release criteria. Acceptable decision error probabilities for testing the hypothesis were arbitrarily chosen as $\alpha = \beta = 0.05$.

Number of Data Points for WRS test

The number of data points were obtained directly from MARSSIM Table 5.3. For $\alpha = \beta = 0.05$, and Δ/σ_s provided above:

South of South Guard House	N/2 = 11
Former 001 Drainage	N/2 = 11
Initial Lime Neutralization	N/2 = 39
Former Sod Storage	N/2 = 9
Front Lawn	N/2 = 11

Determining Survey Locations

Units will be surveyed on a random-start triangular grid pattern. The spacing of the grid was determined specific to each unit in accordance with MARSSIM:

South of South Guard House
L = evenly spaced down drainage
Former 001 Drainage
L = evenly spaced down drainage
Initial Lime Neutralization
$L = \sqrt{(15000m^2/(0.866*39))}$
$= 21m$
Former Sod Storage
$L = \sqrt{(840m^2/(0.866*9))}$
$= 10m$
Front Lawn
$L = \sqrt{(10000m^2/(0.866*11))}$
$= 32m$

Integrated Survey Strategy

Sampling will be completed on the previously described grid. Scanning will be completed for nearly 100% of each unit. Biased samples may be collected based on elevated scanning results.

4.3.4 Class 2-Th

Survey Units

This area will be considered as three subareas; inside the fence of Pond 4, outside the fence of Pond 4, and outside the fence at Pond 2 to the south, west and north. Each subarea will be divided into units of 10000m².

Estimated Number of Data Points

The estimated number of sample locations was derived in accordance with Section 5.5.2.2 of MARSSIM. The standard deviations (σ_s) used in the following calculations were derived from surface soil samples in the respective subarea.

Calculate Relative Shift

Inside fence at Pond 4

In order to obtain a manageable sample requirement, σ_s was derived from 28 thorium-230 sample results for the bottom of Pond 4, excluding the minimum and maximum results.

The relative shift (Δ/σ_s) was calculated using an upper bound of the gray region (UBGR) equal to the DCGL = 19 pCi/g, a lower bound of the gray region (LBGR) of ½DCGL = 9.5 pCi/g, and σ_s = 18 pCi/g: Δ/σ_s = 0.5.

Outside fence at Pond 4

The σ_s was derived from eight thorium-230 sample results for this subarea.

The Δ/σ_s was calculated using an UBGR equal to the DCGL = 19 pCi/g, a LBGR of ½DCGL = 9.5 pCi/g, and σ_s = 25 pCi/g: Δ/σ_s = 0.4

Outside fence at Pond 2

The standard deviation was developed from 13 sample results for this subarea.

The Δ/σ_s was calculated using an UBGR equal to the DCGL = 19 pCi/g, a LBGR of ½DCGL = 9.5 pCi/g, and σ_s = 5.9 pCi/g: Δ/σ_s = 1.6.

Decision Error Percentiles

The null hypothesis for this Class 2-Th survey is that each survey unit does not meet the release criteria. Acceptable decision error probabilities for testing the hypothesis were arbitrarily chosen as $\alpha = 0.05$ and $\beta =$ 0.05

Number of Data Points for WRS test

The number of data points were obtained directly from MARSSIM Table 5.3. For $\alpha = \beta = 0.05$, and Δ/σ_s provided above:

Inside fence at Pond 4	N/2 = 114
Outside fence at Pond 4	N/2 = 175
Outside fence at Pond 2	N/2 = 16

Determining Survey Locations

Units will be surveyed on a random-start triangular grid pattern. The spacing of the grid was determined specific to each unit in accordance with MARSSIM:

Inside fence at Pond 4

$$L = \sqrt{(10000m^2/0.866*114)}$$
$$= 10m$$

Outside fence Pond 4

$$L = \sqrt{(10000m^2/0.866*175)}$$
$$= 8m$$

Outside fence at Pond 2

$$L = \sqrt{(10000m^2/0.866*16)}$$
$$= 27m$$

Integrated Survey Strategy

Sampling will be completed on the previously described grid. Scanning will be completed for nearly 100% of each unit. Biased samples may be collected based on elevated scanning results.

