TECHNICAL SPECIFICATIONS FOR THE SEQUOYAH FUELS CORPORATION DISPOSAL CELL

Prepared For:
Sequoyah Fuels Corporation
I-40 & Highway 10
Gore, Oklahoma 74435

Prepared By:
MFG Inc.
3801 Automation Way, Suite 100
Fort Collins, Colorado 80525

Final Revisions Prepared By:
Sequoyah Fuels Corporation
I-40 & Highway 10
Gore, Oklahoma 74435

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consulting
scientists and
engineers

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LIST OF DRAWINGS

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1.0 SPECIAL PROVISIONS

1.1 SCOPE OF DOCUMENT

The following technical specifications have been prepared for the construction, operation, and closure of the on-site disposal cell at the proposed Sequoyah Fuels Corporation (SFC) site near Gore, Oklahoma. These technical specifications have been prepared for review and approval by the U.S. Nuclear Regulatory Commission (NRC), and will form part of contracts for reclamation of the site, for work tasks conducted by contractors selected by and under contract with SFC.

1.2 DEFINITIONS

These technical specifications are referred to in this document as the Specifications. Sections referred to in this document are specific sections of the technical specifications. The Drawings referred to in this document are the construction drawings, issued for each phase of the project, that form a necessary component of these Specifications. These Specifications and Drawings comprise Attachment A of the SFC Reclamation Plan.

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For these Specifications, SFC is referred to as the Owner, with overall responsibility for disposal cell construction, operation, closure; as well as overall site reclamation.

The Contractor is defined as the group (or groups) selected by SFC and responsible for conducting the work tasks outlined in Section 1.3 under the direction of and under contract with SFC.

The QA Manager is defined as the person appointed by SFC responsible for inspection and Quality Assurance (QA) testing of construction work to ensure that the engineering aspects of site reclamation work are conducted as outlined in these Specifications.

The Reclamation Project Manager is defined as the person appointed by SFC responsible for ensuring that reclamation activities, including construction work and inspection and QA testing of construction, are conducted according to these Specifications and the intent of the design.

The Manager, Health and Safety is defined as the person appointed by SFC responsible for worker safety and personnel monitoring. The Manager, Health and Safety will be responsible for personnel safety training, personnel health monitoring, and documentation. These tasks will be conducted in accordance with the Health and Safety Plan for site reclamation work as well as pertinent sections of these Specifications.

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1.3 SCOPE OF WORK

The work outlined in these Specifications consists of execution of the following tasks associated with construction and operation of the disposal cell and associated site reclamation.

1. Preparation of borrow areas for material excavation by removal of vegetation; and stripping, salvaging, and stockpiling of topsoil.

2. Preparation of material staging and stockpile areas by removal of vegetation; stripping, salvaging, and stockpiling of topsoil; and providing for stormwater diversion and internal water collection.

3. Staged preparation of the disposal cell base and liner system for placement of on-site materials and construction of stormwater diversion and internal water collection facilities.

4. Removal of residual process and waste materials from ponds and storage areas on site, with treatment or dewatering, and placement in the disposal cell.

5. Removal of liner materials and contaminated subsoils from beneath waste material pond and storage areas, and placement in the disposal cell.

6. Excavation of process area structure foundations, paved areas, concrete pads and roadways, and placement of these materials in the disposal cell.

7. Excavation of contaminated subsoils from the process area, and placement in the disposal cell.

8. Construction of the cover system over the disposal cell, with placement of rock mulch and topsoil over the disposal cell cover surface.

9. Regrading and placement of topsoil over excavated areas, stockpile and staging areas, and other disturbed areas of the site.

10. Establishment of vegetation on the disposal cell surface and surrounding reclaimed areas on site.

Work not included in these Specifications consists of pressure filtration and bagging of raffinate sludge, off-site removal of raffinate sludge and associated materials, salvage of facility equipment, demolition of facility structures, groundwater monitoring and remediation, and post-reclamation performance monitoring.

1.4 APPLICABLE REGULATIONS AND STANDARDS

The work shall conform to applicable Federal, State, and County environmental and safety regulations. The work shall conform to applicable conditions in the Radioactive Materials License with NRC. Geotechnical testing procedures shall conform to applicable ASTM standards, as documented in the edition of standards in force at the start of work (ASTM, 2003 or future annual edition). Personnel safety procedures and monitoring shall be conducted in accordance with the Health and Safety Plan for site reclamation.

1.5 INSPECTION AND QUALITY ASSURANCE

Full-time, on-site training, personnel monitoring, and inspection of construction activities shall be conducted by the Manager, Health and Safety (and approved assistants as needed) while the site reclamation work is in progress. The Manager, Health and Safety (and assistants) will be independent representatives of SFC, appointed by SFC. The responsibilities and duties of the Manager, Health and Safety shall be as outlined in the Health and Safety Plan for site reclamation.

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Full-time, on-site inspection of all construction activities and quality assurance (QA) testing outlined in these Specifications shall be conducted by the QA Manager (and approved assistants as needed) while the construction work is in progress. The QA Manager (and assistants) will be independent representatives of SFC, appointed by SFC. The inspection and QA testing conducted by the QA Manager shall be under the supervision of the Reclamation Project Manager. Inspection and QA testing shall include the tasks listed below.

1. Observation of construction practices and procedures for conformance with the Specifications.

2. Testing material characteristics to ensure that earthen materials used in the construction conform to the requirements in the Specifications.

3. Testing liner material characteristics and installation to ensure placement, compaction, deployment, seaming, and other work practices conform to the requirements in the Specifications.

4. Documentation of construction activities, test locations, samples, and test results.

5. Notification of results from quality assurance testing to SFC and the Contractor.

6. Documentation of field design modifications or approved construction work that deviates from the Specifications.

Documentation outlined above shall be recorded by the QA Manager on a daily basis. Deviations from the Specifications shall be approved by the Reclamation Project Manager and the SFC President, with notification to NRC or other appropriate Oklahoma state regulatory agency personnel.

1.6 CONSTRUCTION DOCUMENTATION

During construction, documentation of construction inspection work will be recorded by the QA Manager on a daily basis. Documentation will include the following items.

1. Work performed by the Contractor.

2. QA testing and surveying work conducted.

3. Discussions with SFC and the Contractor.

4. Key decisions, important communications, or design modifications.

5. General comments, including weather conditions, soil or liner surface conditions, visitors to the site.

All earthwork and synthetic liner QA test results will be documented on a daily basis (on separate reporting forms), with a copy of the results given to the QA Manager by the end of the following working day after the testing. Photographs of key construction activities and critical items for documentation will be taken by the QA Manager or his representative.

A final construction report documenting the as-built conditions of the disposal cell will be submitted to NRC after the completion of disposal cell construction. This report will include the following items.

1. All design modifications or changes to the specifications that were made during construction.

2. An as-built layout of the disposal cell prior to material disposal, and at the completion of cover construction.

3. An as-built layout of other reclaimed areas of the site.

4. Documentation of soil cleanup verification work (soil radiation survey and soil sampling and analyses) in areas of contaminated soil excavation.

1.7 DESIGN MODIFICATIONS

Design modifications (due to unanticipated site conditions or field improvements to the design) will be made following the protocol outlined below.

1. Communication of modification with the Reclamation Project Manager, and approval of modification by the SFC President.

2. Documentation of modification in the as-built construction report.

1.8 ENVIRONMENTAL REQUIREMENTS

The Contractor shall store materials, confine equipment, and maintain construction operations according to applicable laws, ordinances, or permits for the project site. Fuel, lubricating oils, and chemicals shall be stored and dispensed in such a manner as to prevent or contain spills and prevent said liquids from reaching local streams or ground water. If quantities of fuel, lubricating oils or chemicals exceed the threshold quantities specified in Oklahoma regulations, the Contractor shall prepare and follow a Spill Prevention Control and Countermeasures Plan (SPCCP), as prescribed in applicable Oklahoma regulations. SFC shall approve said plan. Used lubricating oils shall be disposed of or recycled at an appropriate facility.

1.9 WATER MANAGEMENT

The Contractor shall construct and maintain all temporary diversion and protective works required to divert stormwater from around work areas. The Contractor shall furnish, install, maintain, and operate all equipment required to keep excavations and other work areas free from water in order to construct the facilities as specified.

Water required by the Contractor for dust suppression or soil moisture conditioning shall be obtained from wells or surface water storage areas identified by the Owner. Contaminated water will not be used for disposal cell construction.

1.10 HISTORICAL AND ARCHEOLOGICAL CONSIDERATIONS

Due to construction and operational activity at the site, it is unlikely that materials of historical or archeological significance are present in the disposal cell area. However, if materials are discovered or uncovered that are of potential historical or archeological significance, the Contractor shall immediately notify the Owner. The Owner may stop work in a specific area until the materials can be evaluated for historical, cultural, or archeological significance. All materials determined to be of significance shall be protected as determined by appropriate regulatory agencies, including removal or adjustment of work areas.

1.11 HEALTH AND SAFETY REQUIREMENTS

Work outlined in these specifications shall be conducted under the Health and Safety Plan for site reclamation, as directed by the Manager, Health and Safety.

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The Contractor shall suspend construction or demolition operations or implement necessary precautions whenever (in the opinion of the Reclamation Project Manager or Manager, Health and Safety), unsatisfactory conditions exist due to rain, snow, wind, cold temperatures, excessive water, or unacceptable traction or bearing capacity conditions. The QA Manager, Reclamation Project Manager, and Manager, Health and Safety each have the authority to stop Contractor work if unsafe conditions or deviations from specifications are observed.

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2.0 SITE CONDITIONS

2.1 SITE LOCATION AND LAYOUT

The SFC site is located in north-central Oklahoma, northeast of the confluence of the Illinois River with the Arkansas River (tributaries of the Robert S. Kerr Reservoir). The site encompasses approximately 600 acres on the east bank of the Illinois River, north of Interstate Highway 40 and west of Oklahoma State Highway 10. The SFC facilities are primarily located within the 85-acre process area (shown on the Drawings).

2.2 CLIMATE AND SOIL CONDITIONS

The site is in an area of warm, temperate, continental climate. Annual precipitation averages 39 to 45 inches, and is fairly evenly distributed throughout the year. Annual evaporation averages approximately 70 inches (for Class A pan data) and 50 inches (for shallow lake data).

