e. Fill and Embankment Areas: Perform trenching only after compacted fill or embankments has reached an elevation of not less than one foot above the top of the pipe.

5. Dewatering:

a. Control grading around excavations to prevent surface water from flowing into excavation areas.

b. Drain or pump as required to continuously maintain all excavations and trenches free of water or mud from any source and discharge to approved drains or drainage channels. Commence when water first appears and continue until Work is complete to the extent that no damage will result from hydrostatic pressure, flotation, or other causes.

c. Remove subgrade material rendered unsuitable by excessive wetting and replace with approved backfill material.

6. Waste Materials:

a. Remove unsuitable materials from work area as excavated.

b. Deposit such materials in locations and within areas indicated or designated by Engineer.

c. Grade waste areas and leave free draining with an orderly, neat appearance.

7. Existing Groundwater Monitoring Well Closure

a. The existing groundwater monitoring wells located within the new ash pond or in the area that will be covered by the new ash pond dikes shall be sealed to preclude the introduction of contaminants into the groundwater.

1. All materials, debris and obstructions that may interfere with sealing operations shall be removed from the well.

2. The liner pipe shall be removed or perforated to assure placement of the seal. All casings and screen may be salvaged.

3. The top 10 feet of the hole shall be filled with bentonite grout to within two feet of the "land surface" (bottom of the pond excavation).

4. Casing remaining in the hole shall be cut off at least two feet below the "land surface" (bottom of the pond excavation). The remaining top two feet of the hole shall be filled with "native topsoil".

C. EARTHWORK

1. Compaction:

a. General:

(1) Excavate or backfill as required to construct subgrades to the elevations and grades indicated.

(2) Remove all unsuitable material and replace with acceptable fill material and perform all wetting, drying, shaping and compacting required to prepare subgrade.

b. Subgrade for Fills and Embankments:

Roughen by discing or scarifying and wet or dry top 6 inches as required to bond with fill or embankment.

2. Embankments and Fills:

   a. Construct embankments to the contours and elevations indicated, using suitable approved material from excavations and borrow areas.

      (1) Place fill material in 4-inch to 8-inch layers.

      (2) Place embankment only on subgrades approved by Engineer.

      (3) Do not place snow, ice or frozen earth in fill and do not place fill on a frozen surface.

      (4) Compact to 95 percent of maximum density at optimum moisture content as determined by ASTM D698.

   b. Obtain compaction by the controlled movement of equipment during the placing and grading of layers and to the minimum density specified for indicated locations.

3. Pipe Embedment:

   a. Pipe bedding shall be as indicated using granular material.

   b. Place granular embedment as follows:

      (1) With level bottom layer at proper grade to receive and uniformly support pipe barrel throughout its length.

      (2) Form depression under each joint such that no part of bell or coupling is in contact with trench when pipe is placed in position.

      (3) Add second layer simultaneously to both sides of the pipe with care to avoid displacement.

      (4) Complete promptly after completion of jointing operations.

      (5) Substitute for any part of earth backfill to within 2 feet of final grade at Contractor's option.

   c. Compact Granular Embedment as follows:

      (1) In lifts not exceeding 12 inches in compacted depth.

(4) Tolerance for areas within 10 feet of building and areas to be paved shall not exceed 0.15-foot above or below established subgrade.

(5) Finish all ditches, swales and gutters to drain readily.

c. Finish Grading:

(1) Finish grade the pond basin such that there is a constant negative slope from all parts of the pond to the pumping station in the southwest corner of the pond (elev. 460.0).

(2) All surfaces that receive the synthetic pond liner shall be free of <u>all</u> rocks, roots, construction debris, etc. for a depth of 6".

(3) Recompact and proof roll all surfaces that will receive the synthetic pond liner with a drum type roller such that the surface is smooth with no ridges or gullies.

(4) The synthetic liner installer shall certify is writing that the base subgrade is suitable and acceptable for installation of the liner.

6. Topsoiling:

a. Material:

Use the most suitable material obtained from excavation and stripping operations and borrow.

b. Placement:

(1) Clear areas free of vegetation, rock and other materials which would interfere with grading and tillage operations.

(2) Bond topsoil to the subgrade by scarifying the subgrade to a depth of 2 inches.

(3) Spread topsoil to a minimum depth of 4 inches where grading operations have left less than 4 inches of topsoil in place.

(4) Grade topsoil to bring areas to grades as indicated and to insure that all surfaces are left in an even and properly compacted condition and to prevent ponding of water in depressions.

SECTION 02400

HIGH DENSITY POLYETHYLENE (HDPE) MEMBRANE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide and install 40 mil (pond basin) and 60 mil (interior face of surrounding dikes) High Density Polyethylene (HDPE) geomembrane. Material shall be provided and installed by and approved HDPE geomembrane manufacturer/installer.

B. Provide design of HDPE geomembrane panel layout diagram.

C. Provide required sealing around objects penetrating the liner.

D. Provide quality control testing of HDPE geomembrane as specified in the approved QC manual.

E. Provide supervision of HDPE geomembrane anchoring and covering.

F. Provide adequate men, materials and equipment so the mechanical breakdowns do not affect the progress of work. (Any such interruption and the resulting loss of time for the independent quality assurance team shall be payable by the General Contractor.)

1.02 REFERENCES STANDARDS

A. National Sanitation Foundation (NSF) Standard Number 54.

1.03 QUALIFICATIONS OF CONTRACTOR WORK ACTIVITIES

A. Manufacturer

1. The Manufacturer shall be listed by the National Sanitation Foundation as having met Standard 54 for Flexible Membrane Liners, and shall have at least five (5) years continuous experience in the

manufacture of HDPE geomembrane rolls and/or experience totaling 10,000,000 square feet of manufactured HDPE geomembrane.

2. The manufacturer shall permit the owner or his authorized representatives to visit the manufacturing plant.

B. Installer

1. The installation contractor shall be the manufacturer or an approved contractor trained and licensed to install the manufacturer's geomembrane.