4.3.5 Class 3

Survey Units

The Class 3 area will be considered as three units; sediment of the Storm Water Reservoir, inside the fertilizer ponds, and the remainder.

Estimated Number of Data Points

The estimated number of sample locations was derived in accordance with Section 5.5.2.2 of MARSSIM. Surface soil sample results for the unit were used to provide an estimate of the standard deviation (σ_s) for uranium.

Calculate Relative Shift

Storm Water Reservoir

The σ_s was developed from three sediment samples from this unit.

The relative shift (Δ/σ_s) was calculated using an upper bound of the gray region (UBGR) equal to the DCGL = 110 pCi/g, a lower bound of the gray region (LBGR) of ½DCGL = 55 pCi/g, and σ_s = 0.1 pCi/g: Δ/σ_s = 550 rounded down to 4.

Inside the fertilizer ponds

The standard deviation was developed from 20 soil samples from the bottoms of ponds 3W and 5.

The Δ/σ_s was calculated using an UBGR equal to the DCGL = 110 pCi/g, a LBGR of ½DCGL = 55 pCi/g, and σ_s = 3.6 pCi/g: Δ/σ_s = 15 rounded down to 4.

Remainder

The standard deviation was developed from 39 surface soil samples from this unit.

The Δ/σ_s was calculated using an UBGR equal to the DCGL = 110 pCi/g, a LBGR of ½DCGL = 55 pCi/g, and σ_s = 5.1 pCi/g: Δ/σ_s = 11 rounded down to 4.

Decision Error Percentiles

The null hypothesis for this Class 3 survey is that each survey unit does not meet the release criteria. Acceptable decision error probabilities for testing the hypothesis were arbitrarily chosen as $\alpha = \beta = 0.05$.

Number of Data Points for WRS test

The number of data points were obtained directly from MARSSIM Table 5.3. For $\alpha = \beta = 0.05$, and Δ/σ_s provided above:

Storm Water Reservoir	N/2 = 9
Inside fertilizer ponds	N/2 = 9
Remainder	N/2 = 9

Integrated Survey Strategy

Samples will be collected at random locations. Scanning will be completed for a majority of each unit. Biased samples may be collected based on elevated scanning results.

4.3.6 Class 3-Office Building

Survey Units

The Class 3-Office Building area will be considered as several units. The choice of units is based on the limited time the Facility was in operation after the structure was built and the results of routine contamination surveys inside the structure. The units are the roof, the west exterior warehouse wall, the west exterior office building wall, the warehouse floor, and the first floor of the office building.

Estimated Number of Data Points

Data from weekly contamination surveys for this structure do not indicate the presence of any residual contamination. All direct measurements are recorded as less-than values. Removable measurements do not appear to differ from background. The following calculations are intended to apply to both direct and removable measurements.

Calculate Relative Shift

As a conservative starting point, a coefficient of variation (CV) of 30% is assumed for survey data and the mean is assumed to be ½DCGL. The relative shift (Δ/σ_s) was calculated using an upper bound of the gray region (UBGR) equal to the DCGL = 5000 dpm/100cm², a lower bound of the gray region (LBGR) of ½DCGL = 2500 dpm/100cm², and $\sigma_s = 2500 * 0.30$ dpm/100cm²: $\Delta/\sigma_s = 3.33$ rounded down to 3.

Decision Error Percentiles

The null hypothesis for this Class 3-Office building survey is that each survey unit does not meet the release criteria. Acceptable decision error probabilities for testing the hypothesis were arbitrarily chosen as $\alpha = \beta = 0.05$.