The site is located on a ridge or upland area above the Illinois River, and is underlain by a horizontally bedded sequence of Pennsylvanian Atoka Formation sandstone, siltstone and shale. The Atoka Formation surface has been weathered and eroded, and mantled to varying depths with Pleistocene terrace deposits. Soils investigated from over 500 drill holes on site consist of the terrace deposits and weathered zones of the Atoka Formation. These soils range from sandy, clayey gravels to silty clays of moderate plasticity.

2.3 PAST SFC OPERATIONS

Uranium processing operations at the SFC site started in 1969 under a license with Kerr McGee Corporation. In 1993, SFC notified the NRC of its intent to terminate licensed activities at the site. The NRC license remains in effect until site decommissioning is completed.

2.4 FACILITIES DEMOLITION

Demolition of equipment, structures, and associated facilities at the SFC site will be conducted according to applicable conditions of the NRC license, the demolition plan for the facility, and the SFC Health and Safety Plan for site reclamation. Facilities demolition is not included in this document.

2.5 DISPOSED MATERIALS

The materials to be placed in the disposal cell consist of process waste materials, structural debris, and underlying liner materials and subsoils from planned site cleanup activities. The various materials to be placed in the disposal cell will be disposed in a planned sequence, depending on the timing of excavation. Materials with higher activity concentrations of radionuclides will generally be placed lower in the disposal cell. The four major types of materials are outlined below.

2.5.1 Type A Material

Type A materials consist of five components: (1) raffinate sludge, (2) Emergency Basin sediment, (3) North Ditch sediment, (4) Sanitary Lagoon sediment, and (5) Pond 2 residual materials. Due to the relatively high activity concentration of radionuclides in the first four components (the raffinate sludge and sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon), priority will be given to dispose of these materials at an appropriate offsite location. If it is determined that it is not economically possible to dispose of these materials offsite, these materials, along with the Pond 2 residual materials, shall comprise the lowest layer in the disposal cell profile, and will be placed over a prepared liner within the disposal cell.

Raffinate sludge and other selected Type A materials will be processed or “dewatered” by pressure filtration, with the resulting filtercake loaded by conveyor into polypropylene bags (approximately 3 feet by 3 feet by 4 feet), referred to as supersacks.

If the bagged filtercake is disposed on site, the bags will be placed in the south end of the disposal cell (shown on Drawings). The placed raffinate sludge bags will be encapsulated with an additional synthetic cover and liner system (Sections 5.2, 5.3 and 6.2.1).

2.5.2 Type B

Type B materials consist of soil liner and subsoil materials beneath the clarifier, calcium fluoride basin, Pond 3E, the Emergency Basin, the North Ditch and the Sanitary Lagoon, as well as Pond 1 spoils pile material. The Type B materials (primarily contaminated soils) are listed second in the order, since they will be excavated after removal of Type A materials and placed at the base of the disposal cell or directly on top of Type A materials in the disposal cell.

2.5.3 Type C

Type C materials consist of structural materials, concrete and asphalt, calcium fluoride basin materials, calcium fluoride sediments, and on-site buried materials. These materials will be placed with or above the Type B materials, and covered with contaminated soils (Type D materials).

2.5.4 Type D

Type D materials consist of contaminated soils and sedimentary rock on site that require excavation and placement in the disposal cell. Type D materials will be placed with and on top of Type C materials.

2.6 CELL CONSTRUCTION MATERIALS

Construction materials for disposal cell base and cover systems include soils and weathered sedimentary rock from on-site sources, and granular materials from off-site sources. These materials are outlined below, with selected source locations shown on the Drawings.

2.6.1 Cover Material

The subsoil zone of the cover will be obtained from on-site terrace deposit soils and weathered Atoka Formation shale and sandstone. Available sources of these materials are existing berms and embankments, underlying subsoils, and previously used borrow areas.

2.6.2 Liner Material

The clay liner in the disposal cell base and in the cover system will consist of fine-grained soils obtained from the soil borrow area at the south end of the site. These soils may be amended with off-site clays to meet liner permeability requirements.

2.6.3 Topsoil

Topsoil for the surface of the disposal cell and surrounding areas to be vegetated will be obtained from within the facility boundary.

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2.6.4 Rock Mulch

A layer of rock mulch will form the erosion protection zone on the side slopes and perimeter apron of the disposal cell. The sources of rock are nearby commercial sources of limestone or alluvial gravel and cobbles. Rock mulch shall meet the particle-size distribution and durability requirements outlined in Section 7.

2.6.5 Perimeter Apron Material

A layer of rock will form the erosion protection on the perimeter apron and as protection of Gully 005 from headward erosion. The sources of rock are nearby commercial sources of limestone or alluvial gravel and cobbles. Perimeter apron material shall meet the particle-size distribution and durability requirements outlined in Section 7.

2.6.6 Granular Materials

Granular materials will be used for (1) filter material, and (2) the synthetic liner cover and bedding layer for the cell liner and cover systems. Granular materials may also be used for subsurface fill for the cell base. The sources of these materials are nearby commercial sources of alluvial sand and gravel.

2.7 STAGING AND STOCKPILE AREAS

Areas on site identified as staging areas or stockpile locations will be approved by SFC. These areas will be constructed and used in a manner consistent with SFC plans for stormwater management.

2.8 ACCESS AND SECURITY

Access to the SFC site will be controlled at gated entrances through the existing Protected Area fence. The gated entrances will be operated by SFC.

2.9 UTILITIES

Utilities on site will be maintained by SFC outside of work areas (areas to be demolished or reclaimed). Utilities inside of work areas may be connected to SFC systems as approved by SFC or provided by the contractor. Utilities inside of work areas will be maintained by the Contractor.

2.10 SANITATION FACILITIES

Sanitation facilities will be maintained by the Contractor, in accordance with the Health and Safety Plan for site reclamation.

3.0 WORK AREA PREPARATION

3.1 GENERAL

This Section describes the preparation of site areas for reclamation. This work will be conducted according to applicable sections of the Health and Safety Plan for site reclamation.

3.2 WATER MANAGEMENT

Preparation for work in the site area will include the water management tasks outlined below.

1. Removal and treatment of fluids and removal and filtration of raffinate sludge from the clarifier ponds. The clarifier ponds liners will be cleaned and repaired if necessary for affected stormwater storage and treatment.

2. Removal, treatment and permitted discharge of water in the remaining existing ponds.

3. Diversion of clean area stormwater runoff from work areas (where facilities demolition and material excavation will take place) and from the disposal cell footprint area.

4. Collection of stormwater runoff from within the work areas and the disposal cell footprint for treatment and permitted discharge, or for disposed material compaction or dust control. The planned storage location for this affected stormwater is the clarifier pond system (after the ponds have been cleaned).

5. Isolation of water used for processing operations associated with reclamation (such as liquids from pressure filtration) from stormwater runoff.

Water from processing operations or other contaminated water will not be used for disposal cell construction.

3.3 PHASED CELL CONSTRUCTION

The disposal cell base will be constructed in phases. The layout of the three phases of cell base construction, as well as areas and facilities to be removed by phase are shown on the Drawings, and outlined below.

3.3.1 Phase I Area

The phase I (northeast) area of the disposal cell footprint is relatively clean, requiring minimal structure demolition and minor contaminated material or subsoil removal. The phase I area will be prepared by removal and stockpiling of structures and contaminated materials, followed by construction of the disposal cell base (Section 4).

3.3.2 Phase II Area

The phase II (northwest) area of the disposal cell footprint will be prepared by removal of sediments, liner, and contaminated soils from the phase II area of the disposal cell footprint. These materials will be disposed on the prepared liner system in the phase I area of the disposal cell. The residual excavated surface will be regraded or backfilled with subgrade fill to the desired subgrade surface. The phase II liner system will be constructed on the prepared subgrade surface (Section 4).

3.3.3 Phase III Area

The phase III (south) area of the disposal cell footprint will be prepared by removal of sediments, liner, and contaminated soils from the phase III area of the disposal cell footprint. These materials will be disposed on the prepared liner system in the phase II area of the disposal cell. The residual excavated surface will be regraded or backfilled with subgrade fill to the desired subgrade surface. The phase III liner system will be constructed on the prepared subgrade surface (Section 4).

3.3.4 Areas Outside of Cell

Materials from cleanup outside of the disposal cell will be disposed in the phase I, II, or III areas of the disposal cell.

3.4 COVER AND LINER SOIL BORROW AREAS

Disposal cell cover and liner system soils will be excavated from among the identified borrow areas on site.

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The use of specific soil borrow areas will be selected based on haul distance to the disposal cell, ease of excavation of cover material, geotechnical characteristics and uniformity of the borrow material, and acceptable radiological and geochemical characteristics.

Borrow area preparation will consist of setup for stormwater management (Section 3.2), clearing and stripping (Section 3.6).

3.5 TOPSOIL BORROW AREA

The topsoil borrow areas will be located within the facility boundary. Borrow area preparation will include mowing or shredding of existing vegetation prior to topsoil excavation.

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3.6 CLEARING AND STRIPPING

Many of the work areas have been used for processing or construction activities and are free from vegetation. For work areas that are vegetated, preparation work will include the tasks outlined below.

3.6.1 Clearing

Clearing of vegetation and grubbing of roots will be in identified work areas. Clearing and grubbing shall not extend beyond 20 feet from the edge of the work area, unless as shown on the Drawings or as approved by the Reclamation Project Manager.

Vegetation from clearing and grubbing shall be shredded, ground, chipped, or otherwise removed and disposed as approved by the Reclamation Project Manager. Alternative methods of on-site or off-site disposal or burning of stripped vegetation shall be conducted only as approved by the Reclamation Project Manager.

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3.6.2 Stripping

Stripping of salvageable topsoil (if present) shall be done within the entire work area. Stripping of topsoil shall not extend beyond 10 feet from the edge of the work area, unless approved by the Reclamation Project Manager. The depth of stripping of reclamation soil shall be based on the presence of suitable topsoil and approved by the Reclamation Project Manager. Water shall be added to the area of excavation if the soils are dry and stripping work is generating dust.

Topsoil shall be stockpiled in approved stockpile areas. The final stockpile surface shall be graded and smoothed to minimize erosion and facilitate interim revegetation of the stockpile surfaces.

4.0 DISPOSAL CELL BASE CONSTRUCTION

4.1 GENERAL

This section outlines the work associated with construction of the disposal cell base for receipt of materials (as described in Section 6.0). The base of the disposal cell will be lined with a compacted clay liner and synthetic liner system, with intermediate layers of granular materials that contain networks of perforated pipes. The cell base will be constructed in phases as shown on the Drawings and outlined in Section 3.3.