2. Installation shall be performed under the constant direction of a single Field Installation Supervisor who shall remain on site and be responsible, throughout the liner installation, for liner layout, seaming, patching, testing, repairs, and all other activities by the installer.

3. The Installation Supervisor shall have installed or supervised the installation and seaming of a minimum of 2,000,000 square feet of HDPE geomembrane.

4. Actual seaming shall be performed under the direction of a Master Seamer (who may also be the Installation Supervisor) who has seamed a minimum of 2,000,000 square feet of HDPE geomembrane, using the same type of seaming apparatus specified in the current project.

5. Only welders having a weld failure rate less than 1 test in 50 will be allowed to perform welding on the membrane. The installer shall submit the performance records for approval by the owner of welders who will be welding 7 days prior to the start of work. The performance records shall include approximate quantity of linear feet of weld performed in the last 6 months and number of samples tested and weld failure rate as a percentage of samples tested.

6. The Installation Supervisor and/or Master Seamer shall be present whenever seaming is performed.

1.04 SUBMITTALS

A. Manufacturer - The manufacturer shall submit the following information:

Submittals With Bid Documents:

1. Liner material samples, name of manufacturer and minimum material specifications. The specifications shall include the manufacturer's minimum physical properties of the material, test methods (ASTM Standards) used and factory and site seaming methods.

2. A list documenting no less than 10 completed facilities totaling a minimum of 3,000,000 square feet. Each entry in this list should specify the name and purpose of the facility, its location and date of installation, the name of the owner, the project manager, designer, fabricator (if any), and the installer, as well as the name and telephone number of the contact at the facility who can discuss the project. In addition, the geomembrane thickness and total square footage of the installation surface should be included.

Submittals After Contract Award And Prior To Liner Installation:

1. Certification that all resin used in the manufacture of geomembrane for this job meets the specifications.

2. A quality control certificate is required for each roll stating that the product meets or exceeds the project specification.

   a. Any rolls without roll certification will not be accepted and shall be immediately rejected and removed from the site.

3. Properties of the batch of materials proposed for welding HDPE geomembrane.

B. Installation Contractor - The Installer shall provide the following written information:

Submittals With Bid Documents:

1. Certification that both the Installation Supervisor for the installer and the Master Seamer have reviewed the Quality Assurance Plan, the Project Plans, and these specifications.

2. Brief historical background, insurance coverage, installation capabilities and information on equipment and personnel.

3. A list documenting no less than 10 completed facilities totaling a minimum of 2,000,000 square feet for which the Contractor has installed an HDPE geomembrane. Each entry in this list should specify the name and purpose of the facility, its location and date of installation, the name of the owner, the project manager, designer, fabricator (if any), as well as the name and telephone number of the contact at the facility who can discuss the project. In addition, the geomembrane thickness and total square footage of the installation surface should be included.

4. A Quality Control manual describing the details including, but not limited to sampling frequency, standard testing procedures, certification labeling of products and submission of all QC data.

Submittals After Contract Award And Prior To Liner Installation:

1. Written instruction for the storage, handling, installation, seaming, overlap requirements and repair including conditions and limitations of its warranty.

2. Panel dimensions and a detailed layout plan as required for the liner installation.

3. Details showing how the material will be anchored.

4. Details showing the liner configuration around the liner penetrations.

5. A list of the equipment to be used for seaming and

repair of the liner and a description of the seaming and repair procedures so as to ensure changes in environmental conditions will not effect the integrity of the weld.

6. A detailed description including equipment to be used, how the integrity of the field seams and penetrations will be tested and documented.

7. A resume of the qualifications for all personnel who will be involved in the installation, quality control and supervision of the HDPE geomembrane construction including their education and previous HDPE geomembrane installation experience.

8. Weld test data demonstrating the accumulated weld test failures for both peel and shear does not exceed one (1) per every fifty (50) tests or increment thereof for welds performed under normal environmental and operating conditions.

1.05 QUALITY ASSURANCE

A. The manufacturer/installer shall provide the services to perform all required quality assurance testing.

1. The manufacturer/installer shall provide an experienced and qualified inspection team.

a. The inspection team shall be on-site at all times during the HDPE geomembrane installation to observe installation procedures and quality control procedures, coordinate quality assurance tests, and collect data for documentation.

b. The team will take samples of the material at the time of manufacture for conformance testing. The sampling frequency shall be one per 100,000 square feet.

B. Observation of Installation

1. The inspection team shall observe and record the following with handwritten notes and photographs:

a. HDPE geomembrane packaging identification

slips.

b. Subgrade conditions prior to liner installation.

c. Handling of HDPE geomembrane sections.

d. Unfolding and unrolling of each liner panel.

e. Temporary and permanent anchoring of HDPE geomembrane.

f. Confirm that required overlap distances are met.

g. Preparation and cleaning of HDPE geomembrane prior to seaming.

h. Seaming products for proper products, equipment and techniques.

i. Visual inspection of the HDPE geomembrane to ensure it is free from pores, pinholes and other detrimental defects.

j. Visual inspection of fusion welds. Mark all breaks or holes for repairs.

C. Destructive Quality Assurance Testing

1. The installer shall obtain samples of the field seamed HDPE geomembrane of approximately 48 inches along and 18 inches across the seam and centered over the seam prioritized as follows:

a. All areas identified as suspect during non-destructive testing/inspection.

b. A minimum of one sample for each HDPE geomembrane seamer.

c. A minimum of one sample for each seaming condition.

d. A minimum of one sample for each representative working conditions (i.e. weather conditions).

e. A minimum of one every 500 feet of seaming

f. Seams that appear suspect to the inspector.

2. Each sample shall be subject to the following tests at the installer's laboratory:

a. Seam Shear Strength - ASTM D3083.

b. Peel Strength - ASTM 413.

c. Thickness - ASTM D1593.

3. The installer shall be responsible for patching all areas cut for test samples in accordance with the manufacturer's requirements and testing the seams using a vacuum box. Installer shall record locations.

