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Technical Specifications

Leachate Collection and Storage Facility Operable Unit No. 7

Draft Report

October 1994

DRAFT

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Rocky Flats Environmental Technology Site
Golden, Colorado

ADMIN RECCRD

DOCUMENT CLASSIFICATION
REVIEW WAIVER PER
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EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual:
Section:
Effective Date:
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RF/ER-94-00044
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Technical Specifications
Leachate Collection and Storage Facility
Operable Unit No. 7

APPROVED BY:

Group II Closures Manager

Date

Project Manager

Date

QA Manager

Date

Table of Contents

1. SECTION 01010 - SUMMARY OF WORK
2. SECTION 01200 - PROJECT MEETINGS
3. SECTION 01300 - SUBMITTALS
4. SECTION 01510 - TEMPORARY SERVICES
5. SECTION 01560 - DISPOSAL AND TEMPORARY CONTROLS
6. SECTION 01600 - MATERIALS AND EQUIPMENT
7. SECTION 01700 - CONTRACT CLOSEOUT
8. SECTION 02102 CLEARING AND GRUBBING
9. SECTION 02221 TRENCH EXCAVATION AND BACKFILL
10. SECTION 02224 - RIP RAP
11. SECTION 02232 - AGGREGATE BASE COURSE
12. SECTION 02233 - WATERING
13. SECTION 02271 - HIGH-DENSITY POLYETHYLENE LINER
14. SECTION 02272 - GEOTEXTILE
15. SECTION 02274 - HIGH-DENSITY POLYETHYLENE PIPE AND MANHOLE
16. SECTION 02276 - DRAIN ROCK
17. SECTION 02662 - TESTING OF PIPING SYSTEMS
18. SECTION 02723 - PRESSURE PIPING AND APPURTENANCES
19. SECTION 03310 - CONCRETE
20. SECTION 15021 - SUBMERSIBLE PUMP
21. SECTION 15025 - LEACHATE STORAGE TANKS
22. SECTION 16010 - ELECTRICAL

SECTION 01010 - SUMMARY OF WORK

Part 1 General

1-1. Description

- A. The work of this contract consists of the general construction of a leachate collection and storage facility at the OU 7 landfill site including a French drain and pumping facility, forcemain, and tank storage.
- B. All work will be performed under a single contract.

1-2. Location

The work of this project is located in the OU 7 Landfill at the Rocky Flats Technology Site, in Jefferson County, Colorado.

1-3. Contractor's Use of Premises

- A. Confine storage of materials to areas specifically designated by DOE and EG&G representative.
- B. Preservation of Natural Features: Confine all operations within the work limits of the project. Exercise care to maintain natural surroundings undamaged.
- C. Grades: All grades, lines, levels, and bench marks required for the project shall be established and maintained by the Contractor. Verify all grades, lines, levels, and dimensions as indicated on Drawings and report any errors or inconsistencies to Engineer before commencing work. Contractor shall be held responsible for correctness of all work.
- D. Materials: It is the Contractor's responsibility to be certain that all equipment and materials selected by him, or for him by his subcontractors or material suppliers, conform exactly to the requirements of the Drawings and Specifications. Approval of manufacturer's name by Engineer does not relieve Contractor of responsibility for providing materials and equipment which comply with Contract Documents.

- E. **Covering Up Work:** No contractor or subcontractor shall cover up or conceal work of another contractor/subcontractor until same has been thoroughly tested and approved.
- F. **Mechanical and Electrical Work:** Mechanical and electrical drawings are generally diagrammatic; and unless specifically dimensioned, the locations of fixtures, outlets, equipment, and the routing of piping, mechanical and electrical shall be located and confirmed by the Contractor. It is the responsibility of the Contractor to coordinate the work of his mechanical and electrical subcontractors. To this end, the Contractor shall require that various mechanical and electrical subcontractors carefully examine and familiarize themselves with the architectural and structural drawings and other drawings covering the work of other trades and that they consult frequently with all other trades so that work may be properly coordinated.
- G. **Codes:** Work will meet the requirements of UBC current edition (if more rigid than those specified herein govern), the latest edition of the National Electrical Code, the National Plumbing Code, and the National Board of Fire Underwriters. Also comply with applicable laws, statutes, regulations, ordinances of federal, state, and county requirements, and as may be further referenced in this Specification.
- H. **Dimensions and Measurements:** Figured dimensions on drawings or notes indicating dimensions shall be used instead of measurements of the drawings by scale and shall be strictly complied with.
- I. **Number of Specified Items Required:** Whenever a piece of equipment, an article, or device is referred to in singular number, such reference applies to as many such items as are shown on the Drawings or required to complete the work.
- J. **Manufacturer's Specifications, Recommendations, and Instructions:** Manufacturer's specifications, recommendations, or instructions for installing materials, equipment, or appurtenances furnished as a part of this Contract shall govern the installation unless in conflict with the Specifications for the project or unless local conditions prevent installations in the prescribed manner in which case approval of Engineer shall be obtained before proceeding with this part of the work.

6

Reference to manufacturer's specifications shall mean and intend the latest specification for the product so mentioned. Equipment specifications are based on models and/or construction and installation methods prevailing at the date of receipt of bids. Equipment installations requiring modification due to manufacturer's model and/or construction changes and other variations from the items specified shall be furnished and installed at no additional cost to DOE and EG&G.

- K. Special Words and Drawing Methods: Where the word "similar" occurs on drawings, it shall be used in its general sense and not as meaning identical; and all details shall be worked out in relation to their location and their connection to other parts of the work.

Where on any drawings a portion of the work is drawn out and the remainder is indicated in the outline, the drawn out parts shall apply also to other like portions of the work. Where ornament or other detail is indicated by the starting only, such details shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts in the work, unless otherwise indicated.

These Specifications are of the abbreviated or "streamlined" type and include incomplete sentences. Omission of words or phrases, such as "the Contractor shall," "in conformity therewith," "shall be," "as noted on the Drawings," "according to the plans," "an," "the," and "all" are intentional. Omitted words or phrases shall be supplied by inference in the same manner as they are when a "note" occurs on the Drawings. Wherever the words "as approved," "satisfactory," and "directed" are used, it shall be assumed that the word "Engineer" follows the verb as the object of the clause. The word "shown," "indicated," or similar words or phrases are used, it shall be assumed that the words "on the drawing" follow.

1-4. *Contractor-Furnished Items: All Materials*

Part 2 Materials - Not Used

Part 3 Execution - Not used

SECTION 01200 - PROJECT MEETINGS

Part 1 General

1-1. *Preconstruction Conference*

Before start of construction, DOE, EG&G, and Engineer will arrange an onsite meeting with Contractor. The meeting agenda will include the following:

Correspondence procedures

Designation of responsible personnel

Changes

Payments to Contractor

Subcontractors

Documents required under the contract

Tentative construction schedule

Health and Safety

Submittal of shop drawings, project data, and samples

Part 2 Materials - Not used

Part 3 Execution - Not used

4

SECTION 01300 - SUBMITTALS

Part 1 General

1-1. *Submittal Procedure*

- A. At least 30 days prior to his need for the materials, the Contractor shall forward to Owner's representative all submittals required by the individual sections of the specifications. Unless a different number is called for in the individual sections, submit five copies of each shop drawing, five copies of all operation and maintenance instructions, and three specimens of each sample requested, three of which will be retained by the Owner. Two shall be returned to the Contractor. Each submittal shall be consecutively numbered and accompanied by a transmittal form. When submittals are returned they shall be marked "May be Furnished", "May be Furnished, Note Comments, Resubmittal Not Required", "Note Comments/Markings, Resubmittal Required", or "Rejected, Resubmit". If marked "May be Furnished" the Contractor may use the material as submitted on the project. If marked, "May be Furnished, Note Comments, Resubmittal Not Required" the Contractor shall meet the conditions of all comments and may use the revised material on the project. If marked "Note Comments/Markings Resubmittal Required" the Contractor shall revise the submittal to meet all comments and markings and resubmit five copies. If marked "Rejected, Resubmit", the Contractor shall revise the submittal to meet specifications and resubmit five copies.
- B. All materials, equipment, construction methods, mechanical or electrical layouts, and architectural devices require shop drawings.
- C. Engineering data covering all equipment and materials to be furnished under the Contract Documents shall be submitted to the Engineer for review and approval. This data shall include drawings and descriptive information in sufficient arrangement, and operation of component materials and devices, external connections, anchorages and supports required, performance characteristics, and dimensions needed for installation and correlation with other materials and equipment or both. Data to be submitted shall include drawings, as required, clearly indicating essential details of any changes in design or construction proposed by the Contractor and all required wiring and piping layouts. O & M brochures shall also be submitted at this time.

EG&G Rocky Flats Plant	Manual:	RF/ER-94-00044
OU 7 Leachate Collection and Storage	Section:	Submittals, Rev. 0
Facility Technical Specifications	Effective Date:	2 of 5
Category	Organization:	RPD

No work shall be performed in connection with the fabrication or manufacture of materials, equipment, devices, or items shown by any drawing thereof, nor shall any accessory appurtenance, or device, not fabricated or manufactured by the Contractor or his subcontractor, be purchased until the drawing or drawings and data therefor have been reviewed and marked "May be Furnished", or "May be Furnished, Note Comments, Resubmittal Not Required" except at the Contractor's own risk and responsibility.

- D. Submittals that are related to or affect each other shall be forwarded simultaneously as a package to facilitate coordinate review. Uncoordinated submittals will be rejected.
- E. Owner reserves the right to require submittals in addition to those called for in individual sections.

1-2. *Owner's Review*

Owner will indicate his review comments, if resubmittal is required, reasons for the resubmittal shall be included. When submittals have been revised, five shall be resubmitted. Any work done before approval shall be at Contractor's own risk. The Owner's review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures therefrom. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

1-3. *Shop Drawings:*

- A. The term "shop drawings" includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by Contractor to explain in detail specific portions of the work required by the contract.
- B. Contractor shall coordinate all such drawings, and review them for legibility, accuracy, completeness and compliance with contract requirements, and shall indicate his approval thereon as evidence of such coordination and review. Shop drawings submitted to Owner without evidence of Contractor's approval will be returned for resubmission.

- C. Approval by Owner shall not relieve Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with requirements of this contract, except with respect to variations described and approved in accordance with Paragraph D below.
- D. If shop drawings show variations from contract requirements, Contractor shall describe such variations in writing, separate from the drawings, at time of submission. All such variation must be reviewed and stamped by Owner.

1-4. *Owner and Maintenance Instructions*

Manufacturer's printed instructions shall include installation instructions, operation instructions, schematics for electrical systems, maintenance literature, and parts lists.

O & M Brochures (three each) shall be submitted with the shop drawings. The brochure shall include:

1. Installation instructions
2. Start-up procedure
3. Typical sectional drawings
4. Parts list
5. Troubleshooting and service instructions
6. Routine maintenance instructions
7. Operational procedures
8. Shutdown procedures
9. Instructions for any required testing
10. Instructions for determining any required chemical feed rates
11. List of recommended spare parts

12. List of recommended safety equipment

General brochures shall be acceptable as long as they contain the above information on the specific equipment provided and as long as inapplicable information is crossed off. Two copies of O & M brochures shall be returned with the shop drawings.

After all submittals have been made and approved and prior to 90% completion of the project, the Contractor shall furnish to the Engineer three complete sets of O & M brochures, indexed and bound in three ring binders.

1-5. *Certificates*

For those items called for in individual sections, furnished certificates from manufacturers, suppliers, or others certifying that materials or equipment being furnished under the contract comply with the requirements of these specifications.

1-6. *Samples*

Samples shall be of sufficient size to clearly illustrate functional characteristics and full range of color, texture, and pattern.

1-7. *Progress Schedule*

Within 15 calendar days after receiving Notice of Award and before any work is begun, submit four copies of a Progress Schedule (normally in bar chart form) showing estimated starting and completion dates for each part of the work. The first progress payment will not be issued until the progress schedule is submitted.

1-8. *Schedule Of Values*

- A. Submit a schedule of dollar values for the various portions of the work. The schedule shall be based on the Contract Bid Schedule or Bid Form and Shall include all bid items.
- B. Each lump-sum bid item and each unit price bid item that involves a series of operations shall be broken down into component parts for which progress payments are desired by Contractor. The dollar value of each component shall include a directly proportional amount

EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual:
Section:
Effective Date:
Organization:

RF/ER-94-00044
Submittals, Rev. 0
5 of 5
RPD

of overhead and profit. The total costs for the component parts shall equal the amount bid by the Contractor for that item, and the total cost of all items shall equal the contract sum.

C. When requested, show dollar values with data to show their correctness. The Schedule of Values will form the basis for progress payments as provided in the General Provisions.

1-9. *Review Of Schedules*

Submit Schedule of Values and Progress Schedule as a package. Both the Progress Schedule and the Schedule of Values shall be subject to review by Owner both for format and content.

Part 2. Materials Not Used

Part 3. Execution Not Used

EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual:
Section:
Effective Date:
Organization:

RF/ER-94-00044
Temporary Services, Rev. 0
1 of 1
RPD

SECTION 01510 - TEMPORARY SERVICES

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of providing temporary services required for Contractor's performance of the Contract.

PART 2: MATERIALS

2-1 GENERAL: Materials may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

2-2 SANITARY FACILITIES: Sufficiently lighted and ventilate toilet facilities in weatherproof, sightproof, sturdy enclosures.

2-3 FIRE PROTECTION EQUIPMENT: UL Class 2A, 2-1/2 gallon water type, stored pressure extinguisher and UL Class 10, Type I, 15 pound, B:C carbon dioxide extinguisher.

PART 3: EXECUTION

3-1 GENERAL: The Contractor shall provide and shall pay all costs for necessary heat, electricity, electrical power, temporary heat, wiring, and other utilities for construction purposes until final acceptance of the project. At his own expense, the Contractor shall make any additional necessary connections to nearest available service and disconnect same when through.

3-2 CONSTRUCTION YARD: Yard site is available without a charge to the Contractor. Upon completion of the project, the site is to be left in clean condition with all debris and temporary improvements removed. Yard site shall remain within designated area.

3-3 REMOVAL OF TEMPORARY CONSTRUCTION: Temporary office facilities -- toilets, storage sheds, and other construction of a temporary nature -- shall be removed from the site as soon as the progress of the work will permit; and the portions of the site occupied by same shall be properly reconditioned and restored to a condition acceptable to the Owner.