4.2 MATERIALS DESCRIPTION

4.2.1 Subgrade Fill

The disposal cell footprint is likely to have an irregular surface from areas that have been excavated for waste materials and sediments, contaminated liner soils and subsoils, and underground utilities. This excavated surface will be filled in low areas to form a smooth, competent foundation for liner system construction. Subgrade fill will be used for fill in excavated areas of the disposal cell footprint to meet desired grades and elevations for the disposal cell foundation (shown on the Drawings).

Subgrade fill will consist of off-site granular materials, soils and weathered sedimentary rock from approved on-site excavation areas, or crushed concrete. Subgrade fill shall be minus 6-inch size, and shall be free from roots, branches, rubbish, process area debris, and reinforcing steel. Subgrade fill shall have radionuclide activity concentrations lower than the selected subsurface soil cleanup level.

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4.2.2 Clay Liner

Clay liner material will consist of soils from approved on-site borrow areas. Clay liner material shall be minus 1-inch size, and shall be free from roots, branches, rubbish, and process area debris. Clay liner material shall have a minimum of 50 percent passing the No. 200 sieve and a minimum plasticity index of 10. Compacted clay material shall have a maximum saturated hydraulic conductivity of 1×10^{-7} cm/s (0.1 ft/yr). Clay liner material shall have radionuclide activity concentrations lower than the selected subsurface soil cleanup level.

4.2.3 Synthetic Liner Bedding Material

Synthetic liner bedding material shall consist of gravelly sand from off-site sources. Synthetic liner bedding material shall be free from roots, branches, rubbish, process area debris, and other angular or pointed materials that could damage the synthetic liner. Synthetic liner bedding material shall have radionuclide activity concentrations lower than the selected subsurface soil cleanup level. Synthetic liner bedding material shall meet the following particle-size specifications:

Sieve Size	Percent Passing
1 inch	100
No. 4	65-100
No. 16	25-85
No. 40	5-45
No. 200	0-10

In areas not immediately adjacent to leak detection pipe (more than 6 inches from the pipe), synthetic liner bedding material may consist of silty sand from nearby, alternative, sources. The material shall meet the same requirements as given above, with the following particle-size specifications:

Sieve Size	Percent Passing
1 inch	100
No. 4	95-100
No. 40	70-100
No. 100	20-90
No. 200	0-35

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4.2.4 Synthetic Liner

Synthetic liner material (geomembrane) shall be 60-mil nominal thickness HDPE, with smooth surfaces on both sides and material characteristics outlined in Section 5.2.1.

4.2.5 Synthetic Liner Cover

Synthetic liner cover material shall be placed over the synthetic liner to provide a cover material for protection of the synthetic liner during material placement.

Synthetic liner cover material shall consist of gravelly sand from off-site sources. Synthetic liner cover material shall be free from roots, branches, rubbish, process area debris, and other angular or pointed materials that could damage the synthetic liner. Synthetic liner cover material shall have radionuclide activity concentrations lower than the selected subsurface soil cleanup level. Synthetic liner cover material shall meet the following particle-size specifications:

Sieve Size	Percent Passing
1 inch	100
No. 4	65-100
No. 16	25-85
No. 40	5-45
No. 200	0-10

4.2.6 Synthetic Liner Anchor Backfill

Synthetic liner anchor backfill shall be placed over the synthetic liner to hold the edge of the synthetic liner in-place. The synthetic liner anchor backfill may be placed in anchor trenches or on flat extensions of synthetic liner along the perimeter of the lined area of the disposal cell. The method of synthetic liner anchoring shall be approved by the Reclamation Project Manager.

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Synthetic liner anchor backfill shall consist of soils and weathered sedimentary rock from approved on-site excavation areas. Synthetic liner anchor backfill shall be minus 1-inch size, and shall be free from roots, branches, rubbish, process area debris, and other angular or pointed materials that could damage the synthetic liner.

4.2.7 Leak Detection System Pipe

Leak detection system pipe (to be installed in the synthetic liner bedding material) shall consist of 4-inch diameter HDPE pipe (or approved equivalent). Pipe connections shall be welded according to manufacturer's recommendations. Leak detection system pipe shall be perforated within the perimeter of the disposal cell, with perforated sections starting a minimum of 20 feet inside of the perimeter berm (as shown on the Drawings). Perforations in leak detection system pipe shall be 1/8 inch (3 mm) in maximum diameter, with a minimum inlet area of 0.3 square inches per linear foot (6 square centimeters per linear meter) of pipe.

4.2.8 Leachate Collection System Pipe

Leachate collection system pipe (to be installed in the liner cover layer) shall consist of 6-inch diameter, SDR-11 HDPE pipe (or approved equivalent). Pipe connections shall be welded according to manufacturer's recommendations. Leak detection system pipe shall be perforated within the perimeter of the disposal cell, with slotted sections starting within the inside toe of the perimeter berm (as shown on the Drawings). Perforations in leachate detection system pipe shall be 1/8 inch (3 mm) in maximum diameter, with a minimum inlet area of 0.5 square inches per linear foot (10 square centimeters per linear meter) of pipe.

4.3 WORK DESCRIPTION

4.3.1 Foundation Preparation

The footprint of the disposal cell will consist of excavated areas, existing concrete pads, and areas with placed subgrade fill. The footprint of the disposal cell shall form a competent foundation for clay liner and cover construction. The surface of the disposal cell footprint shall be filled (where required) in low areas to form a smooth, competent foundation for clay liner and cover construction, as well as provide separation between the clay liner and underlying groundwater (where required). Subgrade fill (Section 4.2.1) shall be placed in lifts and compacted in excavated areas of the disposal cell footprint to meet desired grades and elevations for the disposal cell foundation (shown on the Drawings). The final filled surface shall be compacted with approved construction equipment to provide a foundation surface with uniform density for clay liner placement.

4.3.2 Subgrade Fill Placement

Subgrade fill (Section 4.2.1) shall be placed in lifts and compacted in excavated areas of the disposal cell footprint to meet desired grades and elevations for the disposal cell foundation. Subgrade fill may be (1) granular material from off-site commercial sources, or (2) soils and weathered sedimentary rock from approved on-site excavation areas.

For fine-grained subgrade fill (materials with more than 10 percent passing the No. 200 sieve), these materials will be placed in lifts not exceeding 8 inches in loose thickness. Each lift shall be compacted to a minimum of 90 percent of Standard Proctor density and within three percent of optimum moisture content for the material.

For coarse-grained or granular subgrade fill (materials with less than 10 percent passing the No. 200 sieve), these materials will be will be placed in lifts not exceeding 8 inches in loose thickness. Each lift shall be compacted by method specification to achieve a minimum relative density of 75 percent for the material. A test section will be established at the site to correlate the number of passes with vibratory equipment to the relative density of the granular material.

4.3.3 Disposal Cell Foundation Area

The disposal cell has been designed to accommodate a variation in total contaminated soil (Type D material) volume. The footprint of the disposal cell is established along the north, east, and west sides of the cell (shown on the Drawings). The location of the south side of the disposal cell (shown on the Drawings) will be based on a total disposed volume of approximately 9 million cubic feet. The final location of the south side of the disposal cell, the transition to the other sides of the cell, and the corresponding foundation area within the disposal cell will be established as the final volume of Type D material is determined during contaminated soil excavation.

4.3.4 Clay Liner Material Placement

Clay liner material (Section 4.2.2) shall be placed in lifts with maximum compacted thickness of 6 inches to form a continuous layer with a total minimum compacted layer thickness of 36 inches. Clay liner material shall be placed over the prepared subgrade surface of the disposal cell (Section 4.3.1). Along the perimeter of the disposal cell, the clay liner material shall be used to construct the perimeter berm (shown on the Drawings).

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Each lift of clay liner material shall be compacted to at least 95 percent of the maximum dry density for the material, as determined by the Standard Proctor test. During compaction, the material shall be within 2 percent above to 2 percent below optimum moisture content for the material, as determined by the Standard Proctor test. If water addition is required to achieve this range of moisture contents, the added water shall be thoroughly mixed into the material prior to compaction.

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Compaction of the clay liner material shall be done with a sheepsfoot or tamping-foot roller of sufficient weight to achieve the required compaction specifications. Rubber-tired equipment shall not be used solely to compact the clay liner material.

The top surface of compacted clay liner shall be covered with the liner bedding layer material (Section 4.3.5) within 24 hours of liner testing and approval.

4.3.5 Leak Detection System Pipe Installation

Leak detection system pipe (Section 4.2.7) shall be placed on the completed clay layer surface in the general layout (oriented for gravity drainage) shown on the Drawings. The nominal pipe spacing within the perimeter of the disposal cell shall be 40 feet. The pipe layout may be modified during construction to improve the rate of drainage, based on completed top-of-clay surface elevations. The pipe layout for a particular phase of the disposal cell is not connected to the pipe layout for the other phases of the disposal cell.

4.3.6 Synthetic Liner Bedding Layer Material Placement

Synthetic liner bedding material shall be placed over the footprint of the prepared disposal cell liner area to provide a protective bedding material for placement and installation of the synthetic liner. Synthetic liner bedding material (Section 4.2.3) shall be placed in one or more lifts to form a zone a minimum of 6 inches thick. The final synthetic liner bedding material surface shall be rolled with approved compaction equipment to form a smooth base for synthetic liner installation.

4.3.7 Synthetic Liner Material Installation

Synthetic liner material (Section 4.2.4) shall be installed on the final surface of the clay liner as outlined in Section 5.3.

4.3.8 Leachate Collection System Pipe Installation

Leachate collection system pipe (Section 4.2.8) shall be placed on the completed synthetic liner surface in the general layout (oriented for gravity drainage) shown on the Drawings. The nominal pipe spacing within the perimeter of the disposal cell shall be 60 feet or less. The pipe layout may be modified during construction to improve the rate of drainage, based on completed top-of-clay surface elevations. The pipe layout for a particular phase of the disposal cell is not connected to the pipe layout for the other phases of the disposal cell. .

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4.3.9 Synthetic Liner Cover Placement

Synthetic liner cover material shall be placed over the completed synthetic liner to provide a protective cover for placement of disposal material. Synthetic liner cover material (Section 4.2.5) shall be placed in one lift to form a zone a minimum of 18 inches thick. The lift of synthetic liner cover shall be placed with a small dozer or other approved equipment in a manner that does not tear, puncture, or otherwise damage the synthetic liner.