4. Failed tests shall be subject to additional testing until a passing area is found. A passing area is defined as a seam(s) bounded by a passing destructive test. Seams will be tracked until a passing destructive test is found or until a previous passing destructive test is reached. Seams will be tracked to the welding apparatus and the machine operator. At the Company's discretion, trail seams may be substituted for tracking the geomembrane seam beyond the limits of each seaming period. Trial seams will be subject to a destructive testing in accordance with items D.1 and 2 of this section.

D. Non-Destructive Quality Control Testing By Installer

1. The installer shall inspect all field seaming using one or more non-destructive test methods.

2. The installer shall perform testing at the beginning of each crew shift and immediately following any work stoppage (i.e. for lunch, weather, etc.) of 30 minutes or more.

a. Seaming operation shall not commence until the Construction Supervisor has determined that the seaming process is meeting the specification requirements and is acceptable.

b. Testing shall include visual observation of a test weld three (3) feet long on scrap HDPE geomembrane material.

1) Mark date, ambient temperature, welding machine number, welding technicians initials, machine temperature and speed. For extrusion welding record the nozzle and extrusion settings.

2) Test seams by pulling by hand in peel.

The welds should not peel.

3. Non-destructive testing shall consist of the following techniques:

a. Vacuum chamber testing of the whole seam or pressure testing if double hot shoe welding is used.

b. Mechanical point stressing.

4. The installer is responsible for formulating a program meeting the minimum requirements of the specifications for non-destructive testing.

5. There shall be no limit to the non-destructive quality assurance testing if deemed necessary by the Construction Supervisor.

E. Report of Quality Control Testing Inspection

1. Installer shall provide written quality control reports for all testing and observations made.

a. Provide reports to the Construction Supervisor at the end of each day.

b. Provide copies of all field laboratory test results within 24 hours of completion of tests.

F. Warranty and Guarantee

1. A written Warranty shall be obtained from the Manufacturer (for material) and the Installation Contractor (for workmanship). These documents

shall warrant both the quality of the material and workmanship for 20 years.

PART 2 PRODUCTS

2.01 HDPE GEOMEMBRANE - GENERAL

A. The geomembrane shall be high density polyethylene containing approximately 97% to 98% polymer and 2% to 3% of carbon black, anti-oxidants and heat stabilizers.

B. HDPE geomembrane shall be:

1. Pond bottom: 40 mil (1.0 mm) (**minimum certifiable thickness**) with no factory seams.

2. Inside dike face: 60 mil (1.5 mm) (**minimum certifiable thickness**) with no factory seams.

C. HDPE geomembrane shall be manufactured for exposure at the Labadie Power Plant, Labadie, Missouri.

D. HDPE geomembrane shall contain no additive which will leach out or cause deterioration over time.

E. HDPE geomembrane shall be free of holes, blisters, undispersed raw materials and any sign of contamination by foreign matter.

F. HDPE geomembrane shall be manufactured in panels having a minimum width of twenty-two (22) feet and minimum length of four hundred (400) feet. Labels on rolls shall identify thickness, length, width and manufacturer's mark number.

G. HDPE geomembrane liner shall be manufactured and installed by **Gundle Lining Systems Inc.** or **Poly-Flex Polyethylene Geomembranes**. Alternates may be submitted in addition to Gundle or Poly-Flex for consideration.

2.02 HDPE GEOMEMBRANE - WELDING PRODUCTS

A. HDPE geomembrane field welding material shall be manufactured from the same materials used in the manufacture of the HDPE geomembrane.

B. HDPE geomembrane field welding shall result in a

homogeneous bond which is durable, strong, and air tight.

2.03 HDPE GEOMEMBRANE SPECIFICATION

See Appendix "C"

PART 3 EXECUTION

3.01 SHIPPING AND DELIVERY OF HDPE GEOMEMBRANE

A. All materials shall be suitably prepared and packaged to prevent damage or deterioration such as excessive aging or puncturing during shipment.

B. All material packaging shall identify the thickness, length, width and manufacturer's mark.

1. QC data shall be provided with each HDPE geomembrane material package (roll certifications).

C. All material shall be dry upon arrival on site (i.e. free of water, snow, etc.).

D. All packaging cores shall be open such that a metal rod can be inserted for deployment.

E. Rolls shall be stored appropriately to allow the Construction Supervisor access to the packaging slips of each roll so that verification of the roll inventory can be performed prior to job start-up.

3.02 SURFACE PREPARATION

A. Surface preparation including grading, recompaction and proof rolling shall be the responsibility of the general contractor.

B. The installer shall certify in writing that the base subgrade is suitable and acceptable for installation of the HDPE geomembrane.

3.03 SUPERVISION OF HDPE GEOMEMBRANE INSTALLATION

A. A daily meeting shall be held at the work area just prior to commencement of the work day. At a minimum, the meeting will be attended by the Installer and the

Inspector. The purpose of the meeting is to:

1. Review the work activity and location for the day.

2. Discuss the Installer's personnel assignment for the day.

3. Review the previous day's activity.

4. Review the work schedule.

5. Discuss possible problem areas and situations.

3.04 INSTALLATION OF HDPE GEOMEMBRANE

A. Climatic Conditions

1. Temperature: Unless otherwise authorized by the Construction Supervisor, the temperature range for HDPE geomembrane installation is 5 to 40 degrees C (40 to 104 degrees F). As a minimum, the Construction Supervisor will require that a performance evaluation of temperatures outside this range be made through a trial seam and destructive testing program.

2. Wind: Do not attempt installation when wind velocity and/or dusty conditions interfere with liner placement, alignment of seams or cleanliness of seam area.

3. Precipitation: Do not attempt installation when precipitation interferes with having a dry seaming surface (i.e., rain, sleet, snow or heavy dew).

B. HDPE Geomembrane Layout

1. Layout HDPE geomembrane, overlap a minimum of 4 inches.

2. Prepare areas for welding in accordance with the manufacturers/installer's requirements including cleaning.

3. Place temporary anchoring such as sand bags on 2 foot centers on liner immediately after layout.

4. HDPE geomembrane installer shall provide sufficient personnel to properly place the HDPE geomembrane and to operate the equipment so that the project proceeds in a workmanlike manner to completion.