3-4 TEMPORARY FACILITIES: Make arrangements and necessary connections for water, electricity, and other utilities necessary for construction purposes and for general lighting by employing electrical and mechanical subcontractors retained for permanent system. Furnish, install, maintain, and operate in safe manner temporary wiring system, including the providing of general lighting throughout project to be constructed under this Contract. Wiring system shall conform to requirements of Local and State

safety rules and regulations and shall provide not less than 10 foot candles of light. All other temporary and portable wiring for power and for special lighting shall also be provided; however, all temporary and portable wiring shall be installed and maintained in safe and workmanlike manner in accordance with State and Local regulations.

The electrical subcontractor shall install permanent electrical service, riser, and panels as soon as practicable to provide for use of this service by other trades.

Temporary utilities will be provided by the Contractor for the job office.

3-5 TELEPHONE: Telephone service is not presently at the site. The Contractor shall provide telephone services. [REDACTED]

3-6 TEMPORARY HEAT: Provide heating and maintain protections (as required for protection of work and for proper drying of all material installations) from beginning of work until final completion, acceptance, or occupancy. (Methods and extent of protection and heating shall be subject to the Engineer's review).

3-7 SANITARY FACILITIES:

A. Place in approved locations where facilities will be seclude from public observation and convenient to work stations. Relocate as work progress requires. Provide adequate temporary chemical toilet facilities for all those connected with work. Comply with applicable building and sanitation ordinances, laws, and codes.

B. Completely remove sanitary facilities on completion of work.

3-8 FIRE PREVENTION AND PROTECTION:

A. Hazard Control: Take all necessary precautions to prevent fire during construction. Provide adequate ventilation during use of volatile or noxious substances.

B. Spark Arresters: Equip all gasoline or diesel powered equipment used with spark arresters approved by the U.S. Fire Service.

C. Locate internal combustion equipment so that exhausts discharge well away from combustible materials.

D. Locate service areas a minimum of 50 feet from buildings. Shut down equipment before refueling.

E. Smoking: Smoking within buildings or temporary storage sheds

is prohibited.

F. Welding: cutting by torch or welding shall be performed only when adequate fire protection is provided.

3-9 PROTECTION EQUIPMENT REQUIRED:

Buildings: Furnish a minimum of one extinguisher for each 1,500 square feet of area or major fraction thereof. Travel distance from any work station to the nearest extinguisher shall not exceed 75 feet.

B. Vehicles and Equipment: Provide one extinguisher for each vehicle or piece of equipment.

3-10 DRINKING WATER: Provide from proven safe source for all those connected with work. Water shall be transported in such a manner as to keep it clean and fresh. Serve in single service containers or sanitary drinking fountains.

3-11 SHORING: Provide all temporary shoring required for project in accordance with the best and safest engineering practice. The Contractor shall assume responsibility for this work and make good any damage caused by improper supports or failure of shoring in any respect. When permanent supports are complete, remove shoring.

3-12 STORAGE AND USE OF PREMISES/SITE: Confine operations and storage to project site and authorized construction yard site or layout. Carry work on so as not to encumber adjacent roads. Keep work areas clean and orderly at all times. At all times, keep roads leading to the project open for traffic.

3-13 WATCHMEN: If the Contractor deems it necessary, he shall, at his own expense, employ and maintain sufficient watchmen, as required, to protect his equipment, the construction project/work, and the Owner's property.

3-14 ADDITIONAL PROTECTION: Protect excavations, trenches, and the building from damage by rain water, ground water, and other water. Provide pumps, equipment, and enclosures as required. Construct and maintain necessary temporary drainage, do pumping necessary to keep excavations water-free.

3-15 PROTECTION OF WORK IN PLACE: Work in place that is subject to injury because of operations being carried on adjacent thereto shall be covered, boarded up, or substantially enclosed with adequate protection. Permanent openings used as thoroughfares for the introduction of work and materials to the structure(s) shall have heads, jambs, and sills well blocked and boarded.

3-16 TEMPORARY SIGNS: The Contractor shall install Engineer and

01510-3

Owner furnished signs, as directed. The only other sign that will be allowed on the site is that of the General Contractor.

3-17 FIELD OFFICE: The Contractor shall provide a temporary field office building for use by himself, his subcontractors, the Resident Engineer, and the Inspectors. The building shall afford protection against weather, have a door, have at least one window or shutter, have a plan rack, and have a shelf for perusal of drawings. Openings shall have suitable locks. The field office shall be maintained full-time during the operation of the work of the Contract. During cold weather months, the field office shall be suitably insulated and equipped with a heating device to maintain 60°F. temperature during the working day. Upon completion of the work of this Contract, the Contractor shall remove the building from the premises. Phone service shall be provided at the Contractor's expense.

END

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01510-4

77

SECTION 01560 - DISPOSAL AND TEMPORARY CONTROLS

PART 1: GENERAL - Not used

PART 2: MATERIALS - Not used.

PART 3: EXECUTION

3-1 HOUSEKEEPING:

- A. Keep project neat, orderly, and in a safe condition at all times. Store and use equipment, tools, and materials in a manner that does not present a hazard. Immediately remove all hazardous rubbish. Do not allow rubbish to accumulate. Provide on-site containers for collection of rubbish or dispose of it at frequent intervals during progress of work.
- B. Wet down dry materials and rubbish to prevent blowing dust.
- C. Keep volatile wastes in covered containers.
- D. Utilize excavated material as soon as possible; do not stockpile.

3-2 DISPOSAL:

- A. Do not burn or bury refuse on-site.
- B. Dispose of excess excavated material and unsuitable materials from demolition at the onsite location designated by the Owner. If offsite disposal beyond a 2,500 foot haul is required, it shall be paid for as extra work.

3-3 AIR AND WATER POLLUTION CONTROL:

- A. Take all necessary reasonable measures to reduce air and water pollution by any material or equipment used during construction.
- B. Do not dispose of volatile wastes or oils in storm or sanitary drains.
- C. Do not allow waste materials to be washed into streams or bodies of water.

SECTION 01600 - MATERIALS AND EQUIPMENT

PART 1: GENERAL

1-1 MANUFACTURER'S INSTRUCTIONS:

A. When contract documents require that installation of work shall comply with manufacturer's printed instructions, provide two copies of instructions to the Engineer. Maintain one set of complete instructions at the project site during installation and until completion.

B. Perform work in accordance with manufacturer's instructions.

1-2 TRANSPORTATION AND HANDLING:

A. Arrange deliveries of materials in accordance with construction schedules; coordinate to avoid conflict with work and conditions at the site. Deliver materials in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

1-3 STORAGE AND PROTECTION:

A. Store materials in accordance with manufacturer's instructions, with seals and labels intact, legible and accessible for inspection.

1. Store products subject to damage by the elements in weathertight enclosures.

2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.

B. Exterior Storage:

1. Store fabricated products above the ground, on blocking or skids; prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

2. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

3. Construction material may be stored at designated areas. Any other sites may be used only with the expressed permission of the Owner.

C. Protection After Installation: Provide adequate coverings as necessary to protect installed materials from damage resulting from natural elements, traffic, and subsequent construction. Remove when no longer needed.

1-4 MATERIALS SPECIFIED BY REFERENCE STANDARDS: Select any item meeting that standard.

1-5 APPROVED EQUALS:

A. For each item proposed as an "approved equal," submit a separate request for approval in accordance with Section 01300. With each request submit supporting data, including:

1. Drawings and samples as appropriate.
2. Comparison of the qualities of the proposed item with that specified.
3. Changes required in other elements of the work because of the substitution.
4. Availability of maintenance service and source of replacement materials.

B. A request for approval constitutes a representation that Contractor:

1. Has investigated the proposed item and determined that it is equal or superior in all respects to that specified.
2. Will provide the same warranties for the proposed item as for the item specified.
3. Will coordinate the installation of an approved item, and make such other changes as may be required to make the work complete in all respects.
4. Waives all claims for additional costs, under his responsibility, which may subsequently become apparent.
5. Has determined that the proposed item is compatible with interfacing items.

PART 2: MATERIALS None used.

PART 3: EXECUTION

- A. Contractor shall at all times conduct his operations to insure the least inconvenience to the public.
- B. Interruption of existing utility service shall be limited to that necessary to accomplish the work. All interruptions shall be coordinated at least five working days in advance with the Owner.
- C. Confine storage of materials to areas specifically designated

01600-2

by the Owner.

D. Preservation of Natural Features: Confine all operations within the work limits of the project. Exercise special care to maintain natural surroundings undamaged. Restore damaged areas at no additional expense to the Owner.

E. DELIVERY: Deliver products bearing manufacturer's name and brand with the labels intact and legible. If products are usually packaged for delivery by manufacturer, deliver in the original, unopened, and undamaged packaging. Also deliver fire-rated products bearing testing agency label and required fire classification numbers.

F. HANDLING: Handle/transport products with care to prevent soiling and other physical damage. Protect from weather of all types. Pad or cover as required. When installing, avoid damage to adjacent products.

G. STORAGE: Store products in dry locations so as to keep clean and free from damage, deterioration due to weather, moisture, foreign materials, physical damage, and other deterioration from elements. Completely cover and protect products until they are incorporated into project. Covering for materials, if used, shall be of a non-staining type. If covers or enclosures are used, allow air to circulate around products -- take care not to create humidity chamber. If place on floor or roof systems, avoid overloading them.

H. DAMAGE OR MARRED PRODUCTS: Replace as directed.

END

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EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual:
Section:
Effective Date:
Organization:

RF/ER-94-00044
Contract Closeout, Rev. 0
1 of 1
RPD

SECTION 01700 - CONTRACT CLOSEOUT

PART 1: GENERAL Not used.

PART 2: MATERIALS

2-1 CLEANING MATERIALS: As recommended by the manufacturer of surface to be cleaned.

PART 3: EXECUTION

3-1 CLEANING:

A. Exterior Cleaning: Sweep paved surfaces; rake other surfaces or grounds. Clean building surfaces with recommended products.

B. Interior Cleaning: Sweep interior building areas when ready for painting and continue cleaning as needed until acceptance of building.

C. Final Cleaning: Remove all tools, equipment, surplus materials, and rubbish. Remove grease, dirt, stains, foreign materials and labels from interior and exterior finished surfaces. Do any required waxing and polishing. At time of final inspection, project shall be thoroughly clean and ready for use.

a. Remove marks, stains, fingerprints, dust, and dirt from painted and decorated work.

b. Clean and polish hardware for all trades. This shall include the removal of stains, dust, dirt, paint, and the like.

c. Clean exterior and interior metal surfaces, including doors and windows, or oil, stains, dust, dirt, paint, and the like. Polish and leave without fingermarks or other blemishes.

d. Remove from site all crates, packing materials, etc.

The above work is not to be delegated to any of the other prime or subcontractors who originally performed the various items of work. It is recommended, but not required, that the Contractor engaged a building maintenance firm to perform this final clean-up work.

3-2 PROJECT RECORD DRAWINGS:

A. Using colored ink, make changes on a set of clean prints or original tracings. Show all changes and revisions to the original design that affect the permanent structures and will exist in the completed work. Reference underground utilities to semipermanent or permanent physical object.

Reference pipelines and electrical equipment with terminal numbers shown.

B. Keep record drawings current. Inspection will be made monthly. Certification of accuracy and completeness will be required on monthly submitted payment requisitions. Project record drawings are the property of the Owner and shall be delivered to the Owner before closeout.

3-3 SUBSTANTIAL COMPLETION AND FINAL INSPECTION: Submit written certification that project, or designated portion of project, is substantially complete, and request, in writing, a final inspection. Owner will make an inspection within 10 days of receipt of request.

A. When Owner determines that the work is substantially complete, he will prepare a list of deficiencies that need to be corrected before final acceptance and issue a Notices of Substantial Completion with the deficiencies noted.

B. If Owner determines that the work is not substantially complete, he will immediately notify Contractor, in writing, stating reasons. After completing work, Contractor shall resubmit certification and request a new final inspection.

The Engineer shall prepare a punch list when notified by the Contractor that work is completed. Note, failure of the Engineer to include any items in the punch list does not alter the responsibility of the Contractor to complete the work in accordance with Contract Documents. Deliver all items called for herein and under various Specification Sections to the Engineer at completion of work. Receipt of items is necessary to permit release of project completion notice.

Prior to substantial completion and following receipt of written notice and final application for payment, the Engineer will make the inspection and issue a punch list. He will make inspections and issue punch lists twice more for total of three times, if required. Any further final inspections will be made at \$1,000.00 per trip, at the Contractor's expense.

3-4 ACCEPTANCE OF THE WORK: After all deficiencies have been corrected, a Letter of Final Acceptance will be issued.

A. Acceptance may be given before correction of deficiencies that do not prevent operation and use of the facility; however, final payment will be withheld until all deficiencies are corrected.

B. Until receipt of Letter of Final Acceptance, Contractor shall be responsible for the work of this Contract.

3-5 OPERATING INSTRUCTIONS: After equipment and systems are complete and operating, in cooperation with Owner, instruct operating personnel how to operate them.

3-6 START-UP: Prior to final acceptance demonstrate systems and instruct operating personnel in correct operation. Familiarize them with locations switches, junction boxes, and circuiting.

3-7 CLOSEOUT SUBMITTALS: Submit before final payment request.

A. Project Record Drawings: As specified above.

B. Guarantees, Bonds and Releases: As specified in individual sections.

C. Spare Parts and Materials: As specified in individual sections.

D. Keys and Keying Schedule: Submit all keys including duplicates. Wire all keys for each lock securely together. Tag and plainly mark with lock number or equipment identification, and indicate physical location, such as building and room name or number, or panel or switch number.

E. Operating Handles and Special Tools: Clearly identify as to related equipment.

F. Four copies of manufacturers' operation and maintenance manuals for all equipment provided. Furnished operating manuals/instructions and maintenance manuals/instructions (4 copies of each) for the mechanical screen, pumps, generator, and motor control center, and instruct the Owner's representative in the operation and maintenance of equipment/systems/items through one complete cycle in the presence of the Owner's representative. Each manual shall bear the name, address, and telephone number of manufacturer's representative in project area. Place copies in 4 separate 8-1/2 x 11 inch looseleaf binders. Deliver the binders to the Engineer prior to receipt of final payment by Owner.

The information contained in the manuals shall include the manufacturer's warranty/guarantee forms; operating instructions; the manufacturer's recommendations for care, cleaning, and maintenance, including type of and frequency of care, cleaning, and maintenance; a complete description of drawings; wiring diagrams; catalog cuts; and a repair parts list. The data in the manuals shall be neat, clean copies.

See also Section 01300.