Number of Data Points for WRS test

The number of data points were obtained directly from MARSSIM Table 5.3. For $\alpha = \beta = 0.05$, and $\Delta/\sigma_s = 3$, then N/2 = 10.

Integrated Survey Strategy

Samples will be collected at random locations. Scanning will be performed in areas of highest potential for residual contamination; e.g. corners, drains, steps, ledges.

4.4 Quality Assurance and Quality Control

4.4.1 Introduction

SFC will use it's existing quality assurance/quality control (QA/QC) program and procedures as a quality system. The quality system will ensure that the final status survey decisions will be supported by sufficient data of adequate quality and usability for their intended purpose, and further ensure that such data are authentic, appropriately documented, and technically defensible. The applicable guidance in MARSSIM will be considered during planning, implementation, and evaluation of the final status surveys and the quality system will be updated or revised as necessary.

4.4.2 Development of a Quality Assurance Project Plan

A quality assurance project plan(s) (QAPP) will be developed for the final status survey effort. The QAPP will be developed using a graded approach. The graded approach will base the levels of controls on the intended use of the results and the degree of confidence needed in their quality. The QAPP may exist across several documents that describe QA/QC, survey planning, survey implementation, and results evaluation (e.g. Decommissioning Plan, Field Sampling Plan).

4.4.3 Data Assessment

Assessment of the final status survey data will be made to determine if the data meet the objectives of the surveys, and to whether the data are sufficient to determine compliance with the DCGL. The assessment will consist of three phases: data verification, data validation, and data quality assessment (DQA).

Data Verification

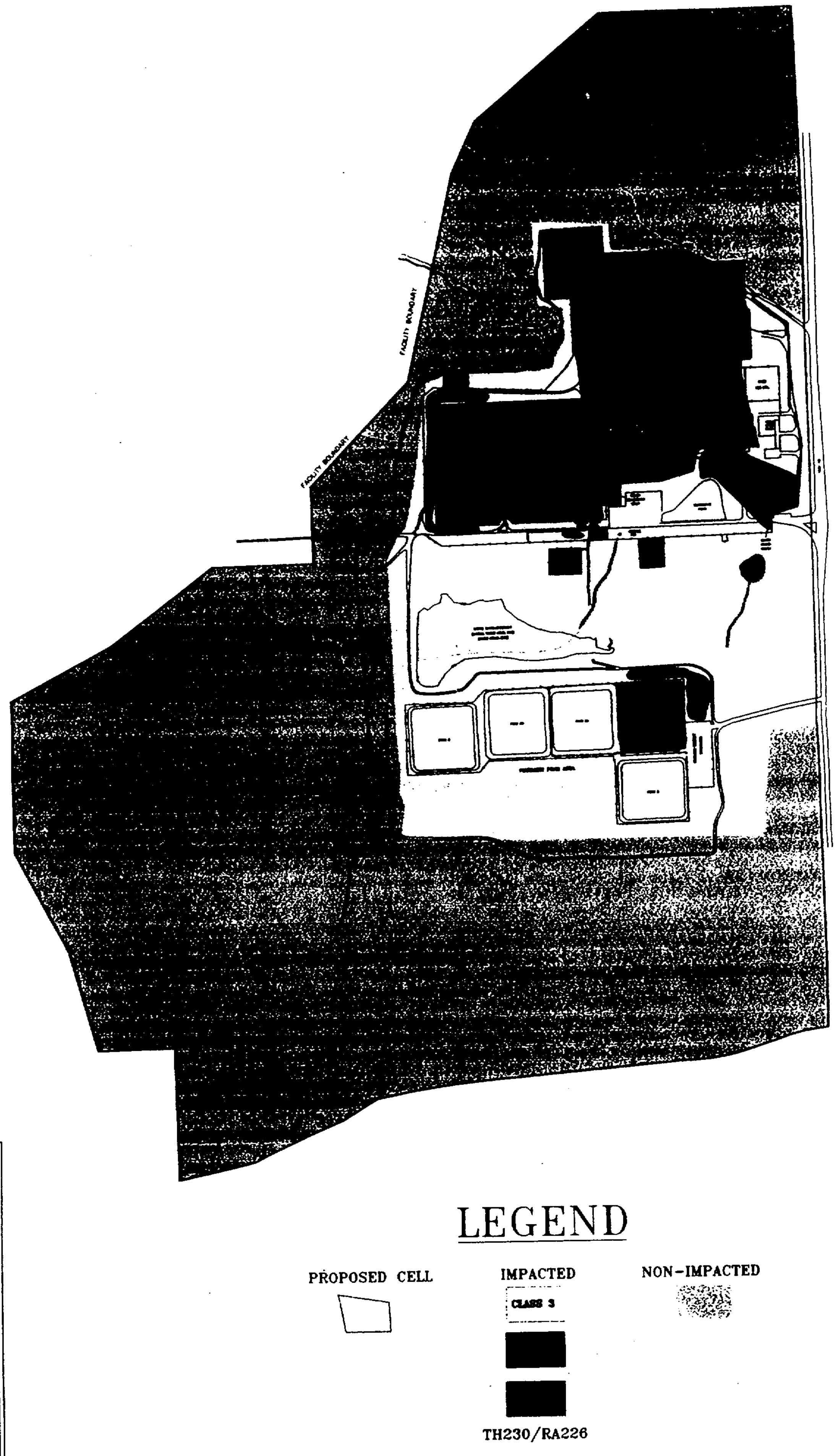
Data verification efforts will be completed to ensure that requirements stated in planning documents are implemented as prescribed. Identified deficiencies or problems that occur during implementation will be documented and reported. Activities performed during the implementation phase will be assessed regularly with findings documented and reported to management. Corrective actions will be reviewed for adequacy and appropriateness and documented in response to the findings. Data verification activities are expected to include inspections, QC checks, surveillance, and audits.