C. HDPE Geomembrane Welding

1. Weld together by extrusion welding or by hot shoe welding.

2. Welding equipment shall be capable of continuously monitoring and controlling the temperature in the zone of contact or on the extrusion welder.

3. Seams parallel to the toe of the slopes shall be located 10 to 15 feet from the toe.

4. Installer shall mark any burnouts or defects found along the seam while welding.

5. A minimum of three hot shoe welders and three extrusion welders shall be on-site all times.

6. Welds shall extend a minimum of 1 foot into the anchor trench.

D. HDPE Geomembrane Repair

1. Repair and patch all areas of the HDPE geomembrane which show injury, scuffing, puncture or distress.

2. Repair and patch all defective welds.

3. Repairing and patching shall be completed in accordance with the manufacturer's recommendations.

E. HDPE Geomembrane Anchoring

1. Anchor in accordance with the anchoring details shown on the drawings. Excavate the trench only for such lengths as will be used for anchoring on any particular day. Use temporary anchors until the panels are welded and are ready for anchoring.

2. Excavation of anchor trench and compacting soil in anchor trench to 90% of the Standard Proctor Maximum Density (ASTM D-698) is the responsibility

of the general contractor.

F. HDPE Geomembrane Joints To Structures

1. Attach HDPE geomembrane to structures in accordance with the details shown on the drawings.

2. Provide manufacturer fabricated boots for joints.

3. Joints shall be constructed in accordance with the manufacturer's recommendations.

G. QC Testing

1. Complete quality control testing in accordance with 1.05 of this section and the manufacturer/installer's requirements.

2. One or more rolls of HDPE geomembrane material shall be set aside for the purpose of patching.

3. A minimum of two vacuum boxes shall be on-site at all times.

3.05 RESPONSIBILITY FOR LINER LEAKAGE AND INTEGRITY

A. The installer is responsible for maintaining the integrity of the HDPE geomembrane until final payment and acceptance by the Construction Supervisor.

1. The installer shall coordinate and supervise the activities of the general contractor during the installation, anchoring and covering of the HDPE geomembrane.

B. The installer is responsible for providing a watertight basin.

1. If leakage is detected within the warranty period, the installer shall repair leaks at no charge.

2. All leaks discovered shall be repaired immediately and tested as per 1.04 of this section.

SECTION 02500

COMPACTED EARTH LINER
(ALTERNATE)

PART 1 GENERAL

A. WORK INCLUDED

Construct a one foot thick pond liner from imported clay.

B. RELATED WORK

Section 02000 - Sitework

C. SUBMITTALS

1. Sufficient boring or test pit logs shall be submitted to indicate a volume of borrow soils for a earth liner greater than 125 percent of the estimated volume of liner material to be place at 95 percent of Standard proctor density. For each soil type the following minimum tests results are required:

Target Property	Test Method
Moisture/density curve standard Proctor	ASTM D 698
In-situ moisture/density drive cylinder method or undisturbed thin-walled sampler	ASTM D 2937
Laboratory Hydraulic Conductivity back-pressure saturated	COE EM 1110-2-1906
Plasticity; Atterberg limits	ASTM D 4318
Grain size distribution sieve and hydrometer	ASTM D 422

2. The laboratory hydraulic conductivity test shall be performed at 95 percent standard Proctor at moisture contents 2 to 3 percent above optimum.

3. To meet the intent of the design, the specifications for soil and soil placement are more stringent than the minimum required by the Department of Natural Resources. In accordance with 10 CSR 20-8 (17) (C) 1. of the Department of Natural Resources, soils used to construct a liner should meet the following minimum specifications:

A. Be classified under the Unified Soil Classification System as Cl, Ch, Gc, or Sc;

B. Allow more than fifty percent (50%) passage through a No. 200 sieve;

C. Have a liquid limit equal to or greater than thirty (30);

D. Have a plasticity index equal to or greater than twenty (20); and

E. Have a coefficient of permeability equal to or less than 1 x 10-7 centimeters per second when compacted to ninety percent (90%) of standard Proctor density with moisture content between two percent (2%) below and four percent (4%) above the optimum moisture content.

4. Prior to award of contract the Owner may require additional exploration and testing of the borrow source. It shall be the Bidder's responsibility to provide site access and cooperate with the Owner during the exploration.

PART 2 EXECUTION

2.01 SUBGRADE PREPARATION

A. Subgrade for earth liner shall be stripped of all deleterious materials including rocks greater than 4 inches, roots, stumps, and debris. The subgrade shall be scarified and compacted to ninety percent (90%) of standard Proctor density. Wet, loose or soft areas that can not be adequately compacted shall be removed and replaced with compacted soil. Before placing earth liner the subgrade shall be shaped uniformly, compacted and continuous, and shall not contain standing water.

B. Subgrade for earth liner that is also the inside slope of the levee shall be compacted to 95 percent of standard Proctor density.

2.02 EARTH LINER

A. The compacted earth liner shall have a minimum thickness of not less than one foot. The soil shall be compacted to a minimum density of 95 percent Standard Proctor (ASTM D-698) at 2 to 3 percent above optimum moisture content, compacted in 6- to 8-inch lifts (loose thickness). The resulting earth liner shall be a homogeneous mass that has a maximum hydraulic conductivity of 1 x 10-7 cm/sec.