4.3.10 Synthetic Liner Anchor Backfill Placement

Liner anchor backfill placement and compaction shall be approved by the Reclamation Project Manager, and shall be conducted in a manner that does not tear, puncture, or damage the synthetic liner. The final liner anchor material surface shall be rolled with approved compaction equipment to match the adjacent synthetic liner cover surface.

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4.4 PERFORMANCE STANDARDS AND TESTING

4.4.1 Subgrade Testing

Where required, checking of compaction of compacted subgrade fill and the final subgrade surface shall consist of a minimum of one field density test per 1,000 cubic yards of material compacted. Field density tests shall be compared with Standard Proctor tests (ASTM D-698 Method A or C) or Maximum Index Density tests (ASTM D-4253) on the same material. Where required, Standard Proctor or Maximum Index Density tests shall be conducted at a frequency of at least one test per 2,000 cubic yards of material compacted, or when material characteristics show significant variation.

Field density testing may be conducted with the sand cone test (ASTM D-1556) or a nuclear density gauge (ASTM D-6938, or as modified by the QA Manager). Correlation of nuclear density gauge results shall be by comparison with results from sand cone test(s) and laboratory testing for water content(s) using the oven drying method on similar material.

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Subgrade fill shall be placed in low areas such that the completed top surface of subgrade fill shall be two feet above the highest level of groundwater in the terrace or Shale 1 unit.

4.4.2 Clay Liner Testing

Material specifications for the clay liner material shall be confirmed by gradation testing conducted by approved personnel. Testing shall consist of No. 200 sieve wash and maximum particle size testing (ASTM D-422), and Atterberg limit testing (ASTM D-4318) on samples of clay liner materials, at a frequency of at least one test per 2,000 cubic yards of fill placed, or when material characteristics show a significant variation.

Checking of compaction of the clay liner material shall consist of a minimum of one field density test per 1,000 cubic yards of material compacted. Field density tests shall be compared with Standard Proctor tests (ASTM D-698 Method A or C) on the same material. Standard Proctor tests shall be conducted at a frequency of at least one test per 2,000 cubic yards of material compacted, or when material characteristics show significant variation.

Field density testing may be conducted with the sand cone test (ASTM D-1556) or a nuclear density gauge (ASTM D-6938, or as modified by the QA Manager). Correlation of nuclear density gauge results shall be by comparison with results from sand cone test(s) and laboratory testing for water content(s) using the oven drying method on similar material.

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Permeability of the compacted clay liner material shall be confirmed by performing back pressure permeability testing by constant head or flow pump (EPA 9100 or ASTM D-5084) on samples of clay liner material recompacted to density and moisture of field placed compacted clay liner. Testing shall be completed at a frequency of one test per phase of cell base liner construction, or when material characteristics show significant variation.

The completed clay liner shall have a minimum thickness of 3.0 feet. The final surface of the clay liner shall slope toward the leak detection sump location, and shall be smoothed to avoid abrupt changes in surface grade.

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4.4.3 Synthetic Liner Bedding Layer Testing

If used in the disposal cell base, the completed synthetic liner bedding layer surface shall be constructed with a minimum thickness of 6 inches as shown on the Drawings. The final surface of the synthetic liner bedding material shall be smoothed or rolled to avoid abrupt changes in surface grade. The surface shall provide a smooth and unyielding foundation for the synthetic liner with no sharp or protruding objects. The final surface shall be inspected and approved by the QA Manager prior to initiation of liner installation.

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4.4.4 Synthetic Liner Testing

The synthetic liner panels and seams shall be tested as outlined in Section 5.4. The final synthetic liner surface shall be inspected and approved by the QA Manager prior to initiation of synthetic liner cover placement.

4.4.5 Synthetic Liner Cover Testing

Material specifications for synthetic liner cover material (Section 4.2.5) shall be confirmed by gradation testing conducted by approved personnel. Testing shall consist of No. 200 sieve wash and maximum particle size testing (ASTM D-422) at a frequency of at least one test per 2,000 cubic yards of fill placed, or when material characteristics show a significant variation.

4.4.6 Synthetic Liner Anchor Backfill Testing

Checking of compaction of the liner anchor backfill shall consist of a minimum of one field density test per 1,000 cubic yards of material compacted. Field density tests shall be compared with Standard Proctor tests (ASTM D-698 Method A or C) on the same material. Standard Proctor tests shall be conducted at a

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frequency of at least one test per 2,000 cubic yards of material compacted, or when material characteristics show significant variation.

Field density testing may be conducted with the sand cone test (ASTM D-1556) or a nuclear density gauge (ASTM D-6938, or as modified by the QA Manager). Correlation of nuclear density gauge results shall be by comparison with results from sand cone test(s) and laboratory testing for water content(s) using the oven drying method on similar material.

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5.0 SYNTHETIC MATERIAL INSTALLATION

5.1 GENERAL

This Specification Section describes the placement, seaming, testing, and protection of synthetic liner (geomembrane). Synthetic liner is to be installed: (1) at the base of the disposal cell, (2) surrounding the filtered raffinate sludge (if disposed on site), (3) in the cover system, and (4) on the inside slopes of the stormwater retention berms.

5.2 MATERIALS DESCRIPTION

5.2.1 Synthetic Liner

The synthetic liner shall be used on the base of the disposal cell, surrounding the filtered raffinate sludge, and in the bottom zone of the cover system (as shown on the Drawings). The synthetic liner shall consist of high-density polyethylene (HDPE) geomembrane. The nominal geomembrane thickness shall be 60 mil (0.060 inches). The synthetic liner at the base of the disposal cell and surrounding the filtered raffinate sludge (if disposed on site) shall have a smooth surface on both sides. The synthetic liner in the cover system shall have a textured surface on both sides.

The geomembrane shall be manufactured with products designed and manufactured for the purpose of liquid containment. The geomembrane shall conform to the following minimum physical requirements listed below:

Tensile strength at break	210 lbs/inch width
Elongation at break	700 percent

Labels on the geomembrane roll or panel shall identify the thickness, length, width, and manufacturer's mark number. Transport and storage of the geomembrane material shall be according to manufacturer's recommendations. Geomembrane rolls stored on site shall be kept off of the ground surface and covered. Prior to liner deployment, the outer liner surface of each roll shall be inspected for punctures, scratches or other damage. If the outer liner surface of the roll is damaged, the outer two wraps of the roll shall be removed and discarded prior to liner deployment.

The geomembrane shall be manufactured to be free of holes, blisters, undispersed raw materials, gels, or visible evidence of contamination by foreign matter. Any such defect shall render that roll or panel of material unacceptable for use and shall be replaced with material that is free of any such defects. Defects may be repaired in lieu of material replacement only upon approval of the QA Manager.

5.2.2 Stormwater Liner

If suitable materials of low permeability are not available for construction of the stormwater berms, the berms shall be constructed with a liner, on the inside slopes, to maintain stormwater containment within the berms.

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If used, the stormwater liner shall be placed on the inside slopes of the stormwater retention berms in the disposal cell (as shown on the Drawings). The stormwater liner shall consist of high-density polyethylene (HDPE) geomembrane with a smooth surface on both sides, or approved equivalent new material or on-site used material. The nominal geomembrane thickness shall be 40 mil (0.040 inches).

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The geomembrane shall be manufactured with products designed and manufactured for the purpose of liquid containment. The geomembrane shall conform to the following minimum physical requirements listed below:

Tensile strength at break	150 lbs/inch width
Elongation at break	700 percent

Labels on the geomembrane roll or panel shall identify the thickness, length, width, and manufacturer's mark number. Transport and storage of the geomembrane material shall be according to manufacturer's recommendations. Geomembrane rolls stored on site shall be kept off of the ground surface and covered. Prior to liner deployment, the outer liner surface of each roll shall be inspected for punctures, scratches or other damage. If the outer liner surface of the roll is damaged, the outer two wraps of the roll shall be removed and discarded prior to liner deployment.

The geomembrane shall be manufactured to be free of holes, blisters, undispersed raw materials, gels, or visible evidence of contamination by foreign matter. Any such defect shall render that roll or panel of material unacceptable for use and shall be replaced with material that is free of any such defects. Defects may be repaired in lieu of material replacement only upon approval of the QA Manager.

5.2.3 Geogrid

Geogrid (if used to improve bearing capacity of soft disposed materials) shall be HDPE or polypropylene material specifically manufactured for the purpose of bearing capacity support. The geogrid shall have minimum unit weight of 6 ounces per square yard and a maximum aperture size of 1.5 inches.

Transport and storage of the geogrid shall be according to manufacturer's recommendations. Geogrid rolls stored on site shall be kept off of the ground surface and covered. Prior to geogrid deployment, the outer liner surface of each roll shall be inspected for punctures, scratches or other damage. If the outer liner surface of the roll is damaged, the outer wrap of the roll shall be removed and discarded prior to geogrid deployment.

5.3 WORK DESCRIPTION

Installation of geomembrane, filter fabric, or geogrid shall be only on areas approved by the Reclamation Project Manager, as outlined in the Drawings.

5.3.1 Geomembrane Deployment

Individual panels of geomembrane shall be laid out and overlapped a minimum of 4 inches prior to welding, or as recommended otherwise by the manufacturer. Where possible, the overlapping panels shall be shingled, such that the up-slope panel is on top on the down-slope panel. On the side slopes, panels shall be placed with the long dimension perpendicular to the slope contours. The liner panel and roll number shall be marked on the panel and recorded as the material is being deployed.

The geomembrane shall not be placed during precipitation, high winds, or in the presence of excessive liner bedding material moisture. Geomembrane that has been damaged due to wind uplift shall be discarded.

5.3.2 Geomembrane Seaming

All geomembrane panel seams shall be welded to form a continuous, watertight barrier. The seams to be welded shall be cleaned and prepared according to manufacturer's guidelines to be free from dust, debris, oil, moisture, or other material that would interfere with liner seaming.

Panel seams shall be hot wedge welded whenever possible. This shall consist of two parallel welds along the overlap between liner panels that allow pressure testing of the channel between welds. Where wedge welding is not possible, field welds for the remaining seams shall be by a heat extrusion process.