G. Painting: Leave 1 gallon of each type of paint in original unopened container of each color used in that type for the project. Label for positive identification.

01700-3

24

3-8 POST-CONSTRUCTION INSPECTION: Before expiration of guarantee period, Owner will inspect project and notify Contractor in writing of all deficiencies. Contractor shall correct said deficiencies within 30 days. If the Contractor fails to make the corrections, the guarantee bond shall be forfeited.

END

* * * * *

01700-4

25

SECTION 02102 CLEARING AND GRUBBING

Part 1 General

1-1. Description

The work of this section consists of the removal and disposal of trees, shrubs, stumps, brush, roots, vegetation, debris and other objectionable materials as required to prepare the site. The work also includes selective clearing, protection from injury or defacement of all vegetation and objects designated to remain, and the backfill and compaction of holes created by the grubbing operations.

1-2. Job Conditions

- A. Work Limits: Specific areas to be cleared and grubbed within the construction area.
- B. Landscape and Structure Preservation: Protect all vegetation and structures not designated for removal from injury or damage.
- C. Burning: No burning shall be allowed on site.
- D. Dust Control: Use all means necessary to prevent the spread of dust during performance of the work of this Section; thoroughly moisten all surfaces as required to prevent dust being a nuisance to the public, neighbors, and concurrent performance of other work on the site.
- E. Protection: Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements indicated to remain in place. Protect improvements on adjoining properties as well as those on the Owner's property. Any improvement damages by this work shall be restored to original conditions as approved by authority having jurisdiction. Repairs and replacement of items damaged during construction shall be conducted by the Contractor at no cost to the Owner.

Part 2 Materials

Not used

Part 3 Execution

3-1. *Tree And Plant Protection: Not Used*

3-3. *Clearing*

- A. All surface objects, shrubs, brush, vegetation, debris, stumps, snags or other protruding obstructions, not designated by DOE and EG&G to remain, shall be cleared.

3-4. *Grubbing*

- A. Trenches: Cut and remove all roots in the wall and bottom to be flush with the excavated area.
- B. Other Areas: In all excavated areas remove stumps, roots, debris or other obstruction a minimum of 12 inches below the subgrade elevations.

EG&G Rocky Flats Plant	Manual:	RF/ER-94-00044
OU 7 Leachate Collection and Storage	Section:	Trench Excavation and Backfill, Rev. 0
Facility Technical Specifications	Effective Date:	1 of 9
Category	Organization:	RPD

SECTION 02221 TRENCH EXCAVATION AND BACKFILL

Part 1 General

1-1. *Scope*

This work shall consist of performing all operations necessary to excavate earth and rock or other material, of whatever nature, including removing water, regardless of character and subsurface conditions necessary for the construction of the project facilities; to place backfill for all project facilities, including site grading, piping, concrete structures, roadwork, removal and replacing unsuitable material; to place backfill material for all required project facilities.

1-2. *Not Used*

1-3. *Safety*

To ensure the safety of workmen and to protect and facilitate the work, sufficient bracing and shoring shall comply with rules, orders, and regulations of California OSHA. The Owner shall in no way be responsible for supervising shoring installation or maintenance. All sheeting, timbering, lagging, and bracing shall be removed during backfilling in such a manner as to prevent any movement of the ground or damage to the piping or structures, unless otherwise approved or required by EG&G or DOE.

1-4. *Erosion and Sediment Control*

All actions and costs for erosion and sedimentation control shall be the responsibility of the Contractor.

The Contractor shall provide all reasonable erosion and sedimentation control measures that may be required by Federal, State, County and/or local jurisdictions.

Precautions shall be taken by the Contractor to ensure that vehicles and equipment do not track and/or spill earth and/or materials off the project site. Any spillage and/or tracking shall be immediately removed should it occur.

EG&G Rocky Flats Plant	Manual:	RF/ER-94-00044
OU 7 Leachate Collection and Storage	Section:	Trench Excavation and Backfill, Rev. 0
Facility Technical Specifications	Effective Date:	2 of 9
Category	Organization:	RPD

1-5. *Quality Assurance*

- A. All compaction testing and gradation analysis will be arranged and paid for by DOE. Contractor shall be present when samples of bedding, select backfill, and backfill materials are gathered for analysis.

1-6. *Traffic Control: Not used.*

1-7. *Submittals*

In accordance with Section 01300.

- A. Written procedure for trench dewatering and disposal of fluidized materials removed in the construction of the French drain.
- B. Written description of barricading, shoring, cribbing, bracing, and sloping precautions in the construction of the French drain and installation of pressure piping.

1-8. *Project Conditions*

- A. Arrange construction sequences to provide the shortest practical time that the trenches will be open to avoid hazard.

1-9. *Excavation Classification*

Regardless of the nature of material excavated, all excavation will be considered unclassified.

1-10. *Tree Protection: Not used.*

Part 2 Materials

2-1. *General*

All backfill material shall be approved before use and be free of cinders, ashes, ice, frozen soil, large hard clods, organic debris, or other deleterious items.

Excavation is unclassified. Complete all excavation regardless of the type, character, nature, or condition of the materials encountered. The Contractor shall make his own estimate of the kind and extent of the various materials to be excavated in order to accomplish the work.

2-2. *Materials For Backfilling*

All backfill and bedding material shall be free from organic matter, construction materials, debris, and other deleterious materials.

Backfill and bedding material may be selected from on-site excavations or approved borrow pits. Backfill and bedding materials which stipulate a maximum particle size shall be screened to eliminate all larger particles. It shall be the responsibility of the Contractor to secure a disposal site for all unsuitable backfill material and all excess excavated material at no additional cost to DOE.

2-3. *Bedding AND Initial Backfill*

Bedding and initial backfill material shall meet the following criteria:

- A. Shall be clean, sound, and durable natural sand.
- B. Shall conform to the following grading when tested in accordance with ASTM C136:

Sieve Size	Percent Passing
3/4"	100
No. 4	90-100
No. 20	0-60
No. 200	0-15

Initial backfill shall be defined as the material to be placed between the top of the bedding and a point 12 inches above the top of the pipe.

The initial backfill shall be placed immediately after the pipe joints have been completed and inspected. The backfill shall be carefully placed so as not to disturb or damage the pipe coating or joints, and shall be brought up evenly on both sides of the pipe. The initial backfill shall be manually compacted using care not to damage the pipe and pipe coating or joints. "Manually compacted" as herein used does not exclude careful use of hand-controlled, power-operated units

such as air tampers, vibrating tampers, or other hand controlled tools used so as not to damage the pipe and pipe coating or joints.

2-4. *Intermediate Backfill*

Intermediate backfill is above initial backfill and below surface restoration.

Intermediate backfill shall consist of excavated or imported material free from debris, organic material and rocks larger than one inch in greatest dimension. Intermediate backfill shall be compacted to mound so that drainage to the trench will not occur.

2-5. *Locating Cable*

Direct burial copper cable, No. 12 insulated, shall be laid above the force main before backfilling. The cable shall be procured from the vender complete with an approved epoxy splice kit and cable joints shall be spliced in accordance with the manufacturer's instructions to form a set of continuous electrical conductors throughout the pipe system.

2-6. *Force Main Marking: Not Used*

Part 3 Execution

3-1. *Trench Excavation*

Trench excavation shall include the removal of all materials or obstructions of any nature, except as otherwise specified to be protected, the installation and removal of all sheeting and bracing and the control of water, necessary to construct the work as shown. Unless otherwise indicated on the drawings or permitted by the Engineer, excavation shall be by open cut. Trenching machines may be used.

A. Trenching Guidelines: Excavate the trench to the approximate level of the top of the force main to be installed, using adequate trench width and side slopes to safely accommodate worker access. Continue excavating for the utility line, to a width not greater than the appropriate trench detail shown on the drawings.

1. Rocky Trench Bottom: Where ledge rock, hard pan, boulders, or sharp-edged materials are encountered, over-excavate a minimum depth of 6 inches below the bottom of the

utility exterior wall to permit adequate bedding preparation. The installed forcemain shall have at least 6 inches of clearance from any rock protrusion.

2. Unstable Trench Bottom: Secure approval of depth of over- excavation and stabilization method. For wet trench construction, use approved method of dewatering through diversion, damming and pumping, well points, or underdrain systems. Dispose of removed fluidized materials as approved. Use pea gravel to build a suitable foundation to within 6 inches of finished forcemain grade, prior to bedding with the specified material. Compact layers to 95 percent of maximum density in not greater than 6 inch layers. Do not proceed with forcemain installation until wet trench and unstable conditions are under control.
3. Hand Excavation: Perform hand excavation of trenches dug within the drip line of selected trees. Carefully excavate around all roots 2 inches in diameter and larger to insure against damage.
4. All excavation shall be carefully made to avoid disturbance to natural terrain outside the limits of excavation.

3-2. *Shoring and Sheeting*

- A. Construct and maintain all shoring, sheeting, and slope layback necessary to protect the excavation, as needed for the safety of the employees and as required by applicable State and Federal laws.
- B. For trenches over 5 feet deep, provide suitable barricades for worker protection. Provide suitable barricades for public safety, regardless of trench depth.
- C. For trenches over 4 feet deep, provide suitable exit means in accordance with applicable provisions of OSHA.
- D. Do not remove timber or sheeting if it is in a compacted zone. Instead, trim it off at a safe level above that zone.

EG&G Rocky Flats Plant	Manual:	RF/ER-94-00044
OU 7 Leachate Collection and Storage	Section:	Trench Excavation and Backfill, Rev. 0
Facility Technical Specifications	Effective Date:	6 of 9
Category	Organization:	RPD

3-3. *Control of Water*

When water is encountered, the Contractor shall furnish, install, maintain and operate all necessary machinery, appliances and equipment to keep excavations free from water during jointing of the pipe, pouring of concrete, and placing of the shading material and until installation of all facilities has been completed, inspected and approved, and all danger of floatation and other damages are removed. Groundwater pumped from the trench shall be disposed of in the OU 7 pond.

3-4. *Maximum Length of Trench Open*

At the end of the working day, the Contractor shall completely enclose the trench. Trench shall be closed by properly backfilling as per the requirements of these specifications.

3-5. *Disposal of Excess Excavated Material*

Excess excavated inorganic material, unsuitable or not required for backfill, shall be disposed of by the Contractor at a location designated by EG&G and DOE.

3-6. *Not used.*

3-7. *Grade*

Carry the bottom of the trench to the line and grade shown, or as established by the Engineer. Allow for pipe thickness and pipe bedding. Any part of the trench excavated below grade shall be backfilled with pipe bedding compacted to the specified density.

3-8. *Trench Backfill*

Pipe shall be bedded uniformly throughout its length. The specified bedding shall be placed to give the required minimum thickness after placing the pipe and shall be compacted and "struck-off" to give a uniform surface for laying the pipe. The Contractor shall place backfill material to the spring line of the pipe compacting it by shovel if gravel, or by light tamping if sand, to provide pipe support. Care should be taken not to disturb the pipe.

3-9. *Compaction*

- A. General: The moisture content of the material being compacted shall be such that the degree of compaction specified and as shown on the drawings will be obtained with the compacting equipment being used. Before compacting, the material shall be worked to produce a uniform moisture content throughout the layer being compacted.

The compacting equipment shall be capable of producing the specified degree of compaction without damaging the structure or pipeline. All damage to structures and pipes shall be repaired or replaced at the Contractor's expense.

Bedding material and initial backfill materials shall be compacted.

B. Compaction:

1. Compaction: Use vibratory compactors for sands and gravels (noncohesive soils). Use mechanical tampers for sand and gravel containing a significant portion of fine-grained material, such as silt and clay (cohesive soils). Hand tamp around pipe or cable to protect the lines until adequate cushion is attained. Puddling or water flooding for consolidation of backfill or compaction by wheel rolling with construction equipment will not be permitted. After completion of compaction, the bedding shall meet a minimum 1.9 load factor.
2. Bedding: Compact the specified material to 95 percent of maximum density to the finished forcemain grade as defined by Paragraph 3-10.

Shape the trench bottom to assure uniform contact with the full length of the installed line and remove any sharp-edged material that might damage the line. Compaction shall be maintained beneath the line.

3. Initial Backfill: Fill around the forcemain to just over half depth, and compact in a manner to insure against lateral or vertical displacement. Place backfill to 12 inches above the forcemain line in not more than 6-inch layers. Compact each layer to 95 percent of maximum density.

4. Intermediate Backfill: Fill and compact in 8-inch maximum layers to 90 percent of maximum density.

3-10. *Tests*

EG&G and DOE reserve the right to take samples and perform moisture content, gradation, compaction, and density tests during placement of backfill materials to check compliance with these specifications. The Contractor shall remove surface material at locations designated by EG&G and DOE and provide such assistance as necessary for sampling and testing by EG&G and DOE and his representatives. EG&G and DOE may direct the Contractor to cut inspection trenches in compacted or consolidated backfill to determine that the Contractor has complied with these specifications. If any of the parts of the work have been covered up in contravention of EG&G and DOE's instructions, or if on being opened up it is found not to be in accordance with these specifications, then the expense of the opening and covering up again, whether done by the Contractor or not, shall be charged to the Contractor.

Tests may be made by EG&G and DOE in accordance with the following:

Test	Standard Procedure
1. Moisture Content	ASTM D3017
2. Gradation	ASTM D422
3. Density in Place	ASTM D1557 or ASTM D2922 or D4254 at the option of the Engineer
4. Plasticity Index	ASTM D423 and ASTM D424
5. Relative Density	ASTM D4254
6. Relative Compaction	ASTM D1557-70

3-11. *Other Backfill Requirements*

Where cribbing is used in the trench, the fill shall be carried to height sufficient to prevent the surrounding ground from cracking or caving into the trench before the cribbing is removed.

EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual: RF/ER-94-00044
Section: Trench Excavation and Backfill, Rev. 0
Effective Date: 9 of 9
Organization: RPD

3-12. *Surface Restoration*

Surface restoration shall be defined as that work necessary to restore the excavated area above intermediate backfill and the scarred surrounding work areas to a condition equivalent to or better than existed prior to the construction.

3-13. *Dewatering and Sediment Control*

Dewatering will be, at times, necessary for construction of the pipeline. The Contractor shall meet all requirements for erosion and sediment control as specified in these specifications.

36

SECTION 02224 - RIP RAP

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of furnishing and placing stone rip rap and grouted rip rap for embankment protection.

PART 2: MATERIALS

2-1 HAND LAID RIP RAP: Shall be well graded angular quarry stones, sound and hard, of durability to withstand exposure to water and weathering.