B. Liner Installation. Construction of the liner shall be accomplished as follows:

1. Coverage by compaction equipment shall be uniform;

2. The maximum speed of compaction equipment during compaction shall be 5 miles per hour;

3. The initial lift and successive lifts shall be bonded together by scarifying the surface and by using a sheepsfoot roller, or equivalent, for compaction;

4. Earth liner shall be protected from drying and desiccation by wetting, covering with a protective layer of soil or other methods with the approval of the Owner;

5. Frozen material shall not be used for liner construction;

6. Earth liner material shall be at specified range of moisture content prior to and during placement;

7. To prevent damage to completed sections of liner, work areas shall be maintained in the immediate area of liner construction; haul roads shall not be routed over completed sections of liner;

8. The Contractor shall be responsible for repair of damage to the completed liner caused by his methods of operation;

9. Construction of earth liner shall only be accomplished during favorable weather conditions;

10. Sufficient one-foot thickness of liner shall be verified by accomplishing two surveys: the first survey shall be conducted upon completion of the subgrade and the second survey shall be conducted after liner has been placed. The surveys shall be conducted along profiles a minimum of 50 feet apart and under the direction of the site surveyor; and

11. At the end of each workday, lifts will be staggered to limit vertical interfaces between subsequent placing of earth liner.

C. Sampling and Testing To verify that the properties of the liner meets the specifications set forth in 10 CSR 20-8 (17) (C) 1., the following tests will be performed by Owner's representative:

1. In-situ moisture/density tests will be performed at random during liner construction, averaging a minimum of one test for every 1000 cubic yards of material placed. Moisture/density curves of imported material will be performed at random during construction averaging a minimum of one test for every 10,000 cubic yards of material placed.

D. Test Liner Acceptability. The minimum acceptable values for moisture/density test results will be equal to or greater than 95 percent of standard Proctor maximum density and the moisture content is between optimum and 4 percent above optimum.

C. Sampling Methodology. Prior to liner construction, a plot of density versus moisture content (moisture/density curve) will be determined using the Standard Proctor method, for each type of material used for liner construction. During construction, frequent in-situ moisture/density tests will be performed and compared to the maximum density and optimum moisture content of the liner material as determined from the standard Proctor test(s).

D. Test Methods. The liner will be sampled and tested by the following methods:

Target Property	Test Method
Moisture/density curve Proctor	ASTM D 698 Standard
In-situ moisture/density nuclear methods	ASTM D 2922 and 3017
Laboratory Hydraulic Conductivity back-pressure saturated	COE EM 1110-2-1906
Plasticity Atterberg limits	ASTM D 4318
Grain size distribution and hydrometer	ASTM D 422 sieve

SECTION 02936

SEEDING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Preparation of topsoil.

B. Fertilizing.

C. Seeding.

D. Mulching.

E. Maintenance.

1.2 REFERENCES

A. FS O-F-241 - Fertilizers, Mixed, Commercial.

1.3 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

B. Use of herbicides shall be subject to approval by Union Electric.

1.4 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

B. Seeding shall not begin before September 1, 1992, and shall be completed by October 1, 1992.

1.5 TESTS

A. Analyze soils to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.

B. Submit minimum 10 oz. sample of each soil type. Forward sample to approved testing laboratory in sealed containers to prevent contamination.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 PRODUCTS

2.1 SEED MIXTURE

A. Seed Mixture:

1.	Kentucky 31:	60 lb/ACRE
2.	Annual Rye Grass:	60 lb/ACRE
3.	Perennial Rye Grass:	75 lb/ACRE
4.	Redtop:	15 lb/ACRE
5.	Birdsfoot Trefoil:	10 lb/ACRE
		250 lb/ACRE

2.2 SOIL MATERIALS

A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.

B. Topsoil: Excavated from site and free of weeds.

2.3 ACCESSORIES

A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

B. Fertilizer: FS O-F-241, recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil as indicated in analysis; otherwise, use the following proportions: Nitrogen 12 percent, phosphoric acid 12 percent, soluble potash 12 percent.

C. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that prepared soil base is ready to receive the work of this Section.

B. Beginning of installation means acceptance of existing site conditions.

3.2 PREPARATION OF TOPSOIL

A. Prepare topsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials, weeds, and undesirable plants and their roots. Remove contaminated soil.

C. Scarify topsoil to a depth of 3 inches (75 mm). Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

3.3 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions at a rate of 305 lb/ACRE.

B. Apply after smooth raking of topsoil and prior to roller compaction.

C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

D. Mix thoroughly into upper 2 inches of topsoil.

E. Lightly water to aid the dissipation of fertilizer.

3.4 SEEDING

A. Apply seed evenly in two intersecting directions, to obtain the coverages specified in paragraph 2.1A. Rake in lightly. Do not seed area in excess of that which can be mulched on same day.

B. Do not sow immediately following rain, when ground is too dry, or during windy periods.

C. Immediately following seeding apply mulch at a rate of two tons per acre. Ditch bottoms and other erosion susceptible areas should receive a double application of mulch.

D. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.5 HYDROSEEDING

A. At contractors option, seeding may be done with a hydraulic seeder. Do not hydroseed area in excess of that which can be mulched on the same day.

3.6 SEED PROTECTION

A. Seeded areas subject to traffic damage should be identified with stakes and string. Set string height at approx. 30 inches.

B. Protect seeded areas with waring signs during maintenance period.

3.7 MAINTENANCE

A. Immediately reseed areas which show bare spots.

B. New seedlings shall be kept moist by watering, for a period of six weeks after planting. Frequency of watering shall not exceed 7 days.

C. Maintain seeded areas for six weeks from date of seeding.

D. Water will be available on site.

SECTION 03001

CONCRETE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Formwork, shoring, bracing and anchorage.

B. Concrete reinforcement and accessories.

C. Cast-in-place concrete.

1.02 REFERENCES

A. ACI 301 Specifications of Structural Concrete for Buildings.

B. ACI 305R - Hot Weather Concreting.

C. ACI318, Parts 1,2,and 3 - Building Code Requirements for Reinforced Concrete.

D. ACI 347 - Recommended Practice for Concrete Formwork.

E. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.