Field welding shall form a continuous bond between the extrudate and liner material, according to the guidelines of the manufacturer. The field welding equipment shall be capable of continuously monitoring and controlling the temperatures and pressures in zone of contact where the machine is actually fusing the lining material to prevent changes in environmental conditions from affecting the integrity of the weld. Field welding shall be conducted when the air temperature (measured 12 inches above the synthetic liner surface) is between 30°F and 110°F. When the measured air temperature is outside of this range, field welding may be conducted, but only if the Contractor can demonstrate that seaming performance is acceptable (in terms of shear and peel testing outlined in Specification Section 5.4.3).

5.3.3 Geomembrane Anchoring

Around the perimeter of the lined area of the disposal cell, the edge of the geomembrane shall be continuously anchored as shown in the Drawings. The geomembrane shall extend a minimum of five feet beyond the outside toe of the perimeter berm. Backfill material (Section 4.2.6) shall be placed (as outlined in Section 4.3.10) to retain, in-place, the edge of the geomembrane.

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Along the liner anchor, welded panel seams shall extend a minimum of six inches beyond the outside toe of the perimeter berm

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Geomembrane anchoring shall be done when the air temperature above the liner is relatively cool, in order to minimize liner shrinkage due to decreasing temperature after the liner is anchored.

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5.3.4 Geomembrane Repairs

Geomembrane installation shall be done without puncturing, tearing, or otherwise damaging the geomembrane panels or seams. No vehicles shall be driven or parked on top of the uncovered geomembrane. Punctures, overlaps (fishmouths), or other unacceptable liner conditions shall be repaired with an overlapping patch bonded to the geomembrane by field welding. Geomembrane patching shall be done with the patch material extending a minimum of six inches beyond the puncture, tear, or joint in the liner. Small punctures may be patched with extrusion welds, only if approved by the QA Manager. Repair of damage to the deployed geomembrane and testing of geomembrane patches will be the responsibility of Contractor, with repairs approved by the QA Manager.

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5.3.5 Geomembrane Protection

Upon completion of geomembrane seaming, the liner shall be protected from uplift due to wind by placing sand bags or similar approved material on the liner surface. These protective materials shall be of a spacing and weight sufficient to prevent uplift or movement of the liner without puncturing, tearing, or otherwise damaging the geomembrane.

5.3.6 Geogrid Installation

Rolls of geogrid shall be handled and unrolled according to manufacturer's guidelines. The edges and ends of the geogrid rolls shall have a minimum overlap of six inches. Where necessary, the overlapped edges of the geogrid shall be tied together according to manufacturer's guidelines.

5.3.7 Liner Boot Installation

Where the leak detection pipe system (Section 4.3.9) or leachate collection pipe system (Section 4.3.10) penetrate the synthetic liner at the perimeter of the disposal cell, the penetrating pipes shall be sealed to the synthetic liner with an HDPE liner boot (as shown on the Drawings). The liner boot shall be installed and seamed to the synthetic liner and the HDPE pipe according to manufacturer's recommendations.

5.4 PERFORMANCE STANDARDS AND TESTING

5.4.1 General Requirements

Testing of the installed geomembrane shall consist of the following items.

1. Visual examination of the panels upon delivery to the site, with documentation of the panel thickness, length, width, and manufacturer's mark number and receipt of mill certification and material property data.

2. Physical examination of the panels upon unfolding and spreading, with checking of nominal widths and examination for material flaws or defects.

3. Pressure testing of the air channel between panel seam welds, as outlined in Specification Section 5.4.2.

4. Destructive (shear and peel) tests on seam samples extracted from all panel seams at a frequency equivalent to one sample collected from up to 1000 linear feet of seam. If the integrity of the seam, weather conditions, or welder operation are of concern to the QA Manager, the maximum spacing shall be reduced to one sample for 500 linear feet of seam. Tests are outlined in Specification Section 5.4.3.

5. Vacuum testing of all extrusion welded seams and patch seams, as outlined in Specification Section 5.4.4.

6. Physical examination of the completed liner surface, checking for liner damage, punctures and defects in seaming.

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5.4.2 Air Channel Testing

Each geomembrane panel seam shall be tested by air pressure testing of the air channel between parallel seams. The minimum air channel test pressure shall be 30 psi, with a maximum pressure drop of 3 psi over a 5-minute test period.

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5.4.3 Shear and Peel Tests

Each sample cut from the seamed geomembrane shall be tested for both shear and peel tests. The shear (or bonded seam strength) test shall be conducted according to ASTM D-3083 and ASTM D-638, and have a shear strength of 120 lb/inch width of seam. The peel (or peel adhesion) test shall be conducted according to ASTM D-413 and ASTM D-638, and have a minimum peel strength of 70 lb/inch width of seam. Failure for both tests shall be in a ductile manner and observed at the film bond to be acceptable.

Each type of test shall be performed on five replicate specimens from each material sample (equivalent to five shear tests and five peel tests per material sample). The test results shall be reported individually, with four out of five tests meeting strength requirements being acceptable.

In the event of a failed test (less than four of five tests meeting strength requirements), additional samples shall be collected at 50-foot intervals along the seam on either side of the failed sample location, with additional sampling and testing conducted until tested seam conditions are acceptable. The seam in the failed test area between the acceptable test locations shall be extrusion welded and tested.

5.4.4 Vacuum Testing

All extrusion welded geomembrane seams shall be tested with a vacuum box. The minimum vacuum shall be equivalent to 5 psi (10 inches of mercury). Seam failure shall be assessed by complete loss of vacuum or presence of bubbles.

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5.4.5 Testing Documentation

The QA Manager shall review all geomembrane liner test results made by the Contractor and conduct independent tests as necessary. All flaws in the seams or liner panels resulting from the installation shall be repaired and approved by the QA Manager prior to approval for covering with liner cover material.

Geomembrane panel and seam locations, seam test results, repair locations, and seam test results shall be marked on the liner surface and documented by the QA Manager. Final approval of the liner testing will be determined by the QA Manager, based on having acceptable QA test results.

6.0 MATERIAL DISPOSAL

6.1 GENERAL

This section outlines the work associated with placement of materials in the disposal cell. Material placement will be according to the phases of cell construction shown on the Drawings and outlined in Section 3.3.

6.2 MATERIALS DESCRIPTION

Process area materials with similar characteristics have been organized into groups for disposal in specific layers within the disposal cell. Their location in the process area dictates the phase of the disposal cell area where the material will be placed. The types of materials to be disposed in the cell are outlined below.

6.2.1 Stabilized Calcium Fluoride Sludge

A portion of calcium fluoride sludge (Type C materials) will be placed as an initial layer on the completed disposal cell base (Section 4). The calcium fluoride sludge will be used as a tracer for subsequent leak detection purposes. Calcium fluoride sludge shall be mixed with fly ash prior to placement in the disposal cell at a ratio of one part fly ash to no more than two parts calcium fluoride sludge. The mixture shall be placed over the disposal cell base in all three phases of the disposal cell.

6.2.2 Type A Materials

Type A materials consist of five components: (1) raffinate sludge, (2) Emergency Basin sediment, (3) North Ditch sediment, (4) Sanitary Lagoon sediment, and (5) Pond 2 residual materials. The locations of these materials are shown on the Drawings.

Due to the relatively high activity concentration of radionuclides in the first four components (raffinate sludge and sediments from Emergency Basin, North Ditch and Sanitary Lagoon, priority will be given to dispose of these materials at an appropriate offsite location. If it is determined that it is not economically possible to dispose of these materials offsite, these materials, along with Pond 2 residual materials, will comprise the lowest layer in the disposal cell profile, and be placed early in the disposal sequence for each phase of the cell (on top of the stabilized calcium fluoride sludge).

Raffinate sludge is being processed or "dewatered" by pressure filtration, with the resulting filtercake loaded by conveyor into polypropylene bags (approximately 3 feet by 3 feet by 4 feet), referred to as supersacks. The supersacks of filtercake are planned for removal from the site.

In the event that the resulting filtercake is disposed on site, the bags will be placed within the disposal cell (shown on Drawings). The placed raffinate sludge bags will be encapsulated with an additional synthetic liner system (Sections 5.2 and 5.3).

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6.2.3 Type B Materials

Type B materials include soil liner and subsoil materials beneath the clarifier, Pond 4, the Emergency Basin, the North Ditch and the Sanitary Lagoon, as well as Pond 1 spoils pile material. Type B materials also include interim soil storage cell materials and soils from the equipment storage area. The locations of these materials are shown on the Drawings.

The Type B materials (primarily contaminated soils) are second in the disposal order, since these materials will be excavated after removal of Type A materials and will have the second highest activity concentrations of radionuclides. Where feasible, Type B materials will be placed over, or adjacent to, Type A materials in the disposal cell profile or over other prepared areas of the disposal cell liner system.

6.2.4 Type C Materials

Type C materials consist of structural materials, concrete and asphalt, calcium fluoride basin materials, calcium fluoride sediments, residual calcium fluoride sludge (not used for stabilized sludge, Section 6.2.1), calcium fluoride basin liners and subsoils, and on-site buried materials. The locations of these materials are shown on the Drawings. Type C materials will be placed directly over, or adjacent to, Type A materials, with Type B materials, or over other prepared areas of the disposal cell liner system.

6.2.5 Type D Materials

Type D materials consist of contaminated soils and sedimentary rock that require cleanup. The approximate area of Type D material cleanup is shown on the Drawings.

Type D materials will be placed over, or adjacent to, Type A, B, or C materials, or over other prepared areas of the disposal cell liner system. Type D materials will be used to cover plant equipment and structural debris (Type C materials) to minimize void spaces, and may be used for additional bedding material for plant equipment and structural debris. Type D materials may comprise the primary component of the stormwater retention berms for the disposal cell, depending on schedule and availability.

6.3 WORK DESCRIPTION

6.3.1 Stabilized Calcium Fluoride Sludge Placement

Calcium fluoride sludge shall be stabilized or solidified by mixing with fly ash at a maximum sludge to fly ash ratio of two to one by volume, using mixing techniques approved by SFC. The mixture shall be placed in lifts at least six inches thick but not to exceed one foot in loose thickness and compacted as outlined in Section 6.3.4.5. The mixture shall be placed on completed disposal cell base (Section 4) in all three phases of cell construction. Stabilized calcium fluoride sludge may be used to construct stormwater retention berms. Stabilized calcium fluoride sludge may also be placed and compacted around demolition debris to minimize void spaces.

6.3.2 Type A Material Placement

Type A materials (Section 6.2.2) that are not filtered (if disposed on site), will be dewatered or solidified/stabilized to eliminate free water prior to placement in the cell. Type A materials will be placed within the disposal cell in lifts prior to covering with additional Type A materials or with Type B materials. Type A materials, other than dewatered raffinate sludge, may also be placed and compacted around demolition debris to minimize void spaces.