2-2 RIP RAP SIZE: The design stone size is the d_{50} median stone diameter which is defined as the stone size that 50% of the mixture by weight is larger than. Diameter of the largest stone shall be 1.5 times the design stone, d_{50} .

[REDACTED]

[REDACTED]

2-3 RIP RAP THICKNESS: Rip rap layer shall be a minimum of 1.5 times the d_{50} stone size.

2-4 GROUTED RIP RAP: *NOT USED*
[REDACTED]

PART 3: EXECUTION

3-1 RIP RAP PLACEMENT: A footing trench shall be excavated along the toe of slope as required by Section 2-3, Rip Rap Thickness.

The larger rocks shall be placed in the footing trench.

Rocks shall be placed with their longitudinal axis normal to the embankment face and arranged so that each rock above the foundation course has a 3-point bearing on the underlying rocks. Foundation course is the course placed on the slope in contact with the ground surface. Placing of rocks by dumping will not be permitted.

Local surface irregularities of the slope protection shall not vary from the planned slope by more than one foot measured at right angles to the slope.

NOT USED

3-2 GROUT PLACEMENT:

as required [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

SECTION 02232 - AGGREGATE BASE COURSE

PART 1: GENERAL

1-1 DESCRIPTION: The work of this section consists of furnishing and placing one or more courses of aggregate and filler, if required, on a prepared subgrade.

1-2 SUBMITTALS: In accordance with Section 01300. If materials are obtained from a commercial source, submit certification from the supplier certifying that aggregate base course meets the requirements of this section.

1-3 QUALITY ASSURANCE: Testing required to determine compliance with the requirements for the work of this section will be the responsibility of the Contractor.

PART 2: MATERIALS

2-1 AGGREGATE: Clean, hard, durable fragments or particles of crushed stone, crushed slag, or crushed or natural gravel. Materials that break up due to freeze-thaw or wet-dry cycling shall not be used.

A. Aggregate:

~~_____~~ SHALL BE TYPE 1, GRADING B AS PER
ASTM D1241-68, AS FOLLOWS:

SIEVE SIZE	% PASS
2 in	100
1 in	75-9
3/8 in	40-7
No. 4	30-6
No. 10	20-4
No. 40	15-3
No. 200	5-15

PART 3: EXECUTION

3-1 PLACING: The minimum compacted thickness of aggregate base surfacing shall be 6 inches. If the required compacted depth of the aggregate base course exceeds 4 inches, it shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 4 inches.

3-2 MIXING:

A. Mix the aggregate by any one of the three following methods:

1. Stationary Plant Method: Mix aggregate base course and appropriate amount of water for compaction in an approved mixer. After mixing, transport aggregate to the job site while it contains the proper moisture content and place on the roadbed by means of an approved aggregate spreader. Before compaction, remove excess moisture.

2. Travel Plant Method: After the material for each layer has been placed through an aggregate spreader or window sizing device, it shall be uniformly mixed by a traveling mixing plant.

3. Road Mix Method: After placing each layer, mix the materials while at optimum moisture content by means of motor graders or other approved equipment until the moisture is uniform throughout.

3-3 COMPACTION: Continue compaction of each layer until a density of not less than 95 percent of the maximum density, as determined by AASHTO T180, Method D, has been achieved. In place field density determinations will be made in accordance with AASHTO T191, T205, or other recognized method. Random tests for compacted depth will be made during the progress of the work.

3-4 SURFACE FINISHING:

A. Use a smooth steel wheel roller for the final rolling of top surface base course. Water surface and evenly spread loose stones before final rolling. Make minimum of two complete passes over area to embed stones. Correct soft spots during rolling.

B. Compacted base course surface shall be smooth and free from waves and other irregularities. Unsatisfactory portions of base course shall be torn up, reworked, relaid, and rerolled, at no additional expense to the Owner.

3-5 MATERIAL ACCEPTANCE REQUIREMENTS: Acceptance will be based on periodic samples and tests taken following mixing and before laying.

3-6 MAINTENANCE: Maintain base course in a satisfactory condition until surfaced or until final acceptance.

END

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02232-2

SECTION 02233 - WATERING

Part 1 General

1-1. Description

The work of this section consists of furnishing, hauling, and applying water required in the compaction of backfills and for dust control and other construction operations.

Part 2 Materials

2-1. Water

Free of debris, organic matter, and other objectionable substances.

Part 3 Execution

3-1. Application

Apply water for compaction and dust control by means of pressure type distributors or pipeline equipped with a spray system with nozzles that will insure a uniform application of water.

3-2. Equipment

Provide all necessary pumping equipment, piping, meters, tanks, and water trucks. Water trucks shall be of at least 1,000 gallon capacity, equipped with a spray bar of ample capacity, and designed to insure uniform and controlled application of water in the amounts designated. When water is to be metered for measurement, use an approved metering device.

3-3. Prewetting

Prewetting the material in excavation areas prior to its removal for placement in embankments will be permitted when accomplished in an acceptable manner. If prewetting is done with a sprinkler system, the water shall be metered through approved devices located near the point of discharge. Provide adequate drilling equipment to check the penetration of moisture for the full depth of the excavation. During prewetting, avoid excessive runoff and minimize water waste. Any required drying of prewetted embankment soils shall be done at no additional expense to the Owner.

SECTION 02271 - HIGH-DENSITY POLYETHYLENE LINER

Part I General

1-1. Summary

- A. Section includes furnishing and installing 60 mil high-density polyethylene liner HDPE.
- B. Related Sections: Section 02274—HDPE Pipe; Section 02272—Geotextile; Section 02276—Drain Rock.

1-2. References

- A. American Society for Testing and Materials (ASTM)
 - 1. D638-87 Standard Test Method for Tensile Properties of Plastics.
 - 2. D746-79 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
 - 3. D792-86 Standard Test Methods for Specific Gravity and Density of Plastics by Displacement.
 - 4. D1004-86 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
 - 5. D1204-84 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
 - 6. D1238-86 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
 - 7. D1505-85 Test Method for Density of Plastics by the Density-Gradient Technique.
 - 8. D1593-81 Specification for Nonrigid Vinyl Chloride Plastic Sheeting.
 - 9. D1603-76 Test Method for Carbon Black in Olefin Plastics.

10. D1693-70 Test Method for Environmental Stress-Cracking of Ethylene Plastics.
11. D3015-85 Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.
12. D3083-90 Standard Specification for Flexible Plastic Sheeting for Pond, Canal, and Reservoir Lining.
13. D3895-80 Standard Test Method for Copper-Induced Oxidative Induction Time of Polyolefins by Thermal Analysis.
14. D4437-88 Standard Practice for Determining the Integrity of Field Seams Used in joining Flexible Polymeric Sheet Geomembranes.

B. Federal Test Method Standards

1. 101C Puncture Resistance

C. National Sanitation Foundation (NSF)

1. SN 54 Flexible Membrane Liners.

D. Geosynthetic Research Institute (GRI)

1. Test Method GM-4 (Multiaxial test)

1-3. *Definitions*

- A. Batch: A quantity of resin, usually the capacity of one railcar, used in the fabrication of high density polyethylene roll. The finished roll will be identified by a roll number corresponding to the resin batch used.
- B. Construction Quality Assurance Monitor (Monitor): Party, independent from Manufacturer or Installer, that is responsible for observing and documenting activities related to the quality assurance during the lining system construction.
- C. Engineer: The individual or firm responsible for the design and preparation of the project construction drawings and specifications.

- D. Fabricator: The party responsible for fabricating HDPE rolls into panels.
- E. HDPE Liner Manufacturer: The party responsible for producing HDPE liner rolls from resin.
- F. Geosynthetic Quality Assurance Laboratory (Testing Laboratory): Party, independent from the Owner, Manufacturer, Fabricator, and Installer responsible for conducting laboratory rest on samples of geosynthetics obtained at the site.
- G. Installer: The party responsible for field handling, transporting, storing, deploying, seaming, temporary restraining (against wind), and installing the HDPE.
- H. Owner: DOE.
- I. Panel: The unit area of HDPE liner that will be seamed in the field. If HDPE liner is not fabricated into panels in a factory, a panel is identified as a roll or portion of a roll.
- J. Monitor: Engineer, Owner or designated representative to inspect, test or provide quality control.

1-4. *Submittals*

- A. Conform to pertinent provisions of Section 01300, Submittals.
- B. Furnish the following production date in writing to the Engineer a minimum of 7 days prior to HDPE liner shipment to the site:
 - 1. Resin Data.
 - a. Statement of production date or dates.
 - b. Certification stating that resin meets specification requirements (see Article 2-1B)
 - c. Certification stating all resin is from the same manufacturer.
 - d. Copy of quality assurance/control certificates issued by manufacturer and resin supplier.
 - 2. HDPE Liner Roll

- a. Statement of production date or dates.
 - b. Laboratory certification stating HDPE liner meets the specification requirements (see Article 2-1D).
 - c. Certification stating all HDPE liner rolls are furnished by one manufacturer, and all rolls are manufactured from one resin type obtained from one resin supplier.
 - d. Copy of quality control certificates issued by manufacturer.
 - e. Statement certifying no reclaimed polymer is added to resin (product run may be recycled).
 - f. HDPE liner delivery, storage, handling and installation instructions.
3. Extrudate Beads and/or rod.
- a. Production date or dates.
 - b. Laboratory certification stating extrudate meets the specifications requirements (see Article 2-1D).
 - c. Certification stating all extrudate is from one manufacturer, is the same resin type, and was obtained from the same resin supplier as the resin used to manufacture the HDPE liner rolls.
 - d. Copy of quality control certificates issued by manufacturer.
- C. Furnish the following schedules and drawings to the Engineer and Owner at the specified times.
1. Installation schedule.
 2. Installation layout drawings: Two weeks prior to installation of HDPE liner, submit drawings showing panel layout indicating both fabrication (if applicable) and field seams, and details not conforming to the contract documents. Once approved, these drawings shall be the basis for installing the HDPE liner.

D. Furnish the following qualifications with the bid form.

1. Supervisor/field engineer resume.
2. Master welder resume.
3. Resumes of installation welders who may work on this project.

E. Submit the following quality control documents at the times indicated.

1. Quality control manual with bid.
2. Quality control documentation prepared during installation.
3. Certificate of Soil Subgrade Acceptance by HDPE liner installer for each area to be conferred by the HDPE liner system signed by the installation supervisor prior to the start of installation. Beginning installation shall mean acceptance and approval of existing foundation condition.

F. Submit the following 7 days prior to start of liner deployment.

1. Equipment list stating quantity and types.
2. List of personnel assigned to perform field seaming operations.

G. Submit to the Engineer upon installation completion.

1. Certificate stating the HDPE liner has been installed in accordance with the contract documents.
2. Manufacturer's/fabricator's material warranty and the installer's installation warranty and the installer's installation warranty.
3. Record drawing showing location of panels, seams, repairs, patches, and destructive samples. Record drawings shall be prepared on D size drawings to a scale determined by the Monitor.

1-5. *Quality Assurance*

A. Personnel Qualifications:

1. Installation supervisor/field engineer shall have worked in a similar capacity on at least 2 jobs similar in size and complexity to the project described in the Contract Documents.
2. The master seamer shall have completed a minimum of 1,000,000 square feet of HDPE liner seaming work using the type of seaming apparatus proposed for use on this project.

B. The Owner will engage and pay for the services of a Geosynthetic Quality Assurance Laboratory for monitoring the quality of installation.

1-6. *Delivery, Storage and Handling*

A. Conform to the manufacturer's requirements to prevent damage to HDPE liner.

B. Delivery:

1. Deliver materials to the site only after the Engineer/Owner approves required submittals.
2. Separate damaged rolls from undamaged rolls and store at locations designated by the Owner until proper disposition of material is determined by Owner/Monitor.
3. Owner will be the final authority regarding damage.
4. Separate rolls without proper documentation and store until Monitor approval received.

C. Onsite Storage:

1. Store in space allocated by the Owner.
2. Protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.
3. Store on level prepared surface (not on wooden pallets).
4. Stack per manufacturer's recommendations but no more than three rolls high.

D. Onsite Handling:

1. Use appropriate handling equipment to load, move or deploy HDPE liner rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader and roll bars for deployment. Dragging panels on ground surface will not be permitted.
2. Do not fold HDPE liner material; folded material shall be rejected.
3. Installer is responsible for off-loading, storage, and transporting material from storage areas to liner facility.

E. Damaged HDPE Liner:

1. HDPE liner damage shall be documented by the Monitor.
2. Damaged HDPE liner shall be repaired, if possible, in accordance with these specifications or shall be replaced at no cost to the Owner (see Article 3-2C).

1-7. *Weather Conditions*

A. HDPE liner shall not be deployed when:

1. The air temperature is below 40°F until verifying that material can be seamed according to specifications and after approval by the Engineer.
2. During precipitation.
3. In the presence of excessive moisture.
4. In areas of ponded water.
5. In the presence of excessive winds.

1-8. *Warranty*

Manufacturer's and installer's warranty for material and workmanship shall meet contract warranty provisions.

Part 2 Products

2-1. *HDPE Liner*

- A. The material shall be single side textured or smooth HDPE as shown on the drawings.
- B. Resin:
 - 1. Shall be HDPE, new, first quality, compounded and manufactured specifically for producing HDPE liners.
 - 2. Do not intermix resin types.
 - 3. Shall meet the following additional requirements:

Test	Test Designation	Minimum Frequency	Requirements
Specific Gravity ⁽¹⁾	ASTM D792 Method A	(2)	0.935 to 0.950
Melt Index	ASTM D1238 Condition E	(2) (2)	≤ g per 10 minutes

¹Resin plus carbon black.

²1 per resin batch.

C. HDPE Liner Roll

- 1. Identify the percentage of processing aids, antioxidants, and other additives other than carbon black. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black.
- 2. The combined percentage of processing aids, antioxidants, carbon black and other additives shall be less than 3.5 percent by weight.
- 3. Use materials produced in the United States or Canada. Material from other sources may be used with prior approval by the Owner/Engineer.

4. Supply HDPE liner in rolls (no folding permitted) free of holes, pinholes, bubbles, blisters, excessive gels or undispersed resins and/or carbon black, contamination by foreign matter, and nicks and cuts on roll edges. Identify each roll with labels indicating both number, thickness, length, width, manufacturer, and plant location.