F. ASTM A615 - Deformed and Plain Billet Steel for Concrete Reinforcement.

G. ASTM C33 - Concrete Aggregates.

H. ASTM C39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens.

I. ASTM C42 - Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

J. ASTM C94 - Ready-Mixed Concrete.

K. ASTM C150 - Portland Cement.

L. ASTM C260 - Air Entraining Admixtures for Concrete.

M. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

N. ASTM D2103 - Polyethylene Film and Sheeting.

O. FS TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301.

B. Maintain copy of ACI 301 on site.

1.04 TESTS

A. Submit proposed mix design for review prior to commencement of work.

B. Company will take cylinders and perform slump tests in accordance with ACI 301.

C. Three concrete test cylinders will be taken for every 50 (or less) cubic yards of concrete placed each day: minimum of 3 for each days pour.

D. One additional test cylinder will be taken during cold weather and cured on site under the same conditions as the concrete it represents.

E. One slump test will be taken for each set of test cylinders taken.

F. If the specified strength of concrete is not attained (per the cylinder tests), the contractor will be notified. He shall take appropriate measures (totally at his own cost) to prove the adequacy of the concrete. Union Electric shall be provided with copies of test results from these actions. Acceptable proof of adequacy of the concrete shall be:

a. Cored specimens obtained in accordance with ASTM C42, and tested in accordance with ASTM C39.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Conform to ACI 301.

B. Plywood Forms: Douglas Fir or Spruce species; solid one side; sound undamaged sheets.

C. Lumber: Douglas fir species; Construction grade; with grade stamp clearly visible.

D. Steel Forms: Minimum 16 gage thick stiffened to support weight of concrete with minimum deflection.

E. Form Ties: Removable or Snap-off metal, of fixed or adjustable length.

2.02 REINFORCING STEEL

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade billet steel; deformed bars; uncoated finish.

B. Welded Steel Wire Fabric: Plain type ASTM A185; in flat sheets or coiled rolls; uncoated finish.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150, normal - Type 1.

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: Clean and not detrimental to concrete.

2.04 ADMIXTURES.

A. Air Entrainment Admixture: ASTM C260.

2.05 ACCESSORIES

A. Bonding Agent: Polymer resin emulsion, latex emulsion, or two component epoxy resin.

B. Form Release Agent: Colorless material which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.

2.06 CURING MATERIALS

A. Water: Clean and drinkable.

B. Absorptive Mat: Cotton fabric, clean, roll goods.

C. Absorptive Mat: Burlap fabric, clean, roll goods.

D. Absorptive Mat: Burlap-polyethylene, bonded to prevent separation during use.

E. Membrane Curing Compound: ASTM C309 or FS TT-C-800.

F. Polyethylene Film: ASTM D2103, 6 mil thick, clear color.

G. Clear Sealer: Sonneborn Lapidolith or Master Builder Saniseal.

2.07 CONCRETE MIX

A. Mix concrete in accordance with ASTM C94.

B. Ultimate strength 28 days 3000 psi, 5 1/2 sacks, minimum, of cement per cubic yard, 6 1/2 gallons of water per sack, maximum, including free moisture on aggregate.

C. Ultimate strength 28 days 4000 psi (use only where specifically required by drawings), 6 sacks, minimum, of cement per cubic yard, 6 gallons of water per sack, maximum, including free moisture on aggregate.

D. Maximum size of aggregate - 3/4".

E. Slump at point of placement - 3 inches with inadvertence margin of 2 inches, rejection at 5 inches.

F. Use air entraining admixture. (3% - 5% air by volume).

G. Contractor shall furnish mix designs for review prior to placing.

H. Mix designs shall be as prepared by a commercial testing laboratory, the Concrete Council of Greater St. Louis, or a design for which sufficient evidence (as determined by the Engineer) can be presented to show conformance to the requirements.

I. All ready mix tickets shall be furnished to the

Construction Supervisor. Each ticket shall show the following:

a. Name of concrete plant

b. Serial number of ticket

c. Date & contractor's name

d. Quantity of concrete

e. Certification that the concrete meets the mix design specified. The Company may, at its option, request the ticket to show the actual batched quantities which would include the adjustments for moisture in the aggregates.

f. Time when batch was loaded, or of first mixing cement, aggregate, and water.

J. Water added to the concrete at the site will be shown on the ticket.

K. Concrete shall be delivered to the job site and discharge completed within 1 1/2 hours after the beginning of the mixing operations.

L. The Company or its assigned representative shall be provided with full access to the batch facilities during normal working hours for the purpose of inspecting ingredients and processes used in the manufacture and delivery of the concrete.

PART 3 EXECUTION

3.01 FORMWORK ERECTION

A. Verify lines, levels, and measurement before proceeding with formwork.

B. Hand trim sides and bottom of earth forms; remove loose dirt.

C. Install formwork in accordance with ACI-347, Recommended Practice for Concrete Formwork.

D. Do not apply form release agent where concrete surfaces

receive special finishes or applied coatings which may be affected by agent.

E. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

3.02 REINFORCEMENT

A. Place, support, and secure reinforcement against displacement.

B. All splice (lap) lengths and development lengths to be calculated and detailed per ACI-318.

3.03 INSPECTION

A. Verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.

3.04 EXISTING WORK

A. Where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels, and pack with non-shrink grout.

B. Prepare previously placed concrete by cleaning with steel brush and apply bonding agent in accordance with manufacturer's instructions.

3.05 PLACING CONCRETE

A. Notify Construction Supervisor minimum 24 hours prior to commencement of concreting operations.

B. Concrete shall not be placed when the outdoor temperature is below 40½F, nor when freezing temperatures are expected before final set, except when adequate provisions (ACI 306A) are made for protection, and prior approval is obtained from the Engineer.

C. When deposited in the forms, the concrete temperature shall be between 60½F and 80½F. The concrete shall be maintained above 50½F for the entire cure period. The

removal of forms and temperature protection equipment shall be such that the concrete shall not be subject to a sudden drop of more than 25½F in 24 hours.

D. Concrete placed during hot weather shall be done in accordance with ACI 305R. Concrete shall have a placing temperature which will not cause loss of slump, flash set, or cold joints. Chemical admixtures may be required.

E. Concrete placement may be prohibited if in the opinion of the Construction Supervisor, the sun, heat, wind, rain, snow, temperature, etc. prevent best results from being obtained.