Data Validation

Data validation activities will be performed to ensure that the results of data collection activities support the objectives of the surveys, or support a determination that these objectives should be modified. The data validation effort will be conducted in consideration of the guidance provided in Appendix N of MARSSIM.

Data Quality Assessment

An assessment of data quality will be performed to determine if the data are of the right type, quality, and quantity to support their intended use. The assessment will include assessment of data quality, application of the statistical tests used in the decision-making process, and the evaluation of the test results. The data validation effort will be conducted in consideration of the guidance provided in Chapter 8 and Appendix E of MARSSIM.



SEQUOYAH FUELS CORPORATION
DECOMMISSIONING PLAN

TITLE: CLASSIFICATION OF AREAS FOR FINAL RADIATION SURVEY

PREPARED BY: SFC
FILENAME: SFC0042A
REVIEWED BY: RHM
DATE: 11/20/98

FIGURE NO. 4-1

5.0 FUNDING

The costs associated with SFC's proposed decommissioning approach are presented in Table 2-2. This represents the best estimate of direct costs for performing the various decommissioning activities based upon conceptual designs studied thus far.

The funding plan and assurance for the funds for decommissioning has been addressed by the settlement agreement between the NRC and SFC which was approved by the Commission on October 8, 1997 (CLI 97-13). SFC provided a decommissioning cash flow projection to the NRC on February 25, 1997 based on available decommissioning cost and schedule information. The projection indicates that SFC will receive sufficient revenue to implement SFC's preferred decommissioning alternative provided that significant delays in the overall schedule do not occur. Table 5-1 provides the most recent estimate of decommissioning cash flow.