D. Shall meet the following requirements:

Test	Test Designation	Frequency (see footnotes)	Textured Requirements	Nontextured Requirements
Sheet Thickness	ASTM D1593 para 9.1.3	1 per roll ⁽¹⁾	60 mils ± 10%	60 mils ± 10%
Oxidation Induction Time of Polyolefins	ASTM D3895	(1)	min 100 minutes	min 100 minutes
Tensile Strength Yield	ASTM D638	(1)	min 2,100 psi	min 2,000 psi
Tensile Strength Break	ASTM D638	(1)	min 1,000 psi	min 4,000 psi
Elongation at Yield	ASTM D638	(1)	min 10%	min 10%
Elongation at Break	ASTM D638	(1)	min 200%	min 600%
Elongation at Break	GRI GM-4	(2)**	min 10%	min 10%
Tear Resistance	ASTM D1004 DIE c		min 650 psi	1,000 ppi
Puncture Resistance	FTMS 101C Method 2065	(1)	min 1,000 ppi	1,200 ppi
Coefficient of Dimensional Stability (each direction)	ASTM D1204 212°, 15 min	(1)	1.5% max change	1.5% max change
Environmental Stress Crack	ASTM D1693	(3)	2,000 hrs	2,000 hrs
Low Temperature Brittleness	ASTM D746	(3)	minus	minus 40°F
Carbon Black Dispersion	ASTM D1603	(1)	A-1, A-2, or B-1	A-1, A-2, or B-1

* Not including texture.

(1) 1 per resin batch.

(2) 1 test on typical sheet with seam. Perform as ASTM D638 test on a sample obtained from the same sheet and an ASTM D4437 test on the seam.

(3) Certification only required.

E. Extrudate Rod or Bead:

1. Shall be made from same resin as the HDPE liner.
2. Additives shall be thoroughly dispersed.
3. Shall be free of contamination by moisture or foreign matter.

2-2. *Equipment*

A. Welding equipment and accessories shall meet the following requirements:

1. Equipped with gauges showing temperatures both in apparatus and at nozzle (extrusion welder) or at wedge (wedge welder).
2. Maintain adequate number of welding apparatuses to avoid delaying work.
3. Use power source capable of providing constant voltage under combined line load.
4. Provide splash pad large enough to catch spilled fuel under electric generator, if located on HDPE liner.

B. Provide tensiometer capable of quantitatively measuring HDPE liner strength:

1. Equipped with gauge accurate to +2 lbs per inch of HDPE liner width.
2. Provide required dies.

Part 3 Execution

3-1. *Preparation*

- A. Repair damage caused to subgrade during HDPE liner installation or other activities.
- B. Round the edges of excavations and grade changes to avoid sharp bends in HDPE liner.

3-2. *Deployment*

- A. Assign each panel a simple and logical identifying code consistent with the installer's submitted installation layout drawings. The coding system shall be subject to approval by the Monitor.
- B. Deploy no more panels in one day than can be welded during that same day. Tack welding may be acceptable with Engineer's approval.
- C. Visually inspect the HDPE liner during deployment for imperfections and mark faulty or suspect areas for repair.
- D. *Deployment of the HDPE liner panels shall conform to the following requirements:*
 - 1. Repair damage to subgrade or other underlying materials prior to deploying of HDPE liner.
 - 2. Unroll HDPE liner panels using methods that will not damage, stretch or crimp HDPE liner and will protect underlying surface from damage.
 - 3. Place ballast on HDPE liner that will not damage HDPE liner to prevent uplift due to wind.
 - 4. Use methods that minimize wrinkles and differential wrinkles.
 - 5. Personnel walking on HDPE liner shall not wear shoes or engage in activities that could damage the HDPE liner. Smoking will not be permitted while working on the HDPE liner.
 - 6. Do not allow vehicular traffic directly on HDPE liner.
 - 7. Equipment shall not damage HDPE liner by handling, trafficking, leakage of hydrocarbons or any other means. Protect HDPE liner in area of heavy traffic by placing compatible protective cover over the HDPE liner.
 - 8. Remove HDPE liner folds.
- E. Sufficient material shall be provided to allow for HDPE liner shrinkage and contraction. Method used to determine required additional material (compensation) shall be approved by the Engineer.

- F. Installer or contractor must take necessary steps to [prevent excess condensation on sheet from softening the underlying low-permeability layer.

3-3. *Field Seaming*

A. Seam location shall meet the following requirements:

1. Orient seams perpendicular to line of slope crest, i.e., down and not across slope.
2. Minimize number of field seams in corners, odd-shaped geometric locations and outside corners.
3. Keep base horizontal seams (seams located on the facility bottom which run parallel to slope) at least 6 feet away from the toe of slope.
4. Use seam numbering system compatible with panel numbering system.

B. During welding operations:

1. Provide at least one master welder meeting the qualification requirements specified in Article 1.5.
2. Provide other welders meeting the qualification requirements specified in Article 1.5.

C. Trial Welds:

1. Perform on HDPE liner samples to verify welding equipment and performance seaming methods and conditions.
2. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully complete trial weld.
3. Frequency of Trial Welds:
 - a. Minimum of two trial welds per day per welding apparatus, one made prior to the start of work and one completed at mid-shift.
 - b. When directed by the Monitor.

53

- c. Every two hours when using a wedge welder to weld across seams.
 - d. Minimum one trial weld per person performing seaming per shift.
4. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
 5. Make trial weld sample at least 2 feet long and 12 inches wide with the seam centered lengthwise.
 6. Cut four, 1 inch wide test strips from opposite ends of the trial weld. Quantitatively test specimens, for peel adhesion, and then for bonded seam strength (shear) (ASTM D4437).
 7. A trial weld specimen shall pass when the following results are achieved in both peel and shear test. For double-wedge welding, both welds shall be tested and both shall be required to pass in peel.
 - a. The break is film tearing bond (FTB).
 - b. The break is ductile.
 - c. The peel strength is 70 percent of the specified sheet yield strength for wedge welded or flat welded seams and 60 percent of the specified sheet strength for extrusion welded seams.
 - d. The ultimate strength is 100 percent of the specified sheet yield strength for shear test at minimum 50 percent strain.
 8. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.
 9. When repeated trial welds fail, do not use welding apparatus and welder for welding until the reason the samples re failing is identified and corrected.
- D. Install HDPE liner using following general seaming procedures:
1. Surface shall be clean of grease, moisture, dust, dirt, debris or other foreign material.

54

2. Panels shall overlap by minimum 3 inches for extrusion and 4 inches for hot wedge welds unless otherwise approved by the Engineer.
 3. Solvents or adhesives shall not be used unless product is approved in writing by the Engineer.
 4. Adequate material must be provided to allow peel testing of both sides of double wedge weld.
- E. Weld to the outside edge of panels placed under anchor berms or in anchor trenches.
- F. If required, provide a firm substrata by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve firm support.
- G. Provide adequate lighting if seaming operations are carried out at night.
- H. Cut fishmouths or wrinkles at seam overlaps to achieve a flap overlap. Extrusion weld or patch the cut fishmouths or wrinkles where the overlap is more than three inches. When there is less than three inches overlap, use an oval or round patch extending a minimum of 6 inches beyond the cut in each direction.
- I. Installer shall log every two hours:
1. Temperature 1/2 inches above the HDPE liner surface.
 2. Extrudate temperatures in barrel and at nozzle (extrusion welder).
 3. Operating temperature of hot wedge (hot wedge welder).
 4. Preheat temperature.
- J. Seam only when liner surface is between 40°F and 100°F unless other limits are approved, in writing, by the Engineer.
- K. Defects and Repairs:

1. Examine all seams and non-seam areas of the HDPE liner for defects, holes, blister, undispersed raw materials, and any sign of contamination by foreign matter. The HDPE liner surface shall be clean at the time of the examination.
2. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover HDPE liner at locations which have been repaired until test results with passing values are available.

L. Extrusion Seaming:

1. Tack bond adjacent panels together using procedures that do not damage HDPE liner, allow required CQA tests to be performed, and are not detrimental to final seaming.
2. Purge welding apparatus of heat-degraded extrudate before welding.
3. Abrade HDPE liner surface a minimum of 1/4 inch beyond weld bead area.
4. Clean HDPE liner surfaces of oxidation by disc grinder or equivalent not more than 1/2 hour before extruding seam.
5. Bevel top edges of HDPE liner before extrusion welding.
6. Grind ends of all seams, which are more than five minutes old, when restarting welding.
7. Grinding shall not remove more than 5 percent of liner thickness.
8. Grind marks shall be across, not parallel to seams.
9. Grind marks shall not extend out more than 1/4 inch from weld head.

M. Interface Extrudate Welding:

1. Equipment accessories shall include the following:
 - a. Variable speed control
 - b. Wheels with non-skid surface
 - c. Directional control

- d. Automatic hot air system for preheating welding surfaces
 - e. Extruder system with appropriate die
 - f. Four adjustable contact pressure rollers
2. Test and set preheat system using scrap material each day prior to commencing seaming.
 3. Adjust hot air velocity to preclude wind effects.
 4. Adjust contact pressure rollers to prevent surface ripples in sheet.
 5. Protect against moisture build-up between sheets.
- N. Hot Wedge Welding:
1. Welding apparatus shall be automated vehicular mounted and equipped with devices giving applicable temperatures and pressures.
 2. Grind edge of cross seams to smooth incline (top and bottom) prior to welding.
 3. Place smooth insulating plate or fabric beneath hot welding apparatus after usage.
 4. Protect against moisture build-up between sheets.
 5. If welding across cross seams, conduct field test seams at least every two hours, otherwise once prior to start of work and once at mid-day.

3-4. *Field Quality Assurance*

- A. General: The manufacturer, fabricator and installer shall participate in any conform with all terms and requirements of the Owner's quality assurance program. The Contractor shall be responsible for assuring this participation. Quality assurance requirements are as specified in this Article and if published in the Construction Quality Assurance Manuals.
- B. Conformance Testing (Performed by Monitor):
 1. Perform conformance testing on HDPE liner rolls.

2. Obtain samples at specified frequency (see 2-1D). Monitor will obtain samples and forward samples to Geosynthetic Quality Assurance Laboratory.
 3. Following test will be performed to determine HDPE liner characteristics:
 - a. Density: ASTM D791, Method A or ASTM D1505
 - b. Thickness: ASTM D1593, Method C
 - c. Tensile Strength: ASTM D638
 - d. Carbon Black Content: ASTM D1603
 - e. Carbon Black Dispersion: ASTM D3015
 - f. Where optional procedures are noted in the test method, the requirements of the specifications shall prevail.
 - g. Additional tests may be performed to verify material or welding conformance with specification (Performed by Monitor with assistance from installer).
 4. Sampling Procedures:
 - a. Sample across the entire width of the roll excluding the first three feet.
 - b. Cut sample 3 feet long by width of roll unless otherwise specified.
 - c. Mark machine direction on the samples with an arrow. Monitor will be responsible for markings.
- C. Field Testing (performed by Installer):
1. Non-destructively test all field seams over their full length using a vacuum test unit, air pressure (for double fusion seams only), or other approved methods. Non-destructive testing shall be carried out prior to installation in French drain trench as the seaming progresses and not as completion of all field seaming.
 2. Vacuum Testing:

a. The equipment shall consist of the following:

- 1) A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole, or valve assembly, and a vacuum gauge
- 2) A vacuum pump assembly equipped with a pressure control
- 3) A rubber pressure/vacuum hose with fittings and connections
- 4) A soapy solution and an applicator

b. Test Procedures:

1. Brush soapy solution on HDPE liner.
2. Place vacuum box over the wetted seam area.
3. Ensure that a leak-tight seal is created.
4. Apply approximately 10 inches of mercury (five psi gauge).
5. Examine the HDPE liner through the viewing window for the presence of soap bubbles for not less than fifteen seconds.
6. All areas where soap

3. Air Pressure Testing (for double seam with an enclosed space):

a. The equipment shall consist of the following:

1. An air pump (manual or motor driven) equipped with pressure gauge capable of generating and sustaining pressure over 40 psi and mounted on a cushion to protect the HDPE liner
2. A rubber hose with fittings and connections
3. A sharp hollow needle, or other approved pressure feed device

4. A pressure gauge with an accuracy of one psi
- b. Test Procedures
1. Seal both ends of the seam to be tested.
 2. Insert needle or other approved pressure feed device into the channel created by the double wedge weld.
 3. Energize the air pump to a minimum pressure of 30 psi or 1/2 psi per mil of liner thickness whichever is greater, close valve, and sustain pressure for at least five minutes.
 4. If pressure loss exceeds 2 psi (10 mm mercury) or does not stabilize, locate faulty area and repair as described in this specification.
 5. Puncture opposite end of seam to release air. If blockage is present, locate and test seam on both sides of blockage.
 6. Remove needle or other approved pressure feed device and seal penetration holes by extrusion welding.
4. Destructive Testing (performed by Monitor with assistance from installer):
- a. Location and Frequency of Testing:
1. Collect one destructive test sample per seam.
 2. Test locations will be determined during seaming. Locations may be prompted by appearance of excess heating, contamination, offset welds, or suspected defect. Monitor will be responsible for choosing the locations. Monitor will not notify installer in advance of selecting locations where seam samples will be taken.
 3. The Monitor may increase the test frequency based on testing results.
- b. Sampling Procedure

1. Installer shall cut samples at locations designated by the Monitor as the seaming progresses to obtain laboratory test results before the HDPE liner is covered.
2. Monitor will number each sample and mark sample number and location on the installation layout drawing.
- c. Installer shall immediately repair all holes in the HDPE liner resulting from destructive sampling. Repair and test the continuity of the repair in accordance with these specifications.
- d. Size of Samples: 12 inches wide by 46 inches long with the seam centered lengthwise. Cut a 2 inch wide strip from each end of the sample for field testings. Cut the remaining sample into three parts for distribution as follows:
 1. One portion for the installer: 12 inches by 12 inches
 2. One portion for Geosynthetic Quality Assurance Laboratory testing: 12 inches by 18 inches
 3. One portion to the Owner for archive storage: 12 inches by 12 inches

D. Laboratory Testing by Geosynthetic Quality Assurance Laboratory:

1. Test sample in peel and shear (ASTM D4437)
2. Minimum acceptable values to be obtained for these tests are as specified in Article 3.3 of this specification.
3. Test at least five specimens for each test method. Four of five specimens must meet minimum requirements.
4. Select specimens for each sample alternately for testing (i.e., peel, shear, peel, shear ...).
5. Provide test results no more than 48 hours after receiving samples.
6. For double wedge seam samples, test both welds in peel.