F. Concrete whose temperature exceeds 90½F will be rejected.

G. The use of calcium chloride is prohibited.

H. All concrete shall be mechanically vibrated, spaded, and hand tamped to assure consolidation, a dense smooth surface, complete embedment of reinforcement, etc.

I. Vibration shall not extend into lower courses which have obtained initial set.

J. Vibrating of concrete shall not disturb the formwork or reinforcement.

K. Vibration shall not be used to "move" concrete.

L. Ensure reinforcements, inserts, embedded parts, formed joints, etc. are not disturbed during concrete placement.

M. Maintain concrete cover and around reinforcing per ACI-318.

N. Place concrete continuously between predetermined construction and control joints.

O. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Construction Supervisor upon discovery.

3.04 SCHEDULE OF FORMED SURFACES/FINISHES

A. Form finish of all exterior concrete except as listed below.

B. Float finish all tops of exterior concrete.

C. Camber all exposed foundation edges 3/4 inch, with 45½ bevel.

D. Broom finish all exterior slabs and slab type surfaces.

3.05 TREATMENT

A. Apply sealer to all exterior concrete.

B. Prior to sealing, the concrete shall be cleaned, flushed, and allowed to thoroughly dry.

C. A minimum of two coats of sealer shall be applied to the concrete surfaces. Manufacturer's directions and application instructions shall be followed. Additional coats shall be applied if recommended by the manufacturer.

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

A. SECTION INCLUDES

1. Structural steel framing members, support members, struts and fasteners.

B. REFERENCES

A. ASTM A6 - General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use.

B. ASTM A36 - Structural Steel.

C. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.

D. ASTM A325 - High Strength Bolts for Structural Steel Joints.

E. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.

F. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

G. AWS A2.0 - Standard Welding Symbols.

H. AWS D1.1 - Structural Welding Code.

I. AISC - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

J. AISC - Code of standard practice for steel buildings and bridges.

K. AISC - Specification for Structural Joints using ASTM A325 or A490 Bolts approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation and endorsed by AISC.

C. SUBMITTALS

1. Submit under provisions of Section 1A.

2. Shop Drawings:

a. Submit shop drawings prepared under supervision of a registered (Missouri) professional engineer, including complete details and schedules for fabrication and assembly of structural steel and all other materials specified in this Section.

b. Verify by taking on-site measurements, dimensions for existing conditions and for items requiring coordination with other trades before fabrication. Show dimensions on the Shop Drawings and note that they have been verified.

c. Indicate profiles, sizes, spacing, and locations of structural members, openings, connections, attachments and fasteners.

d. Indicate welded connections with AWS A2.0 welding symbols. Indicate net weld lengths.

e. Show surface preparation and painting requirements.

3. Welder's Certificates: Submit qualification record of procedures, tackers, welders, and welding operators to the Engineer. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within the previous 12 months. If recertification of welders is required, retesting will be Contractor's responsibility.

F. Product Data: Submit producer's or manufacturer's specifications and installation instructions for all products specified. Include data to show compliance with specifications (including specified standards).

1.4 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC - Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

B. Maintain one copy of document on site.

1.5 QUALIFICATIONS

A. Fabricator: Company specializing in performing the work of this Section with minimum 5 years documented experience.

B. Erector: Company specializing in performing the work of this Section with minimum 10 years documented experience.

1.6 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Storage materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

B. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 PRODUCTS

A. MATERIALS

1. Structural Steel Members, Plates and Bars: ASTM A36.

2. Steel Pipe: ASTM A53, Type E or S, Grade B or ASTM, A501.

C. Cold-Formed Steel Tubing: ASTM A500, Grade B.

D. Unfinished (Machine) Threaded Fasteners: ASTM A307, regular low-carbon steel bolts and nuts with hexagonal heads.

E. High-Strength Threaded Fasteners: ASTM A325, heavy hexagon structural bolts, hot formed heavy hexagon

nuts, and hardened washer. Bolts, nuts, and washers shall conform to the AISC Specification for structural joints using ASTM A325 or A490 bolts.

F. Welding Materials: AWS D1.1; Welding electrodes shall be low hydrogen type electrodes compatible with the type of steel welded. An E70 electrode shall be used for all Carbon Steel to Carbon Steel welds. Weld materials shall match or exceed the base metal in strength.

2.2 FABRICATION

A. Fabricate items of structural steel in accordance with AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings and also in accordance with the final shop drawings.

B. Connections of new steel to existing steel shall typically be welded. Connection of new steel to new steel will be either bolted or welded, as indicated.

1. Provide high-strength threaded fasteners for bolted connections, except where unfinished (machine) bolts are indicated.

C. All bolted joints shall be in accordance with AISC Specification for Structural Joints using ASTM A325 or A490 bolts. All bolted connections shall have a minimum of two bolts.

D. All welded construction shall comply with the building and tubular provisions of AWS D1.1 Code.

1. Assemble and weld built-up sections by methods which will prevent warping.

2. Use welding procedures and sequences that prevent locked-in stresses or distortions.

E. All connections will be subject to the Engineer's review.

2.3 FINISH

A. Clean, prepare, shop prime and finish coat structural component surfaces in accordance with Section 09900.

B. Do not prime surfaces that will be field welded.

2.4 SOURCE QUALITY CONTROL AND TESTS

A. Testing of components will be performed under provisions of Section 1A.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field connections are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

2.02 ERECTION

A. Erect structural steel in accordance with AISC Specification, Bolting Specification and Code of Standard Practice as herein specified.

B. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Field weld components indicated on Drawings.

D. Do not field cut or alter structural members without approval of the Engineer.

E. Provide temporary planking, scaffolding, and working platforms as necessary to effectively complete work.

F. Do not enlarge unfair holes in members by burning or by use of drift pins. Ream holes that must be enlarged to admit bolts.

G. Immediately after erection, prime welds, abrasions and surfaces not shop primed, except surfaces to be in contact with concrete.