Table 5-1: CASH FLOW PROJECTION

	1993 ACTUAL	1994 ACTUAL	1995 ACTUAL	1996 ACTUAL	1997 ACTUAL	1998	1999
INCOME							
UF6 CONVERSION REVENUE	8,288	64	68	39	25	7	13
DUF4 REDUCTION REVENUE	4,562						
DISPOSITION OF INVENTORY	2,034	189	2,004	146	170	203	120
RANCH REVENUE	293	235	317	248	256	204	200
CONVERDYN FEES	7,386	5,098	2,111	7,099	8,088	5,543	4,667
TOTAL REVENUES	22,563	5,586	4,500	7,532	8,539	5,957	5,000
ACTIVITIES RELATED TO DECOMMISSIONING							
CLEAN-UP:							
RAFFINATE SLUDGE	1,633	273	7				
FERTILIZER PONDS	622	780	129	44	14	12	16
SHIP U308/URANIUM PRODUCTS	349	901	3				
DECOMMISSIONING:							
DECOMMISSIONING PLAN				179	144	120	200
SITE CHARACTERIZATION		167	464	140	8	7	
CONTRACTOR MOBILIZATION							
ENG/CONST. MGMT							
SLUDGE, SEDIMENT SOLID.							
CELL CONST/CLOSE							
SOIL REMEDIATION							
BUILDING DECONSTRUCTION							
SITE RESTORATION							
WASTE WATER MGMT						4	38
EIS SUPPORT					130	96	634
ADDL SITE RECL							
LONG TERM SITE CONTROL							
POST CLOSURE MONITORING							
GEN & ADMIN:							
PERSONNEL	7,617	5,878	2,002	2,143	2,103	1,944	1,811
NRC LIC./FEES	1,181	206	332	156	145	50	50
TAXES, INSUR. & OTHER	6,594	2,785	854	938	1,299	1,384	1,071
DUF4 OPERATING	1,773						
PLANT CLEAN-OUT	1,305	(178)					
TRANSITION COST	283						
INTEREST (INC)\EXP	396	162	259	270	(12)	(178)	(471)
RANCH COSTS	208	105	118	31	29	34	28
TOTAL COSTS	21,961	11,079	4,168	3,901	3,860	3,473	3,377
CASH MARGIN	602	(5,493)	332	3,631	4,679	2,484	1,623
(INCR)DECR IN RECEIVABLES	2,290	343	(1,239)	(1,135)	(413)	1,221	1,398
INCR(DECR) IN PAYABLES	(1,112)	2,950	1,148	(1,497)	(3,235)	(970)	(1,136)
PROJECTED NET CASH FLOW BEFORE KM DEBT REPAYMENT	1,780	(2,200)	241	999	1,031	2,735	1,885
CUMULATIVE CASH BALANCE	2,359	159	400	1,399	2,430	5,165	7,050