E. Failed Seam Procedures:

1. The following procedure shall be used when a destructive test failure.
 - a. The installer shall follow one of two options:
 1. Reconstruct the seam between any two passed test locations.
 2. Trace the weld to an intermediate location at least 10 feet minimum or to where seam ends, in both directions from the location of the failed test. Check next seam welded using same welding device if required to obtain additional sample, i.e., if one side of the seam is less than 10 feet long.
 - b. Obtain 4 one inch samples at both locations for an additional field test.
 - c. If these additional test samples pass field tests, then laboratory samples shall be taken.
 - d. If the laboratory samples pass, then the seam shall be reconstructed or capped between the test sample locations.
 - e. If any sample fails, then the process shall be repeated to establish the zone in which the seam shall be reconstructed.

F. Acceptable Seams:

1. Acceptable seam shall be bounded by two locations from which samples have passed destructive tests.
2. For reconstructed seams exceeding fifty feet, a sample taken from within the reconstructed seam shall also pass destructive testing.
3. Whenever a sample fails, additional testing Any be required for seams that were welded by the same welder and welding apparatus or were welded during the same time shift.

G. Seams that Cannot be Non-Destructively Tested:

1. If the seam is accessible to testing equipment prior to final installation, non-destructively test the seam prior to final installation.

2. If the seam cannot be tested prior to final installation, cap strip the entire seam. The seaming and cap-stripping operations shall be observed by the Monitor and installer.

3-5 *Repair Procedures*

- A. Remove damaged HDPE liner and replace with acceptable HDPE liner materials if damage cannot be satisfactorily repaired.
- B. Repair, removal and replacement shall be at Contractor's expense if the damage results from the Contractor's, Installer's, or the Contractor's subcontractor activities.
- C. Repair any portion of the HDPE liner exhibiting a flaw, or failing a destructive or failing non-destructive test. Installer shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be divided between the Monitor and the installer. Procedures available include:
 1. Patching: Use to repair large holes (over 3/8 inch diameter), tears (over 2 inches long), undispersed raw materials, and contamination by foreign matter.
 2. Abrading and re-welding: Used to repair small seam sections (less than 12 inches).
 3. Spot welding: Used to repair small tears (less than 2 inches long), pinholes or other minor, localized flaws, where HDPE liner thickness has been reduced by more than four mils by overgrinding, etc.
 4. Capping: Used to repair large lengths of failed seams.
 5. Removing the seam and replacing with new material.
- D. In addition, the following procedures shall be observed:
 1. HDPE liner surfaces to be repaired shall be abraded (extrusion welds only) no more than 1.2 hour prior to the repair.
 2. HDPE liner surfaces shall be clean and dry at the time of repair.
 3. The repair procedures, materials and techniques shall be approved in advance of the specified repair by the Monitor

EG&G Rocky Flats Plant	Manual:	RF/ER-94-00044
OU 7 Leachate Collection and Storage	Section:	High-Density Polyethylene Liner, Rev. 0
Facility Technical Specifications	Effective Date:	23 of 23
Category	Organization:	RPD

4. Extend patches or caps at least 6 inches beyond the edge of the defect, and round all corners of material to be patched and the patches to a radius of at least 3 inches.
5. For surface impoundments only, unless otherwise instructed by the Engineer, the HDPE liner below large caps shall be cut to avoid water or gas collection between the sheets.

E. Repair Verification

1. Number and log each patch repair (performed by Monitor).
2. Non-destructively test each repair using methods specified in Article 3-4 of this specification.
3. Destructive test may be required at the discretion of the Monitor.

3-6 *HDPE Liner Acceptance:*

- A. Contractor retains all ownership and responsibility for the HDPE liner until acceptance by the Owner.

- B. Owner will accept HDPE liner installer when:

All required documentation from the manufacturer, fabricator and installer has been received and approved.

The installation is finished.

Verification of the adequacy of all field seams and repairs, including associated testing, is complete.

Engineering report including drawings, sealed by a Registered Professional Engineer, has been received by the Owner (provided by Engineer).

64

EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual:
Section:
Effective Date:
Organization:

RF/ER-94-00044
Geotextile, Rev. 0
1 of 1
RPD

SECTION 02272 - GEOTEXTILE

Part 1 General

1-1 Summary

- A. This section includes furnishing and installing of geotextile fabric.
- B. Related Sections: Section 02274 - HDPE Pipe; Section 02271 - HDPE Liner; Section 02276 - Drain Rock

1-2 References

- A. American Society for Testing and Materials (ASTM):
 - 1. D3776-85 Test Methods for Mass Per Unit Area (Weight) of Woven Fabric.
 - 2. D3786-87 Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Test Method.
 - 3. D3787-80 Test Method for (Rev. A) Bursting Strength of Knitted Goods - Constant-Rate Of-Traversal (CRT) Ball Burst Test.
 - 4. D4491-85 Test Methods for Water Permeability of Geotextiles by Permittivity.
 - 5. D533-85 Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
 - 6. D4595-86 Standard Test Method for Tensile Properties of Geotextiles by the Wide Width Strip Method.
 - 7. D4632-86 Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Method)
 - 8. D47751-87 Standard Test Method for Determining Apparent Opening Size of a Geotextile.
- B. U.S. Army Corps of Engineers (COE)

65

1. CW 0221577 Corps of Engineers

1-3 Definitions

- A. Batch: A quantity of resin, usually the capacity of one railcar, used in the fabrication of the geotextile roll. The finished roll will be identified by a roll number corresponding to the resin batch used.
- B. Coefficient of Uniformity (Cu): Ratio of grain diameter (in mm) corresponding to a 60 percent passing (by weight) to the grain diameter (in mm) corresponding to 10 percent passing (by weight).
- C. Construction Quality Assurance Monitor (Monitor): Party, independent from the Fabricator, Owner, Manufacturer or Installer, responsible for observing and documenting activities related to geotextile installation quality assurance.
- D. D85: Grain diameter corresponding to 85 percent passing (by weight) in a sieve analysis.
- E. Engineer: The individual or firm responsible for the design and preparation of the project Construction Drawings and Specifications.
- F. Geosynthetic Quality Assurance Laboratory (Testing Laboratory): Party, independent from the Owner, Manufacturer, Fabricator, CQA Monitor and Installer, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site.
- G. Installer: The part responsible for field handling, transporting, storing, deploying, seaming, repairing, anchoring and other aspects of installing the geotextile.
- H. Manufacturer: The part responsible for the production of geotextile rolls.
- I. Owner: DOE
- J. Panel: The unit area of geotextile that will be seamed in the field. If geotextile is not fabricated into panels in a factor, a panel is identified as a roll or portion of a roll.

EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual:
Section:
Effective Date:
Organization:

RF/ER-94-00044
Geotextile, Rev. 0
3 of 1
RPD

1-4 *Submittals*

- A. Submit samples and complete description of geotextile fabric and thread proposed for use, with bid. The geotextile shall meet or exceed requirements of this specification.
- B. Furnish with bid written instructions for storage and handling of the geotextile.
- C. Submit, prior to delivery, manufacturer's specifications and certification for geotextile thread stating that the material meets or exceeds parameters provided in this specification and as shown on the construction drawings.
- D. Manufacturer's and installer's warranty with bid.

1-5 *Delivery, Storage and Handling*

- A. Protect geotextile from ultraviolet light exposure, precipitation, inundation, mud, dirt, dust, puncture, cutting and other damaging or deleterious condition. Follow manufacturer's written instructions for shipping, storage and handling.
- B. Ship geotextile in closed trailer.
- C. Furnish geotextile in rolls wrapped in relatively impermeable and opaque protective covering.
- D. Roll numbers, manufacturer's name, and lot number shall be marked on protective covering.

1-6 *Warranty*

- A. Geotextile and thread shall be provided with manufacturer's and installer's warranty and the material and workmanship shall meet the warranty provisions of the General Conditions of the Contract.
- B. Exposed geotextile shall be warranted for 1 year against degradation resulting from ultraviolet (UV) exposure.

67

Part 2 Materials

2-1 *Geotextile*

- A. To provide filtration of groundwater before entering French drain as shown on construction drawings.
- B. Shall be manufactured in America.
- C. Shall conform to the property values listed in Table 02272-1,

Table 0222-1

Test	Designation	Test Frequency	Requirement Nonwoven
Fabric Weight	ASTM D37776	(1)	8 oz.
Grab Tensile Strength	ASTM D4632	(1)	—
Grab Tensile Elongation of Yield	ASTM D4632	(1)	—
Wide Strip Tensile Strength (4)	ASTM D4595	(1)	95 ppi
Wide Strip Tensile Elongation (4)	ASTM D4595	(1)	>50%
Burst Strength	ASTM D3786	(1)	360 psi
Permissivity	ASTM D4491	(1)	1 sec ⁻¹
Trapezoid Tear	ASTM D4533	(1)	75 lbs
Puncture Resistance	ASTM D3787	(1)	95 lbs
Apparent Opening Size (AOS)	ASTM D4751	(2)	≤BD ₈₅ (2)
Nonwoven Porosity	CWO-02215-86	(2)	≥30%

(1) One per roll.

(2) Where the coefficient of uniformity (Cu) of the drainage or operations layer is ≤2 or ≥8, B=1; where 2≤Cu<4, B=0.5 Cu; where 4<Cu<8, B=8/Cu.

68

- E. The geotextile shall not be heat-bonded or heat-burnished.

2-2 *Source Quality Control*

- A. The manufacturer shall perform quality control tests on geotextile, at the minimum frequencies shown in Table 02272-1.
- B. Provide the Monitor with quality control certificates from the manufacturer for each lot and each shift's production. The quality control certificates shall include:
 - 1. Roll numbers and identification.
 - 2. Sampling procedures.
 - 3. Results of quality control tests, including a description of test methods used.

2-3 *Damaged Geotextile*

- A. Geotextile damaged during transportation, loading, unloading, delivery, and storage shall be documented by the Monitor and the Contractor.
- B. Repair damaged geotextile to the satisfaction of the Monitor.
- C. Damaged geotextile rejected by the Monitor shall be replaced at no cost to the Owner.

2-4 *Equipment*

- A. Sewing equipment and accessories shall meet the following requirements:
 - 1. Maintain adequate number of seaming apparatus in order to avoid delay in work.
 - 2. Use power source capable of providing constant voltage under combined line load.
 - 3. Provide protective lining and splash pad large enough to catch spilled fuel under electric generator, if located on liner.

2-5 *Labeling*

- A. Mark or tag geotextile rolls with the following information:

1. Manufacturer's name
2. Product identification
3. Lot number
4. Roll number
5. Roll Dimensions
6. Special handling requirements

Part 3 Execution

3-1 *Approval to Deploy*

- A. Obtain approval by the Monitor prior to placing geotextile.

3-2 *Deployment*

- A. Secure geotextile by placing sandbags as ballast during deployment. Leave ballast in place until geotextile is covered. Installer is responsible for geotextile (excluding damage caused by Owner) until geotextile is covered.
- B. Take care to protect other in-place geosynthetic materials when cutting geotextile. Installer shall repair or replace at the Owner's discretion, components damaged during geotextile installation at no cost to the Owner.
- C. Do not entrap excessive dust, stones or moisture in geotextile that could damage or clog drains or filters or hamper subsequent seaming.
- D. Examine geotextile over entire surface to ensure that no potentially harmful foreign objects, such as needles, are present. Remove foreign objects, if encountered.
- E. Unless UV stabilized, cover geotextiles within 48 hours.

3-3 *Seams and Overlaps*

- A. Seam geotextiles by sewing. Overlap geotextile 6 inches prior to sewing. Do not seam horizontally on slopes greater than 10 horizontal to 1 vertical (i.e., seam up and down, not across slopes).
- B. Ensure that no soil materials are present within the seams.
- C. Sew using polymeric thread with chemical resistance properties equal to or exceeding those of the geotextile.
- D. Use a 401 two thread chain stitch or Engineer approved equivalent.
- E. Seams shall have a minimum strength equal to 90 percent for nonwoven and 80 percent for woven of the geotextile strength as measured in a wide strip tensile test.

3-4 *Repairs*

- A. Repair holes or tears in geotextiles as specified herein.
 - 1. Patch from the same geotextile material and continuously sew in place.
 - 2. Remove all sheets with tears exceeding 10 percent of the roll width and replace with new material.

3-5 *Field Quality Assurance*

- A. The Monitor will obtain conformance testing samples of geotextile delivered to the site and forward the samples to the Geosynthetic Quality Assurance Laboratory. One sample per roll. As a minimum, the following tests will be performed on samples of the geotextile:
 - 1. Mass per unit weight.
 - 2. Grab or wide strip tensile strength, depending on specification requirements.
 - 3. Permittivity and apparent opening size depending on specification requirement.
 - 4. Puncture resistance depending on specification requirement.

EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual:
Section:
Effective Date:
Organization:

RF/ER-94-00044
Geotextile, Rev. 0
8 of 1
RPD

- B. Samples will be obtained across the entire width excluding the first three feet of the roll. sample size shall be three feet long by the roll width. The Monitor will mark the machine direction on the sample.

3-6 Acceptance

- A. Contractor shall retain ownership and responsibility for geotextile until acceptance by Owner.

- B. Owner will accept geotextile when all of the following conditions are met:

1. The installation is complete.
2. Required documentation is complete.
3. The Monitor's final report is complete.
4. Verification of the adequacy of all seams and repairs including associated testing, is completed.
5. Written certification documents have been received by the Owner.

72

12. ASTM Draft Designation 01.81.07 (3rd Rev. 11/88) - Standard Method for Determining the Coefficient of Soil and Geosynthetics or Geosynthetics and Geosynthetics Friction by the Direct Shear Method

B. National Sanitation Foundation (NSF):

SN 14-86 - Plastics Piping Components and Related Materials

1. Standard Number 14

1-3 DEFINITIONS:

A. Construction Quality Assurance Monitor (Monitor): Party, independent from Manufacturer, or Installer, that is responsible for observing and documenting activities related to the quality assurance during lining system construction.

B. Engineer: The individual or firm responsible for the design and preparation of the project Construction Drawings and Specifications.

C. Geosynthetic Quality Assurance Laboratory: The party, independent from the Owner, Manufacturer, Fabricator, and Installer, responsible for conducting tests on samples of geosynthetics obtained at the site.

D. Installer: The party responsible for field handling, transporting, storing, deploying, welding, and installation of pipe.