If disposed on site, raffinate sludge filtercake bags (Section 6.2.2 shall be placed within disposal cell (shown on the Drawings). A supplemental liner and cover system shall be constructed around the filtercake bags, as outlined in Section 6.3.6

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6.3.3 Type B Material Placement

Type B materials will be placed within the disposal cell in lifts and spread (if necessary) to allow consolidation and drying of wet materials. Type B materials (Section 6.2.3) will be placed directly over, or adjacent to, Type A materials, within the lined area of the disposal cell, or over other prepared areas of the disposal cell liner system.

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6.3.4 Type C Material Placement

Type C materials will be placed within the disposal cell in lifts. Type C materials (Section 6.2.4) will be placed directly over or adjacent to, Type B or C materials, or over other prepared areas of the disposal cell liner system. The preparation and placement of various Type C materials is outlined below.

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6.3.4.1 Material Sizing and Preparation

Demolition debris to be placed in the disposal cell will consist of equipment and structural material from facilities demolition. The demolition procedures are outlined in the Facility Demolition Plan (Reclamation Plan attachment F). Because of the wide variety in shape and size of demolition debris, material of odd shapes will be cut or dismantled, to the extent practical, prior to disposal to facilitate handling and placement as well as minimize void spaces in the disposal cell. The maximum size of dismantled or cut materials shall not exceed 20 feet in the longest dimension. Smaller dimensions may be necessary for loading, handling, hauling, and placement of material in the disposal cell.

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6.3.4.2 Incompressible Debris

Material that is not compressible (steel columns and beams, concrete, and other solid material) shall be reduced in size for loading, hauling, and placement in the disposal cell. Incompressible debris shall be placed, oriented, or spread in a manner that minimizes void spaces below, between, and above these materials. Incompressible debris shall be placed on and covered with soils or similar materials (Specification Section 6.2.5). Incompressible debris such as steel members shall be placed in the disposal cell with the longest dimension oriented horizontally.

Thick-walled pipe, conduit, tanks, vats, pressure vessels, and other hollow materials that will not be crushed or dismantled shall be transported to the planned location within the disposal cell and oriented for filling and burial. Voids larger than 6 inches in all dimensions, or across (the diameter of) a conduit, on the inside of items, shall be filled with random fill, sand, or grout, prior to burial. Contaminated soil (Section 6.2.5) or sand will be placed outside of the item and compacted with standard compaction equipment (where possible) or hand-operated equipment to the compaction requirements in Specification Section 6.3.4.6. Several lifts of compacted contaminated soil may be necessary to fill around and cover these items.

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6.3.4.3 Compressible Debris

Materials that are compressible (such as thin-walled piping and thin-walled tanks) shall be flattened or crushed in the disposal cell, prior to final placement in the disposal cell. Flattening or crushing shall be done with hydraulic excavator attachments, or with a dozer or other steel-tracked equipment.

These materials shall be placed in the disposal cell and spread to form a lift with a maximum thickness of two feet. Spreading shall be done in a manner resulting in materials laying flat and minimizing void spaces.

6.3.4.4 Soils and Similar Materials

Soils and soil-like materials to be placed in the disposal cell will be from on-site areas identified by SFC for excavation (Sections 6.2.4 and 6.2.5). Soil or soil-like material (Type A (other than dewatered raffinate sludge), B, C, or D material) shall be placed and compacted over each lift of debris (Section 6.3.4.2 or 6.3.4.3) or other Type C materials in lifts not to exceed two feet in loose thickness and compacted prior to placement of additional lifts. Soils will also be used for interim soil cover to minimize exposure of demolition materials and other Type C materials to air and meteoric water. Soils may be placed in the disposal cell to provide access for, and to prevent the contamination of, equipment working to place materials in the cell.

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6.3.4.5 Material Compaction

Soil or similar Type C material shall be compacted with a minimum of six passes with self-propelled, towed, or hand-held vibratory compaction equipment. The number of passes shall be confirmed with actual compaction equipment on site with a field test section of soil to establish a correlation between the field compaction method and 95 percent of maximum dry density for the soil, as determined by the Standard Proctor test.

6.3.5 Type D Material Placement

Type D materials (Section 6.2.5) will be placed directly over Type A, B, or C materials, or over other prepared areas of the disposal cell liner system. Type D soil shall be placed in lifts not exceeding two feet in loose thickness, and shall be compacted with a minimum of six passes with vibratory compaction equipment to work the soil downward into underlying void spaces (if present). The number of passes shall be confirmed with actual compaction equipment on site with a field test section of soil to establish a correlation between the field compaction method and 95 percent of maximum dry density for the soil, as determined by the Standard Proctor test.

6.3.6 Raffinate Sludge Liner and Cover

If disposed on site, the raffinate sludge filtercake bags (supersacks) shall be placed in the designated area of the disposal cell (the raffinate cell), as shown on the Drawings. The supersacks shall be encapsulated within the raffinate cell with synthetic liner (Section 5.2.1), installed along the bottom of the raffinate cell, and over the top of the raffinate cell. Materials beneath the lsynthetic liner and above the covering synthetic liner shall be free of angular rock or debris that may puncture, tear, or damage the synthetic liner. The supersacksshall be placed in lifts one or two bags high on top of the synthetic liner (Section 5.2.1) along the bottom of the raffinate cell. Void spaces between bags (if present) shall be filled with selected disposed materials, following placement of each lift of bags. The final bag surface (after void spaces have been filled) shall be covered with synthetic liner (Section 5.2.1) that is seamed to the synthetic liner, beneath the bags, along the perimeter of the raffinate cell as shown on the Drawings. The raffinate cell shall be covered with disposed materials in compacted lifts to reach the bottom-of-cover grades. The first lift of disposed materials over the synthetic liner, over the top of the raffinate cell, shall be placed with a minimum compacted thickness of 18-inches.

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6.3.7 Stormwater Retention Berms

Type D and C soils shall be used to construct stormwater retention berms. The stormwater retention berms shall be initially constructed on top of the liner material inside the perimeter berms, as shown on the Drawings. Initial stormwater retention berm construction shall be on the lower sides of the phases of the disposal cell. As material is placed in the disposal cell, the stormwater retention berms are

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constructed on outside slopes of each phase to maintain capacity for storage of stormwater on the top of each phase of the cell.

The stormwater retention berm material shall be placed in lifts not exceeding 24 inches in compacted thickness, with slopes and crest widths as shown on the Drawings. The stormwater retention berms shall be constructed in phases or raises to maintain adequate freeboard (five feet minimum) for stormwater above the level of disposed materials inside the stormwater retention berms.

If used, the stormwater liner shall be anchored on the berm crest and continued past the inside toe of the berm onto disposed materials or liner cover material, as shown on the Drawings.

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6.4 PERFORMANCE STANDARDS AND TESTING

6.4.1 Stormwater Retention Berm

Each phase or raise of stormwater retention berm material shall be placed in lifts not exceeding 24 inches in compacted thickness. Phases or raises shall be constructed in an upstream manner, or inside of the previous raise. The outside slopes of the stormwater retention berms shall be 3:1 (horizontal:vertical) or flatter, unless approved otherwise by the Reclamation Project Manager for temporary material storage capacity. The berm crest widths, for areas where vehicles will traffic the berms, shall be a minimum of 15 feet. Where traffic along the berm crest is not planned, the berm crest configuration shall be approved by the Reclamation Project Manager. The crest elevation of the stormwater retention berm shall be a minimum of five feet above the level of disposed materials inside the stormwater berms.

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6.4.2 Final Slope and Grades

The final disposed material surface shall have maximum side slopes of 5:1 and a top surface sloping in the direction shown on the drawings at a nominal slope of 1 percent. The side slopes and top surface shall be free from abrupt changes in grade or areas of runoff concentration. The final disposed material surface shall be compacted with approved construction equipment to form a smooth surface with uniform density for subsequent cover placement.

The upper six inches of the final disposed material surface shall be compacted to 90 percent of the maximum dry density for the material, as determined by the Standard Proctor test. During compaction, the material shall be within 1 percent above to 4 percent below optimum moisture content for the material, as determined by the Standard Proctor test. If water addition is required to achieve this range of moisture contents, the added water shall be thoroughly mixed into the material prior to compaction.

Checking of compaction of the final disposed material surface shall consist of a minimum of one field density test per 1,000 cubic yards of material compacted. Field density tests shall be compared with Standard Proctor tests (ASTM D-698 Method A or C) on the same material. Standard Proctor tests shall be conducted at a frequency of at least one test per 2,000 cubic yards of material compacted, or when material characteristics show significant variation.

Field density testing may be conducted with the sand cone test (ASTM D-1556) or a nuclear density gauge (ASTM D-6938, or as modified by the QA Manager). Correlation of nuclear density gauge results shall be by comparison with results from sand cone test(s) and laboratory testing for water content(s) using the oven drying method on similar material.

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7.0 DISPOSAL CELL COVER CONSTRUCTION

7.1 GENERAL

This section outlines the work associated with construction of the disposal cell cover.

7.2 MATERIALS DESCRIPTION

7.2.1 Clay Liner

Clay liner material will consist of soils from approved on-site borrow areas (Section 3.4). Clay liner material shall be minus 1-inch size, and shall be free from roots, branches, rubbish, and process area debris. Clay liner material shall have a minimum of 50 percent passing the No. 200 sieve and a minimum plasticity index of 10. Compacted clay liner material shall have a maximum saturated hydraulic conductivity of 1 x 10^{-7} cm/s. Clay liner material shall have radionuclide activity concentrations lower than the selected subsurface soil cleanup level.

7.2.2 Synthetic Liner

Synthetic liner material shall be 60-mil nominal thickness HDPE, with textured surfaces on both sides and material characteristics outlined in Section 5.2.1.

7.2.3 Liner Cover Material

Synthetic liner cover material shall be placed over the synthetic liner to provide a cover material for protection of the synthetic liner during material placement.

Synthetic liner cover material shall consist of gravelly sand. Synthetic liner cover material shall be free from roots, branches, rubbish, process area debris, and other angular or pointed materials that could damage the synthetic liner, and meet the following particle-size specifications:

Sieve Size	Percent Passing
1 inch	100
No. 4	60-100
No. 16	25-100
No. 40	35-90
No. 200	5-35

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7.2.4 Subsoil Zone

The subsoil zone of the cover will consist of soils from approved on-site borrow areas (Section 3.4). Subsoil zone material shall be minus 6-inch size, and shall be free from roots, branches, rubbish, and process area debris. Subsoil zone material shall have a minimum of 10 percent passing the No. 200 sieve.