Table 5-1: CASH FLOW PROJECTION

	2000	2001	2002	2003	2004	2005	TOTAL
INCOME							
UF6 CONVERSION REVENUE	7	4	5	2			8,522
DUF4 REDUCTION REVENUE							4,562
DISPOSITION OF INVENTORY							4,863
RANCH REVENUE	200	200	200	200	200		2,753
CONVERDYN FEES	5,320	5,550	5,550	5,375	5,259	4,212	71,258
TOTAL REVENUES	5,527	5,754	5,755	5,577	5,459	4,212	91,961
ACTIVITIES RELATED TO DECOMMISSIONING							
CLEAN-UP:							
RAFFINATE SLUDGE							1,913
FERTILIZER PONDS							1,617
SHIP U308/URANIUM PRODUCTS							1,253
DECOMMISSIONING:							
DECOMMISSIONING PLAN							643
SITE CHARACTERIZATION							786
CONTRACTOR MOBILIZATION	650						650
ENG/CONST. MGMT	248	745	993	497			2,483
SLUDGE, SEDIMENT SOLID.	436	1,307	1,743	871			4,357
CELL CONST/CLOSE	385	1,155	1,540	770			3,850
SOIL REMEDIATION	92	277	369	185			923
BUILDING DECONSTRUCTION	470	1,410	1,880	940			4,700
SITE RESTORATION	222	668	890	446			2,226
WASTE WATER MGMT	50	125	175	108			500
EIS SUPPORT	334						1,194
ADDL SITE RECL							0
LONG TERM SITE CONTROL					2,124		2,124
POST CLOSURE MONITORING				20	20	20	60
GEN & ADMIN:							
PERSONNEL	1,811	1,811	1,811	1,195	598		30,724
NRC LIC./FEES	50	50	50	50	50		2,370
TAXES, INSUR. & OTHER	951	951	951	637	314		18,729
DUF4 OPERATING							1,773
PLANT CLEAN-OUT							1,127
TRANSITION COST							283
INTEREST (INC)\EXP	(320)	(201)				(205)	(345)
RANCH COSTS	41	41	41	41	41		758
TOTAL COSTS	5,420	8,339	10,443	5,760	3,147	(230)	84,698
CASH MARGIN	107	(2,585)	(4,688)	(183)	2,312	4,442	7,263
(INCR)DECR IN RECEIVABLES	(263)	(347)				1,000	2,855
INCR(DECR) IN PAYABLES	(1,175)	(250)	(250)	(39)			(5,566)
PROJECTED NET CASH FLOW BEFORE KM DEBT REPAYMENT	(1,331)	(3,182)	(4,938)	(222)	2,312	5,442	4,552
CUMULATIVE CASH BALANCE	5,719	2,537	(2,401)	(2,623)	(311)	5,131	

6.0 PHYSICAL SECURITY PLAN AND MATERIAL CONTROL AND ACCOUNTING PLAN PROVISIONS IN PLACE DURING DECOMMISSIONING

This section is not applicable to a uranium conversion facility.

7.0 PUBLIC PARTICIPATION

The public participation requirements of 10 CFR 20.1403(d) were adopted over four years after SFC ceased operations and initiated decommissioning planning and other related activities. Early in this process, however, SFC recognized the need to inform the public of its status and decommissioning plans and to gain input from potentially affected parties, particularly nearby residents and communities. SFC instituted a public outreach program in mid-1993 for the purpose of communicating with individuals, organizations and institutions in the community regarding SFC's decommissioning plans.

More than thirty-five presentations were made to a wide variety of organizations in the local community, providing information about the decommissioning plans. During these presentations, SFC representatives described the proposed decommissioning approach, including utilization of a disposal cell, the establishment of land use restrictions, and reliance on an independent third party (such as a government entity) for long-term monitoring and maintenance. Many of these presentations were covered by the media (newspapers and TV), and resulted in an even broader dissemination of the information than was provided by SFC. Attachment 1 to Appendix H lists the groups and individuals with whom SFC discussed its decommissioning plan.

Additionally, during the planning process the NRC conducted a series of public meetings in the vicinity of the facility and SFC held an open house and site tours to share information with the public about the decommissioning plans. NRC also conducted a public meeting intended to focus on the scope of the then planned Environmental Impact Statement (EIS). These SFC and NRC activities provided stakeholders with an early and meaningful opportunity to participate in the planning process. The scope of the meetings was broad and a broad cross-section of community interests was represented. Participants included representatives of other federal agencies, state agencies, local Native American tribal government, environmental organizations, and members of the local community.

During these interactions with the public, SFC representatives have described the proposed decommissioning approach, including utilization of a disposal cell, the establishment of land use restrictions, and reliance on an independent third party (such as a government entity) for long-term monitoring and maintenance. While most of these public meetings were conducted before adoption of 10 CFR 20.1403(d), and were not for the purpose of complying with that Section, they effectively achieved results similar to the public input it requires.

After NRC adopted guidance on the implementation of 10 CFR 20.1403(d), SFC supplemented these earlier public meetings by disseminating information regarding that regulation and SFC's decommissioning plans, and inviting a broad cross-section of the community to participate in discussing those plans, with particular emphasis on