E. Owner: *DOE*

F. Pipe Manufacturer: The party responsible for the production of the pipe from resin and for the resin quality.

G. Production Lot: For testing purposes, a production lot shall consist of all pipe having the same marking number.

1-4 STORAGE AND HANDLING:

A. Exercise care during loading, transit and unloading to prevent damage by abrasion and/or puncturing.

B. Store pipe with support to prevent developing a permanent set.

C. *NOT USED*

D. *NOT USED*

PART 2: MATERIALS

50211

2-1 PIPE:

A. Pipe shall be HDPE which meets the requirements presented in Table 02274-1 and those presented on the contract drawings.

B. Pipe shall also conform to the requirements of ASTM D 3261, ASTM D 3035 and NSF Standard 14.

C. Pipe shall be homogeneous throughout, uniform in color, and free of cracks, holes (except where specified), foreign materials, blisters or deleterious faults.

TABLE 02274-1

Test	Test ASTM Designation	Testing Frequency	Requirement
Density	D 1505-85	(1)	min 0.94
Melt Index	D 1238-88	(1)	max 0.41
Flexural Modulus	D 790-86	(1)	min 120,000 psi
Tensile Strength	D 638-89	(1)	min 3,000 psi
Environmental Stress Crack	D 1638-74 Test Condition C	(2)	1,500 hours failure max 20%
Carbon Black	D 1603-88	(1)	2-3%
Carbon Black Dispersion	D 3015-85	(1)	min A-3

- (1) One per production lot
- (2) Certification only required

D. Provide HDPE pipe to the dimensions shown on the contract drawings.

E. Perforate pipe with holes drilled in locations and dimensioned as directed on contract drawings.

02274-3

75

F. Pipe shall be marked at 10-foot intervals or less with a coded number which identifies the manufacturer, SDR size, material, machine, date and shift on which the pipe was extruded.

2-2 PIPE COUPLINGS AND FITTINGS:

A. HDPE couplings and fittings shall conform to the contract drawings and ASTM D 3261.

B. Fabricated HDPE fittings shall be as shown on the drawings. Fabricate, transport and install in accordance with the manufacturer's recommendations.

C. Fittings and couplings shall be marked with the manufacturer's name or logo, size and material from which they were molded.

D. All fittings and couplings which will be fusion welded to the pipe shall be manufactured using the same resin and additives and shall be from the same manufacturer as the pipe.

2-3 EQUIPMENT: Equipment for handling, welding and laying pipe shall be as recommended by the pipe manufacturer and approved by the monitor.

2-4 DAMAGED PIPE:

A. Pipe damaged during transportation, loading, unloading, delivery, storage, or during construction shall be documented by the monitor and the Contractor.

B. Contractor shall repair or replace damaged pipe at no cost to the Owner and to the satisfaction of the Monitor.

PART 3: EXECUTION

3-1 PIPE CONNECTIONS: Fusion weld all pipe connections in accordance with the manufacturer's recommendations unless otherwise shown on the construction drawings.

3-2 FABRICATED FITTINGS:

A. Pipe installation procedures shall provide for the least possible amount of lifting and moving.

B. A fabricated fitting shall not be used as the point of attachment for a lifting or pulling line.

END

* * * * *

02274-4

C. Do not operate hauling equipment over the synthetic material with less than 12 inches of drainage materials in place.

D. Drainage rock materials may be placed in one continuous lift unless directed otherwise by the Engineer. No compaction is required for the drain rock layer.

~~_____ the Engineer _____
res _____ underlying materials.~~

END

* * * * *

76

EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual:
Section:
Effective Date:
Organization:

RF/ER-94-00044
Testing of Piping Systems, Rev. 0
1 of 1
RPD

SECTION 02662 - TESTING OF PIPING SYSTEMS

WILL BE SPEC FOR
TESTING DOUBLE CONTAINED
POLYPROPYLENE PIPE

EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual:
Section:
Effective Date:
Organization:

RF/ER-94-00044
Pressure Piping and ????, Rev. 0
1 of 1
RPD

SECTION 02723 - PRESSURE PIPING AND APPURTENANCES

WILL BE SPEC FOR
MATERIAL & INSTALLATION
OF DOUBLE CONTAINED POLYPROPYLENE PIPE

SECTION 03310 - CONCRETE

Part 1 General

1-1. Description

The work of this section consists of furnishing and placing concrete and its reinforcing.

1-2. Quality Assurance

- A. Standards: American Concrete Institute (ACI), American Society for Testing and Materials (ASTM), National Bureau of Standards (NBS), Concrete Reinforcing Steel Institute (CRSI), and manufacturer's printed recommendations.
- B. Cement: Furnish from cement manufacturer a written statement showing chemical composition of each cement shipment.
- C. Admixtures: Furnish from admixture manufacturer a written statement showing that no chloride was added during manufacture.
- D. Concrete Mix Design: Concrete mix proportions shall be determined at the expense of the Contractor by a qualified testing laboratory under the supervision of a registered professional engineer who shall affix his signature and registration seal to the concrete mix design report. This report shall be submitted prior to placing concrete and shall specify dry weight of cement, saturated surface dry weights of fine and coarse aggregates, percent of entrained air, weight or volume of mixing water to be used in each cubic yard of concrete, slump of concrete. Proportions shall comply with maximums and minimums specified.
- E. Slump and Air Content Tests: Samples may be required after discharge of 15 percent and 85 percent of load. If slumps differ by more than 2 inches, the mixer or agitator shall not be used until the condition causing this variation is corrected.
- F. Compression Tests: Test specimens using standard ASTM 6 inch diameter by 12 inch height cylinders shall be taken by the Contractor. Curing, shipment to and testing by an independent laboratory shall be at the expense of the Contractor. The Contractor shall supply four plastic cylinders for every 50 cubic yards of concrete placed or for each major placement during the

81

day. These cylinders shall be at the job site before any concrete is placed. Contractor shall supply one curing box for test specimens.

1-3. *Submittals: In accordance with Section 01300*

A. Drawings: Prior to starting concrete work, prepare and submit for approval detailed drawings indicating size, dimension, placing, and construction details. Any error in quantity shown will be the responsibility of the Contractor.

B. Certificates and Reports:

1. Cement: Submit written statement showing chemical composition of each shipment as required.
2. Admixtures: Submit request for use of admixture.
3. Concrete Mix Design: Submit mix Design: Submit mix design report.

1-5. *Product Handling*

- A. Delivery: Upon determination of design slump; mix and transport concrete so slump will not increase nor decrease by more than 1 inch from design slump.
- B. Storage: Store cement and aggregates to prevent deterioration or contamination. Store each size of aggregate separately. Do not use cement which has caked, partially set, or deteriorated, or any material which has become damaged or contaminated.

Part 2 Materials

2-1. *Portland Cement*

ASTM C150, Type II. Use cement containing not more than 0.60 percent alkalis (calculated as the percentage of sodium oxide plus 0.658 times the percentage of potassium oxide: in concrete with aggregate that may be deleteriously reactive.

2-2. *Admixtures*

- A. Air Entraining Admixtures: ASTM C 260. Other admixtures, ASTM C494; approval required. No admixtures containing chlorides will be permitted.

- B. Water Reducing Admixtures: ASTM C494 for Type A admixture; use approved admixture such as Pozzolith 322-N made by the Master Builders Company; or approved equal product. No admixtures containing chlorides will be permitted.

2-3. *Mixing Water*

Clean, Fresh, and free from injurious quantities of oil, acid, alkali, organic matter, or other deleterious substances.

2-4. *Aggregates*

- A. Fine Aggregate: The fine aggregate shall have not more than 45 percent retained between any two consecutive sieves. The fineness modules of fine aggregate shall be not less than 2.3 nor more than 3.1 and shall not vary more than 0.20 from the value used in selecting proportions. Fine aggregate shall be graded within the following limits:

Sieve Size	Percent Passing by Weight
3/8 inch	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

Fine aggregate shall not contain any materials that are deleteriously reactive with the alkalis in the cement in an amount sufficient to cause expansion of mortar or concrete. Fine aggregate shall be free of injurious amounts of organic impurities.

- B. Course Aggregates: Gravel, crushed gravel, crushed stone, or a combination, meeting the requirements of this section.

83

Course aggregates shall be graded between the following limits:

Sieve Size	Percent Passing by Weight
3/4 inch	0
1 inch	20
1-1/2 inch	90
2 inch	100

Coarse aggregate shall not contain any materials that are deleteriously reactive with alkalis in the cement in an amount sufficient to cause expansion of mortar or concrete. Coarse aggregate shall be free of any injurious amounts of organic impurities.

2-5. *Forms*

A. General Requirements:

1. Contractor shall be responsible for design, strength and safety of formwork.

B. Formside Materials:

1. Use lumber, prefabricated wood panels, metal, or plastic lined panels which will produce a smooth, hard, uniform texture on the concrete. Do not use materials with raised grain, torn surfaces, worn edges, patches, dents or other defects that will impair the surface of the concrete.
2. Use orderly and symmetrical panel arrangement with minimum number of joints.
3. Mount panels on rigid supports to minimize deflection.

2-6. *Reinforcing*

- A. Reinforcing Steel Bars: Deformed bars, ASTM A615, including Supplementary Requirement S1, Grade 60, free from rust, scale, oil, or frost.

2-7. *Design of Concrete Mix Proportions*

- A. Concrete shall be composed of portland cement, water, fine aggregates, coarse aggregates, and entrained air. Proportions shall comply with the following maximums and minimums:

General Concrete Mix:

Minimum compressive strength	3,000 pounds per square inch at 28 days
Minimum allowable portland cement per cubic	564 pounds per yard
Entrained air	5% ± 1%
1-1/2 inch maximum aggregate	
Water Reducing Admixture (optional)	
Minimum	3 oz./100# cement
Maximum	7 oz./100# cement
Maximum allowable water cement ratio	5.1 gallons per sack of cement (w/c = 0.45)
Maximum design slump or consistency	4 inches
Maximum additional slump from water reducer	1-1/2 inches

- B. The mix design and resultant concrete, its strength, durability, consistency, and finishability shall be the responsibility of the Contractor. No assistance or approval rendered shall release the Contractor from this responsibility.

2-8. *Measuring Materials*

- A. Cement: Unless otherwise approved, cement shall be measured by weight. Weight on a scale and in a weigh hopper which is separate and distinct from those used for other materials. Quantity of cement used shall be not less than required amount. With approval, cement may be measured in bags of 94 pounds. No fraction of a bag of cement shall be used unless weighed.
- B. Aggregate: Measured by weight. Batch weight shall be based on dry materials and shall be the required weights of dry materials plus the total weight of moisture, both absorbed and surface, contained in the aggregate. When weighed in individual aggregate weight batchers, quantity of the aggregate used in any batch of concrete shall be within 2 percent of required weight. In a cumulative aggregate weigh batcher, the cumulative weight after each successive weighing shall be within 1 percent of required amount.

- C. Mixing water consists of water added to the batch, water added during transit, water occurring as surface moisture on the aggregates, and water introduced in the form of admixtures. Measure the added water by weight or volume to an accurate of 1 percent of required total mixing water. Any wash water shall be discharged prior to loading the next batch of concrete.
- D. Admixture shall be measured by weight or volume. Measuring accuracy shall be within 3 percent of required weight or volume.

2-9. *Bonding Agent*

Intralok manufactured by W.R. Meadows, Inc., Elgin, Illinois 60120, or approved equal.

2-10. *Nonshrink Grout*

Masterflow 713, as manufactured by Master Builders Company, Cleveland, Ohio, or approved equal.

2-11. *Epoxy Grout*

Non-sag, fast set, prepackaged concrete epoxy adhesive as manufactured by Adhesive Engineering Company, San Carlos, CA 94070, as approved or equal.

Part 3 Execution

3-1. *Batching*

- A. In batching plant, provide bins with adequate separate compartments for fine and for each size of coarse aggregate. Design and operate each bin to discharge efficiently and freely, with minimum segregation into the weighing hopper. Provide means of control so that as the quantity desired in the weighing hopper is approached, the material may be shut off with precision. Construct weighing hoppers to eliminate accumulations of tare materials and to discharge fully.
- B. Indicating devices shall be in full view and located for accurate reading while charging the hopper. Operator shall have convenient access to all controls.

- C. Scales for batching concrete ingredients may be either beam or springless dial scales complying with applicable NBS Handbook 44. Methods for weighing such as electric, hydraulic, or load cells, other than beam or springless dial scales, which meet the weighing tolerances are also acceptable.
- D. Adequate standard test weights shall be available for checking accuracy. All exposed fulcrums, clevises, and similar working parts of scales shall be kept clean.
- E. Device for measurement of added water shall be capable of delivering to the batch the quantity required within the accuracy required. Arrange device so measurements will not be affected by variable pressures in the water line.

3-2. *Mixing Equipment*

Mixers may be stationary mixers or truck mixers. Agitators may be truck mixers or truck agitators.

- A. Equip stationary mixers with metal plates plainly marked with the mixing speed of the drum or paddles, and the maximum capacity in terms of the volume of mixed concrete. When used for the complete mixing of concrete, equip stationary mixers with an acceptable timing device that will not permit the batch to be discharged until specified mixing time has elapsed.
- B. Attach to each truck mixer or agitator metal rating plates on which are plainly marked the maximum capacities of the drum or container in terms of the volume both for mixed concrete and for agitated concrete. Rating plates shall also have plainly marked the minimum and maximum speeds of rotation of the drum, blades, or paddles may be readily verified.
- C. All stationary and truck mixers shall be capable of combining the ingredients of the concrete within the specified time into a thoroughly mixed and uniform mass and of discharging the concrete with an acceptable degree of uniformity.
- D. All agitators shall be capable of maintaining the mixed concrete in a thoroughly mixed and uniform mass and of discharging the concrete with an acceptable degree of uniformity.

3-3. *Mixing*

Mix and transport ready-mixed concrete to point directed by means of one of the following combinations of operations:

- A. Operate mixers and agitators within limits of capacity and speed of rotation specified by manufacturer.
- B. When a stationary mixer is used for the complete mixing of the concrete, mixing time shall be measured from the time all the solid materials are in the drum. The batch shall be so charge into the mixer that some water will enter in advance of the cement and aggregate, and all water shall be in the drum by the end of the first one fourth of the specified mixing time.
- C. When the concrete is mixed completely in a truck mixer, a minimum of 70 to 100 revolutions at the mixing speed specified by the manufacturer and required to produce uniformity of the concrete.

3-4. *Depositing*

- A. Discharge concrete into forms within 1-1/2 hours after introduction of water to cement. When temperature of concrete is 85 degrees F, or above, the time between introduction of water to cement and complete discharge of concrete into forms shall not exceed 45 minutes.