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7.2.5 Rock Mulch

The rock mulch will be placed on the disposal cell side slopes and edge of top surface (as shown on the Drawings) for erosion protection. Rock mulch material shall be shall be free from roots, branches, rubbish, and debris.

The rock portion of the rock mulch will consist of granular materials from approved off-site areas meeting NRC long-term durability requirements (a rock quality designation of 65 or more, as outlined in Appendix D of NUREG-1623, Design of Erosion Protection for Long-TermStabilization). The specifications as given below are for rock quality designations of 72 or higher. If actual rock quality designation is between 65 and 71, additional oversizing will be required. Rock quality designations below 65 will not be acceptable.

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If limestone from the Souter Quarry is used for the rock portion of the rock mulch, the median particle size shall be no less than 5.3 inches. The rock portion of the rock mulch shall be angular and meet the following particle-size specifications:

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Percentile	Particle Size	
	Inches	mm
D_{90}	7.8 – 11.8	198 – 300
D_{50}	5.2 – 9.3	132 – 236
D_{10}	1.5 – 3.0	38 – 76

Sieve Size	Percent Passing
12 inch (305 mm)	100
2 inch (51 mm)	0 – 18

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The soil portion of the rock mulch will consist of select material from the on-site topsoil borrow area (Section 3.5).

7.2.6 Perimeter Apron Rock

Material for the perimeter apron and Gully 005 erosion protection will consist of granular materials from approved off-site areas. The perimeter apron rock will be placed along the toe of the disposal cell and in the Gully 005 erosion protection area (as shown on the Drawings). Perimeter apron rock shall meet NRC long-term durability requirements (a rock quality designation of 65 or more, as outlined in Appendix D of NUREG-1623, Design of Erosion Protection for Long-Term Stabilization).

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Perimeter apron rock shall be shall be free from roots, branches, rubbish, and debris. The specifications as given below are for rock quality designations of 72 or higher. If actual rock quality designation is between 65 and 71, additional oversizing will be required. Rock quality designations below 65 will not be acceptable.

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If limestone from the Souter Quarry is used for perimeter apron rock, the median particle size shall be no less than 9.3 inches, and shall meet the following particle-size specifications:

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Percentile	Particle Size	
	Inches	mm
D_{90}	12.2 – 19.3	310 – 490
D_{50}	9.2 – 14.9	234 – 379
D_{10}	2.5 – 5.7	64 – 145

Sieve Size	Percent Passing
20 inch (508 mm)	100
6 inch 152 mm)	10 – 36
3 inch (76 mm)	0 – 15

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7.2.7 Erosion Protection Filter

Erosion protection filter material will be placed under the perimeter apron rock at the head of the Gully 005 erosion protection feature (as shown on the Drawings). The material shall meet NRC long-term durability requirements (a rock quality designation of 60 or more, as outlined in Appendix D of the 1990 NRC Staff Technical Position, Design of Erosion Protective Covers).

Erosion protection filter material shall be shall be free from roots, branches, rubbish, and debris. If limestone from the Souter Quarry or alluvial material from nearby commercial gravel pits are used for erosion protection filter, the median particle size shall be no less than 0.5 inches, and shall and meet the following particle-size specifications:

Sieve Size	Percent Passing
3 inch	100
1-½ inch	55-100
¾ inch	30-75
No. 4	0-45
No. 10	0-25

7.2.8 Topsoil

Topsoil will consist of select material from on-site topsoil borrow areas (Section 3.5).

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7.3 WORK DESCRIPTION

7.3.1 Base Preparation

The final disposed material surface shall be prepared as outlined in Section 6.4.2, and shall be free from sharp objects that would interfere with clay liner placement.

7.3.2 Clay Liner Placement

Clay liner material (Section 7.2.1) shall be placed in lifts with maximum compacted thickness of 6 inches to form a continuous layer with a total minimum compacted layer thickness of 24 inches. Clay liner material shall be placed over the prepared surface of the disposal cell (Section 6.4.2).

Each lift of clay liner material shall be compacted to at least 95 percent of the maximum dry density for the material, as determined by the Standard Proctor test. During compaction, the material shall be within 2 percent above to 2 percent below optimum moisture content for the material, as determined by the Standard Proctor test. If water addition is required to achieve this range of moisture contents, the added water shall be thoroughly mixed into the material prior to compaction.

Compaction of the clay liner material shall be done with a sheepsfoot or tamping-foot roller of sufficient weight to achieve the required compaction specifications. Rubber-tired equipment shall not be used solely to compact the clay liner material.

Compacted clay liner shall be covered with the synthetic liner upon completion of testing and approval. The clay liner must meet all specifications at the time of synthetic liner installation.

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7.3.3 Synthetic Liner Installation

Synthetic liner material (Section 7.2.2) shall be installed on the final surface of the clay liner as outlined in Section 5.3.

7.3.4 Liner Cover Material Placement

Synthetic liner cover material shall be placed over the completed synthetic liner to provide a protective cover for the syntehitic liner. Liner cover material (Section 7.2.3) shall be placed in one lift to form a zone a minimum of 18 inches thick. The lift of synthetic liner cover shall be placed by dumping material and pushing liner cover material over synthetic liner with a small dozer or other approved equipment. Synthetic liner cover placement shall be done in a manner that does not tear, puncture, or otherwise damage the synthetic liner.

7.3.5 Subsoil Zone Placement

Subsoil zone material (Section 7.2.4) shall be placed in lifts of 12-inch maximum loose thickness to form a uniform subsoil layer for the cover system with a minimum thickness of 5.0 feet on the top surface of the disposal cell and a minimum thickness of 4.75 feet on the side slopes of the disposal cell.

7.3.6 Rock and Filter Material Placement

Rock mulch (Section 7.2.5), perimeter apron rock (Section 7.2.6), and erosion protection filter material (Section 7.2.7) shall be placed to the thicknesses outlined in the Drawings and using the methods outlined below. Unless approved otherwise by the QA manager, each type of material shall be placed in one lift to avoid segregation or degradation of particles.

Erosion protection filter material shall be handled, loaded, transported, stockpiled, and placed in a manner that minimizes segregation. Filter material shall be placed in or near its final location by dumping, then spread with a small dozer or other suitable equipment. Filter material shall be placed and spread in a manner that minimizes displacement of underlying cover soils or natural soils. Each layer of filter material shall be track-walked with a small dozer, or densified by other approved methods. The placed thickness of the filter material shall meet the minimum thickness of six inches prior to rock placement.

The rock portion of the rock mulch shall be handled, loaded transported, stockpiles, and placed in a manner that minimizes segregation. Rock mulch material shall be placed in or near its final location by dumping, then spread with a small dozer or other suitable equipment. Rock mulch material shall be placed and spread in a manner that minimizes displacement of underlying cover soils or natural soils. Each layer of rock mulch material shall be track-walked with a small dozer or densified by other approved methods. The placed thickness of the rock portion of the rock mulch shall meet the minimum thickness of ^ 12 inches prior to the addition of the soil portion of the rock mulch.

Following placement of the rock portion of the rock mulch, topsoil (Section 7.2.8) shall be placed and spread in one or more lifts to form a uniform layer. The soil shall be compacted into the voids of the underlying rock with a vibratory roller/compactor.

The completed layer of rock mulch and filter material shall be well-graded in particle-size distribution and free from pockets of smaller material and free from large voids or loose areas.

Perimeter apron rock shall be handled, loaded, transported, stockpiled, and placed in a manner that minimizes segregation. Rock shall be placed in or near its final location by dumping, then spread with a small dozer, the bucket of a trackhoe, or other suitable equipment. Rock shall be placed and spread in a

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manner that minimizes displacement of underlying cover soils, natural soils or filter material. Each layer of placed rock shall be tamped with the bucket of a trackhoe or densified by other approved methods to form an interlocking rock surface. The placed thickness of the perimeter apron rock shall meet the minimum thickness requirement of ^36 inches. No equipment shall travel over the completed surface of the perimeter apron rock unless approved by the QA manager.

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7.3.7 Topsoil Placement

Topsoil (Section 7.2.8) shall be placed in one or more lifts to form a uniform layer with a final thickness of nine inches on the side slopes and perimeter apron and 18 inches on the top surface of the disposal cell (shown on the Drawings).

7.4 PERFORMANCE STANDARD AND TESTING

7.4.1 Clay Liner Testing

Material specifications for the clay liner material shall be confirmed by gradation testing conducted by approved personnel. Testing shall consist of No. 200 sieve wash and maximum particle size testing (ASTM D-422), and Atterberg limit testing (ASTM D-4318) on samples of clay liner materials, at a frequency of at least one test per 2,000 cubic yards of fill placed, or when material characteristics show a significant variation.

Checking of compaction of the clay liner material shall consist of a minimum of one field density test per 1,000 cubic yards of material compacted. Field density tests shall be compared with Standard Proctor tests (ASTM D-698 Method A or C) on the same material. Standard Proctor tests shall be conducted at a frequency of at least one test per 2,000 cubic yards of material compacted, or when material characteristics show significant variation.

Field density testing may be conducted with the sand cone test (ASTM D-1556) or a nuclear density gauge (ASTM D-6938, or as modified by the QA Manager). Correlation of nuclear density gauge results shall be by comparison with results from sand cone test(s) and laboratory testing for water content(s) using the oven drying method on similar material.

Permeability of the compacted clay liner material shall be confirmed by performing back pressure permeability testing by constant head or flow pump (EPA 9100 or ASTM D-5084) on samples of clay liner material recompacted to density and moisture of field placed compacted clay liner. One test shall be completed during cover construction, or when material characteristics show significant variation.

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The completed clay liner shall have a minimum thickness of 2.0 feet. The final surface of the clay liner shall be smoothed to avoid abrupt changes in surface grade.

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7.4.2 Synthetic Liner Testing

The synthetic liner panels and seams shall be tested as outlined in Section 5.4. The final synthetic liner surface shall be inspected and approved by the QA Manager prior to initiation of synthetic liner cover placement.

7.4.3 Synthetic Liner Cover Testing

Material specifications for synthetic liner cover material (Section 7.2.3) shall be confirmed by gradation testing conducted by approved personnel. Testing shall consist of No. 200 sieve wash and maximum particle size testing (ASTM D-422) at a frequency of at least one test per 4,000 cubic yards of fill placed (a minimum of 10 tests on the liner cover sand), or when material characteristics show a significant variation.