3-5. *Formwork*

- A. Arrange formwork construction to allow for proper sequencing and removal without damage. Use orderly and symmetrical panel arrangement with minimum of joints. Before proceeding, secure approval of formwork and procedures.
- B. Forms: Sufficiently tight to prevent loss of mortar. Treat with a nonstaining material to eliminate absorption of water by forms and to act as a form release agent.
- C. Thoroughly remove all dirt, mortar, and foreign matter before each use. Where the bottom of the form is inaccessible from within, access panels shall be provided to permit thorough removal of extraneous materials before placing concrete.

3-6. *Reinforcement*

- A. Design: The reinforcement design indicated on drawings shows only the necessary information for detailing the reinforcement and preparing placing and bending details. Prior to starting concrete work, submitted detailed drawings shall be approved.

88

- B. Placement: Place reinforcement accurately in accordance with drawings. Adequately secure metal reinforcement in position by concrete or metal chairs and spacers.
- C. Protect exposed reinforcement bars intended for bonding with future extensions from corrosion by using adequate covering.
- D. Inspection: After reinforcement has been placed, it shall be inspected and approved prior to placing the concrete.
- E. Condition of Surfaces: At time concrete is placed, all metal reinforcements shall be free from rust, scale, frost, old concrete, or other coatings that would destroy or reduce the bond.

3-7. *Placing of Concrete*

A. Preparations Before Placing:

1. Check formwork for completion, check position and securement of reinforcement, expansion joint material, anchors and other embedded items and obtain approval on entire preparation.
2. Do not place concrete during rain, sleet, or snow unless adequate protection is provided.

B. Depositing:

1. Place concrete in final position to avoid segregation due to rehandling or flowing. Spread concrete in horizontal layers and do not drop more than 5 feet without using drop chutes. Concreting shall be carried on at such a rate that the concrete remains plastic and flows readily into spaces between bars. Place concrete before it has taken its initial set and, except for concrete being agitated, deposit within 30 minutes after mixing. Do not deposit concrete that has partially hardened or become contaminated by foreign materials. Lifts shall be kept between 6 inches and 20 inches high and shall be of a height to minimize surface defects and eliminate rock pockets and cold joints.
2. Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.

C. Compacting:

1. Use high frequency vibrators in the placement of concrete, and design forms to withstand vibrator action. When concrete is being placed on hardened concrete or in bottom of forms, exercise care to assure complete consolidation. After the initial lift, vibrator shall penetrate through and into top of previous lift of concrete.
2. Compact concrete in slabs thoroughly by means of screeds.
3. All reinforcement, forms, fillers, and ground with which the concrete is to come in contact shall be free from frost, oil, grease, or any other contaminating substances.

3-8. *Form Removal*

Carefully remove forms to insure the complete safety of the structure. Where the structure is supported by shoring, beam sides, columns or other vertical forms may be removed after 24 hours, providing the concrete will not be injured. All supporting forms shall remain in place for a minimum of 10 days. Do not remove supporting forms or shoring until members have acquired sufficient strength to support their weight and imposed loads safely.

3-9. *Repairing and Patching*

- A. Clean, thoroughly dampen and patch all repairable defects, immediately after form removal.

3-10. *Finishes for Slabs*

- A. **Screeding:** After concrete has been thoroughly consolidated, screed slabs to the desired elevations and contours by means of accurately placed edge forms and intermediate screed strips.
- B. **Broom Finish:** Exterior slabs on grade shall be given a coarse transverse scored texture by drawing a broom across the surface.

3-11. *Epoxy Grout*

Use epoxy grout to secure reinforcement to existing concrete as shown. Epoxy grout shall be mixed and used in accordance with manufacturer's recommendations. Use a non-rotary machine

EG&G Rocky Flats Plant	Manual:	RF/ER-94-00044
OU 7 Leachate Collection and Storage	Section:	Concrete, Rev. 0
Facility Technical Specifications	Effective Date:	11 of 11
Category	Organization:	RPD

for drilling holes. Drilled holes shall be flushed with water, then blown out using oil-free compressed air and allowed to dry. Reinforcement shall be temporarily wedged and centered in the hole opening until the grout has set.

3-12. *Nonshrink Grout*

Use nonshrink grout to fill sleeves and voids under equipment bases. Grout shall be mixed and used in accordance with manufacturer's recommendations. Exposed edges shall be smooth, straight and even.

3-13. *Testing*

- A. Four compressive test specimens shall be taken for every 50 cubic yards of concrete placed or for each major placement during the day. The Owner has the option to direct the Contractor to take the required test specimens as he deems necessary to insure the concrete meets the specification.
- B. Specimens shall be taken, cured, and tested for compressive strength in accordance with ASTM C31, C39, and C172, respectively. As directed, take specimens from batches being mixed for placement.
- C. Standard age of compressive test shall be 28 days; however, 7 day tests may be used provided that the relation between the 7 day and 28 day strengths of the concrete is established by test for the materials and proportions used.
- D. All test reports shall be sent to the Engineer.

3-14. *Damaged or Defective Concrete*

Remove damaged or defective concrete before completion and acceptance of the work and replace with acceptable concrete at no additional cost to the Owner. Testing required by damaged or defective concrete shall be at the expense of the Contractor.

91

EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual:
Section:
Effective Date:
Organization:

RF/ER-94-00044
Submersible Pump, Rev. 0
1 of 1
RPD

SECTION 15021 - SUBMERSIBLE PUMP

SCOPE: Furnish and install 1 submersible effluent pump (s). Each pump shall be capable of delivering the following performance points, 20 U.S. GPM at 75 TDH; 15 U.S. GPM at 82 TDH; 10 U.S. GPM at 88 TDH, with a shut off head of 96 TDH (minimum). The pump motor speed shall be 3450 RPM, 1 HP (maximum), 3 Phase, 60 Hertz, 460 Volts. The pump (s) shall be manufactured in the United States by a company regularly engaged in the manufacture and assembly of similar units for a minimum of five (5) years. The pump (s) shall be Barnes® Pumps model EFFLUENT SERIES H

PUMP DESIGN: Each pump shall be capable of handling septic tank effluent with solids to 3/4 inch diameter. The pump (s) shall be capable of handling liquids with temperatures to 104 degrees F continuous, 160 degrees F intermittent, and shall be capable of running dry for extended.

PUMP CONSTRUCTION: Pump (s) shall be manufactured in the United States utilizing domestic parts and componentry in its construction. The volute, seal plates and motor housing shall be constructed of high quality ASTM A-48 class 30 cast iron. The pump (s) shall be painted with a acrylic primer coating of 1.0 mil minimum thickness and a water based air dry enamel top coat of 1.5 mil minimum thickness. All exposed hardware shall be 300 series stainless steel. The pump construction shall contain no points of critical clearance nor require periodic adjustment or replacement to maintain operating efficiency. Discharge connection shall be a standard 2 inch NPT in the vertical position. Ail gaskets shall be of the compression square ring type eliminating critical slip fits and the possibility of damage during service associated with sliding o-ring sealing arrangements.

The pump impeller shall be a two vane type ("E" series .5 & 1.0HP to have three vane and "H" series to have single vane), with pump out vanes on on the back side. The "E" and "EHH" (.4 & 1.0HP) series shall be of cast iron construction, "EH" (1750 RPM) and "H" series shall be of polypropylene construction, "EH" (3450 RPM) series shall be of 85-5-5-5 bronze construction, "EHH" (.5HP) series shall be of 81-3-7-9 Brass Alloy, and "SE" series shall be of glass filled nylon construction.

The unit shall utilize a single mechanical shaft seal which will operate in an oil atmosphere. The materials of construction shall be carbon for the rotating face and ceramic for the stationary face, lapped and polished to a tolerance of one light band, 300 series stainless steel hardware, and all elastomer parts to be of Buna-N. A secondary Buna-N lip seal shall be provided between the mechanical seal and pumped fluid. The seal shall be commercially available and not a proprietary design of the manufacture.

The pump shall be designed to be non-overloading throughout the entire pump curve. The rotor and stator assembly shall be of the standard frame design and secured to the pump seal plate by four threaded fasteners allowing for easy serviceability. Motor designs incorporating shrink or press fit assembly between the stator and motor housing shall not be acceptable. The motor shall be constructed with the windings operating in a sealed environment containing clean dielectric oil, making it capable of operating in a totally, partially or non-submerged condition for extended periods of time without damage due to the heat being generated. Air-filled motors shall not be acceptable. The motor windings shall be of Class A insulation. The motor shall meet the standard NEMA Design L for single phase and NEMA design B for three phase. The motor shaft shall be of 416 stainless steel. The lower bearing shall be of the single ball type to accept radial and thrust loads, and the upper bearing of the sleeve design for radial loads. Bearings shall operate in an oil bath atmosphere for superior life. Permanently lubricated bearings are not acceptable.

The pump shall be equipped with _____ ft. of type _____ power cable and connected to the motor via quick disconnect spade terminals. Crimp connected cords are not acceptable. Heat shrink tubes shall be used to connect power cord leads with motor leads. A master heat shrink tube shall be provided and filled with epoxy to seal the outer cable jacket and the individual strands to prevent water from entering the motor housing. A secondary rubber pressure grommet shall be provided as an additional sealing point and strain relief at the point of cable entry. Cable entry designs utilizing terminal boards to connect power cord leads with motor leads shall not be acceptable.

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PUMP TEST: The pump manufacturer shall perform the following inspections and tests in accordance with Hydraulic Institute type B specifications before shipment from the factory:

1. A check of the motor voltage and frequency shall be made as shown on the name plate.
2. A motor and cable insulation test for moisture content or insulation defects shall be made per UL criteria.
3. The pump shall be completely submerged and run to determine that the unit meets three pre-determined hydraulic performance points.
4. A written report shall be available showing the aforementioned tests have been performed in accordance with the specifications.

START-UP: The pump (s) shall be tested at start-up by a qualified representative of the manufacturer. A start-up report as provided by the manufacturer shall be completed before final acceptance of the pump (s).

DOCUMENTATION: The manufacturer, if requested, will supply a minimum of 3 sets of standard submittal data;

Standard submittal data consist of:

- a. Pump catalog data;
- b. Pump performance curve;
- c. Break Awa Fitting (BAF) data;
- d. Access frame data;
- e. Typical installation drawing;
- f. Control panel data
- g. Panel wiring schematic;
- h. Accessory data;
- i. Installation & Operation Manuals with Parts List

EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual:
Section:
Effective Date:
Organization:

RF/ER-94-00044
Leachate Storage Tanks, Rev. 0
1 of 1
RPD

SECTION 15025 - LEACHATE STORAGE TANKS

The tanks shall be manufactured of high density crosslinked rotationally molded polyolefin. The tanks shall have a capacity as required. All openings and fittings shall be provided as shown on the drawings.

Manufacturer shall provide a minimum 10 year performance and service history in the manufacture of crosslinked polyethylene tanks

Tank shall be manufactured to meet or exceed ASTM D 1998-91 standards.

The tank shall have weatherability equal to CL200 resin with 1/2 of 1% U.V. stabilizer. Manufacturer shall have the capability of providing history of tanks with six or more years exposure to sunlight. Weathering information can be furnished equal to weathering meter test run in technical service bulletin TSM-282 by Phillips Chemical Company.

Resin used in the tanks manufacture shall be crosslinkable polyethylene MARLEX CL200 as manufactured by Phillips Chemical or equal. The rotationally molded material shall meet or exceed the following properties:

	ASTM TEST	
Density, gms/cc	D1505	0.938-0.941
Environmental Stress Cracking Resistance, F50, hrs.	D1693	>1,000
Tensile Strength, Ultimate PSI 2" /min.	D638 Type IV Specimen	2,600
Elongation at Break, % 2"/min.	D638 Type IV Specimen	450
Vicat Softening point, F	D1525	~255
Brittleness Temperature, F	D746	<-180

Impact test results must meet the requirements of 120 foot pounds at minus forty (-40) degrees Fahrenheit. Test procedures to be equal to Phillips Chemical procedure described in bulletin SSL-193.

Wall thickness for a given hoop stress is to be calculated by the Barlow formula. Manufacturer to provide, if customer requests, wall thickness required by the Barlow formula for the thickness of the tank being specified. Designed maximum hoop stress shall be no greater than 600 psi.

Wall thickness shall be based on specific gravity of product to be stored. Please consult Tanks Plus for assistance.

Tanks shall be warranted for seven years to be free of defects in material and workmanship. The warranty shall be prorated during the last five years. This warranty is not in effect for all chemicals. Please contact Tanks Plus for specifics.

Manway shall be integrally molded in the top of tank. Cover shall be made of crosslinked polyethylene with 1/2" buttress threads. (No metal)

Fittings:

PVC Fittings shall be compression type, long shank, deep cut thread (not injection molded) with dual wide nut. Fittings will be made vertical on sloping tank tops as indicated.

Bolted-Flange Fittings Bolts shall be _____ (316 SS, Hasteloy C276, Titanium, or Monel) bolts with internal polyethylene injection molded encapsulated heads and _____ (PVC, PPL, or CPVC) external flanges.

Integrally Molded Flanged Outlets (IMFO) shall be molded as an original part of the tank.

✓ Stainless Steel (304 or 316) fittings shall be compression type with external bolts and nuts.

Gaskets shall be of _____ (XLPE, Viton, or Buna-N) material.

(OPTION) Manway shall be integrally molded with gasketed and bolted lid designed to prevent fume escape.

(OPTION) Tank shall be insulated with _____ inches of urethane foam. Exterior surfaces of the insulation shall be coated with waterproof acrylic.

(OPTION) A _____ volt heat tracing apparatus shall be provided between the tank exterior and the tank insulation. The heating device and control shall keep the entire tank contents at a minimum temperature of _____ degrees Fahrenheit in an -20 degree Fahrenheit ambient environment. The heat tracing system shall include a thermostat to automatically control the temperature of the tank contents.

(OPTION) Seismic and wind lateral restraint. The lateral restraint shall be built and installed in conformance with plans and instructions certified by a registered civil or structural engineer. The lateral restraint system shall be designed for seismic zone _____ and wind of _____ MPH, and shall conform to the Uniform Building Code, 1988 edition.

(OPTION) All or part of above specifications must be able to be produced for the buyer at a nominal fee agreed between both parties. Documented gel tests and impact data must be ordered at the same time purchase order is received.

95

EG&G Rocky Flats Plant
OU 7 Leachate Collection and Storage
Facility Technical Specifications
Category

Manual:
Section:
Effective Date:
Organization:

RF/ER-94-00044
Electrical, Rev. 0
1 of 1
RPD

SECTION 16010 - ELECTRICAL

16010

9/27/94