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7.4.4 Subsoil Zone Material Testing

Material specifications for the cover material shall be confirmed by gradation testing conducted by approved personnel. Testing shall consist of No. 200 sieve wash and maximum particle size testing (ASTM D-422) on samples of cover materials, at a frequency of at least one test per 10,000 cubic yards of fill placed (a minimum of 15 tests on the subsoil material), or when material characteristics show a significant variation. Cover material compaction will be verified by the maximum lift thickness outlined in Section 7.3.5.

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7.4.5 Rock Mulch Testing

The gradation specifications for the rock used for rock mulch material (Specification Section 7.2.5) shall be confirmed by gradation testing conducted by approved personnel. Testing shall consist of particle-size distribution testing (ASTM D-^ 5519 or equivalent) ^ on eight (or more) samples from the selected rocksource representing initial production, 1/3 of production, 2/3 of production, and completion of production of the rock mulch. Four samples must be tested for the first one-third of the material produced, at least one additional test for each remaining third of the material volume produced, and one final test representative of the end of the produced material. Samples must be representative of the produced volume. Particle-size testing shall be completed at the intervals prescribed, and additionally if rock characteristics show a significant variation.

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The durability of the rock used for rock mulch material shall be verified by durability tests outlined in Appendix D of the 1990 NRC Staff Technical Position, Design of Erosion Protective Covers. The rock used for the rock mulch material shall have a minimum rock quality designation of ^ 80. Rock with a rock quality designation between ^ 65 and ^ 79 will require additional oversizing to the particle-size distribution given in Specification Section 7.2.5.

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If limestone from the Souter Quarry is used for the rock portion of the rock mulch and the perimeter apron rock, durability tests shall be conducted on four (or more) samples from the selected rock source representing initial production, 1/3 of production, 2/3 of production, and completion of production of the rock mulch and perimeter apron materials.

Gradations on the rock mulch material, including the minimum median particle size (D_{50}) and durability properties shall be sapmled from the quarry, tested, confirmed, and documented prior to delivery to the site. A licensed professional geologist or engineer shall visually inspect the rock, at the source, during production on a regular basis for consistency, irregularities, joints, and planes of weakness that may affect the durability.

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Rock mulch thickness will be established during construction with grade stakes placed on a grid pattern and layer thickness marks on each grade stake. The minimum thickness of the rock mulch layer will be verified by spot checking of layer thickness by excavation in selected locations.

7.4.6 Perimeter Apron Rock Testing

Material specifications for the perimeter apron rock shall be confirmed by gradation testing conducted by approved personnel. Testing shall consist of particle-size distribution testing (ASTM D-^ 5519 or equivalent) on eight (or more) samples from the selected rocksource representing initial production, 1/3 of production, 2/3 of production, and completion of production of the rock mulch. Four samples must be tested for the first one-third of the material produced, at least one additional test for each remaining third of the material volume produced, and one final test representative of the end of the produced material. Samples must be representative of the produced volume. Particle-size testing shall be completed at the intervals prescribed, and additionally if rock characteristics show a significant variation.^

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The durability of the rock shall be verified by durability tests outlined in Specification Section 7.4.5.

Gradations on the rock mulch material, including the minimum median particle size (D_{50}) and durability properties shall be sapmled from the quarry, tested, confirmed, and documented prior to delivery to the site. A licensed professional geologist or engineer shall visually inspect the rock, at the source, during production on a regular basis for consistency, irregularities, joints, and planes of weakness that may affect the durability.

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Rock layer thickness will be established during construction with grade stakes placed on a grid or centerline and offset pattern and layer thickness marks on each grade stake. The minimum thickness of the perimeter apron rock layer will be verified by spot checking of layer thickness by excavation in selected locations.

7.4.7 Erosion Protection Filter Testing

Material specifications for erosion protection filter material (Section 7.2.7) shall be confirmed by gradation testing conducted by approved personnel. Testing shall consist of No. 200 sieve wash and maximum particle size testing (ASTM D-422) at a frequency of at least one test per 2,000 cubic yards of fill placed, or when material characteristics show a significant variation.

The durability of the erosion protection filter material shall be verified upon selection of the material source by durability tests outlined in Appendix D of the 1990 NRC Staff Technical Position, Design of Erosion Protective Covers. The material shall have a minimum rock quality designation of 60. Durability tests shall be conducted on two representative samples from the selected material source.

Filter layer thickness will be established during construction with grade stakes placed on a grid or centerline and offset pattern and layer thickness marks on each grade stake. The minimum thickness of the layer will be verified by spot checking of layer thickness by hand excavation in selected locations.

7.4.6 Topsoil Testing

Topsoil will be sampled for agronomic properties to evaluate the need for growth medium amendments. If topsoil will be collected from different borrow areas on-site, at least one sample from each borrow area should be tested for agronomic properties.

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7.4.7 Surface Slopes and Grades

The final cover surface shall have maximum side slopes of 5:1 and a top surface sloping in the direction shown on the drawings at a nominal slope of 1 percent. The side slopes and top surface shall be free from abrupt changes in grade or areas of runoff concentration. The perimeter apron at the toe of the side slopes shall have a minimum width of 20 feet from the toe of the side slopes and slope away from the toe of the side slopes (as shown on the Drawings).

8.0 REVEGETATION

8.1 GENERAL

Following topsoil placement on the disposal cell, the cover surface will be revegetated. This section describes the requirements for vegetation establishment and where additional vegetation establishment efforts are required. This section may be revised as necessary based on field requirements and soil analysis.

8.2 MATERIALS DESCRIPTION

The following section describes the types of soil amendments, seed mixture, transplant species, and erosion control materials that will be used to achieve vegetation establishment. Submittals for each of the following products shall be provided to SFC for approval prior to use of such products.

8.2.1 Soil Amendments

In order for the cover to function properly as a plant growth media, soil amendments may be needed. Topsoil material will be tested to determine fertilizer requirements, for nutrient availability, pH, texture, and organic matter content. The results from these analyses will be used as a guide for determining site-specific topsoil amendment requirements.

8.2.2 Seed Mix

Species selection for the seed mixture was based on native vegetation found at the site area as well as soil and climatic conditions of the area. Tree species shall not be included in the seed mixture. Changes to the seed mixture will be approved by SFC. The following seed mixture shall be used on all seeded areas.

Scientific Name	Common Name	Seeding Rate (lbs pure live seed/acre)
Andropogon gerardii	Big bluestem	6.0
Schizachyrium scoparium	Little bluestem	3.0
Panicum virgatum	Switchgrass	2.0
Sorghastrum nutans	Indiangrass	2.0
Elymus villosus	Hairy wildrye	2.0
Solidago altiplanities	High plains goldenrod	1.5
Helianthus petiolaris	Prairie sunflower	1.5
Silphium laciniatum	Compassplant	0.5
Liatris Gaertn. Ex Schreb.	Blazing star	0.5
Rhus microphylla	Littleleaf sumac	2.0
	TOTAL	21.0

8.2.3 Erosion Control Materials

Certified weed-free straw shall be applied to all seeded areas at the rate of 2 tons per acre. Straw mulch shall be applied with a blower designed for such purposes.

8.3 WORK DESCRIPTION

Revegetation efforts shall be directed at all areas included in the disposal cell cover. The goal of the revegetation plan is to ensure that a self-sustaining vegetative community is established.

8.3.1 Soil Amendment Application

Following the final placement and grading of the cover, lime will be applied to those areas identified by soil analysis that require an increase in soil pH. The application of lime will be performed by broadcast spreader. Rates of application will be determined from the soil analysis report.

Organic amendments consisting of manure, sewage sludge, wood chips, or similar organic material will be applied to all seeded areas that are shown to contain less than 2 percent organic matter. Rates of application will be determined from the soil analysis report.

Inorganic sources of nitrogen, phosphorus, and potassium will be applied to the soil by broadcast spreader. Rates of application will be determined from previous soil analyses.

8.3.2 Growth Zone Preparation

A favorable seedbed shall be prepared prior to seeding operations. The soil should be loose and friable so as to maximize contact with the seed. Tillage operations not only prepare the seedbed, but also incorporate soil amendments. The soil will be tilled, following site contours with a disc (or similar approved equipment) to a depth of 6 inches. The depth of valleys and the height of ridges caused by the final tillage operations are not to exceed 2 inches. Thus, the total maximum difference from the top of ridges to the bottom of valleys will be 4 inches. Harrowing may be required to further prepare the soil for seeding.

8.3.3 Seed Application

Seeding will follow the application of soil amendments and seedbed preparation, either by drill seeding or broadcast spreading. Seed shall be drilled to a depth of 0.25 to 0.75 inches by a conventional drill; drilling orientation shall follow the contour of the land. Seed shall be drilled at the specified application rate. Seed shall be applied by broadcast spreader at two times the specified application rate. Broadcast seed shall be harrowed into the soil to a depth of 0.25 to 0.75 inches.

8.3.4 Erosion Control Material Application

Immediately following seeding operations, straw shall be blown over the seeded area. The rate of application shall be 2 tons per acre. Straw should be applied in a uniform manner with no obvious clumping of straw at the soil surface. Following the application of straw, plantago based tackifier (or approved equivalent) shall be applied by a hydromulcher at the rate of 150 pounds per acre. Sufficient water shall be used to apply the tackifier in a uniform manner.

8.4 PERFORMANCE STANDARD AND TESTING

The following section describes performance-based criteria for successful revegetation.

8.4.1 Vegetation Establishment Performance

Total vegetative cover sampling shall be performed at a future date to ascertain vegetation establishment success. The revegetation effort shall be deemed successful if the total vegetation cover on the disposal cell cover is at least 70 percent of the total cover of a nearby background reference area for two consecutive years. Areas that do not meet this performance criterion will be reseeded.

8.4.2 Erosion Control

The disposal cell cover shall be inspected two times per year for eroded areas. Any area that has experienced erosion shall be backfilled and reseeded. Straw shall also be applied over the reseeded area.

8.4.3 Weed Control

The cover shall be inspected for the presence of weedy species at least two times per year: once in late spring, and once in mid-summer. Weed species should be identified and the approximate coverage should be noted. Spot-spraying of weeds may be necessary to control unwanted species. Growth of trees on the cover shall be prevented as long as SFC retains control of the site.