3.03 FIELD QUALITY CONTROL

A. Field inspection will be performed under the provisions of Section 1A.

END OF SECTION

SECTION 05520

HANDRAILS AND RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Steel pipe handrails, balusters, and fittings.

1.02 RELATED SECTIONS

A. Section 05120-Structural Steel: Attachment plates and angles.

B. Section 09900 - Painting.

1.03 REFERENCES

A. ASTM A53- Pipe Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.

1.04 DESIGN REQUIREMENTS

A. Handrails shall be in accordance with OSHA requirements.

B. Railing assembly, wall rails, and attachments to resist lateral force of 200 lbs. at any point without damage or permanent set.

1.05 SUBMITTALS

A. Submit under provisions of Section 1A.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1.06 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings and shop Drawings.

PART 2 PRODUCTS

2.01 STEEL RAILING SYSTEM

A. Pipe: ASTM A53, Grade B, Schedule 40.

B. Fittings: Elbows, T-shapes, wall brackets, escutcheons; machined steel.

C. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

D. Splice Connectors: Steel welding collars.

E. Shop Primer for Ferrous Metal: See Section 09900 - Painting

2.02 FABRICATION

A. Fit and shop assemble components in largest practical sizes, for delivery to site.

B. Fabricate components with joints tightly fitted and secured.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

E. Continuously seal joined pieces with weld.

F. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

G. Accurately form components to each other and to building structure.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Provide anchors, plates and angles required for connecting railings to structure. Anchor railing to structure.

C. Field weld anchors as indicated on Drawings. Touch-up welds with primer. Grind welds smooth.

D. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

END OF SECTION

SECTION 05530

GRATING AND FLOOR PLATES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Formed metal gratings and checkered floor plating.

B. Formed openings.

C. Perimeter closures.

1.02 RELATED WORK

A. Section 05120 - Structural Steel: Framed steel openings.

B. Section 05520 - Handrails and Railings.

C. Section 09900 - Painting

1.03 REFERENCES

A. ANSI/NAAMM A202.1 - Metal Bar Grating Manual.

B. ASTM A36 - Structural Steel.

C. ASTM A569 - Steel, Carbon, Hot-rolled Sheet and Strip, Commercial Quality.

1.04 SYSTEM DESCRIPTION

A. Load Design: ANSI/NAAMM A202.1.

B. Live Load: 100 lbs/sq ft. minimum.

C. Deflection Under Live Load: 1/240.

D. Size grating and plates to maximum deflection limits by single support design.

1.05 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 1A.

B. Provide details of grates, plates, supports, span and deflection table, openings, and perimeter construction details and tolerances.

D. Submit two samples 12 x 12 inches in size illustrating surface finish, color, and texture.

E. Submit manufacturer's installation instructions under provisions of Section 1A.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS.

A. The following are acceptable:

IKG Borden, type W194
Blaw-Knox, type 1
McNichols Co, type GW

2.02 MATERIALS

A. Sheet Steel: ASTM A569; A36; carbon steel with raised lug pattern (Medium).

B. Formed Steel: ASTM A36, 36 ksi of shapes indicated.

2.03 FABRICATION

A. Fabricate grates and plates of sizes indicated.

B. Weld joints of intersecting grating sections.

C. Provide support framing for openings.

D. Bearing Bar: 1 1/4" x 3/16" inches size, spaced 1 3/16 inches.

E. Cross Bar: 3/8" x 1/8" inches size, spaced 4" inches.

F. Anchorages: Welded.

2.05 FINISHES

A. Paint: Paint grating sections with manufacturers standard black bituminous paint except for grating

sections listed in Section 09900.

B. Paint: Paint checkered plate per Section 09900.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify that opening sizes and dimensional variations are acceptable to suit grating tolerances.

B. Verify that supports are correctly positioned.

C. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install grates and floor plates in accordance with manufacturer's instructions.

B. Secure grating with welds to prevent movement.

3.03 TOLERANCES

A. Conform to ANSI/NAAMM A202.1.

END OF SECTION

SECTION 09900
PAINTING

PART 1 - GENERAL

1.01 WORK INCLUDED

This work includes providing finishes for the new structural and miscellaneous steel framing. This will also include all items necessary and reasonably incidental to the completion of the overall job. The work generally includes:

A. Prepare surfaces which are to receive finish.

B. Shop finish new steel, field touch-up for damaged coatings and field coating of field welded connection areas. Finish surfaces as indicated in schedule at end of this Section.

1.02 RELATED WORK

A. Section: 05120 Structural Steel
05520 Handrail and Railings
05530 Grating and Floor Plates

1.03 REFERENCES

A. ANSI/ASTM D16 - Definition of Terms Relating to Paint, Varnish, Laquer, and Related Products.

1.04 DEFINITIONS

A. Conform to ANSI/ASTM D16 for interpretation of terms used in this Section.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for flame/fuel/smoke rating requirements for finishes.

B. All coatings, thinners, etc. shall be lead and chromate free, and VOC compliant. Volatile organic compounds per gallon of coating shall be limited to less than 3.5 pounds/gallon (preferably less than 2.8 pounds/gallon) in the coatings thinned, ready to apply state.

1.06 SUBMITTALS

A. Submit product data under provisions of Section 1A.

B. Provide product data on all finishing products.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Paint materials shall be received in sealed original labelled containers, bearing manufacturer's name, type of paint, brand name, color designation and instructions for mixing and/or reducing.

B. Provide adequate storage facilities. Store paint materials at minimum ambient temperature of 45½ F in well ventilated area.

C. Take precautionary measures to prevent fire hazards and spontaneous combustions.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Ensure surface temperatures or the surrounding air temperature is above 50 degrees F, below 100 degrees F, and a minimum of 5½F above dewpoint before applying finishes.

B. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 50 degrees F for 24 hours before, during and 12 hours after application of finishes.

C. Provide minimum 25 foot candles of lighting on surfaces to be finished.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - PAINT

A. Primer: Carbo-Zinc 11HS, Inorganic Zinc Primer

B. Finish: Carboline 801 Epoxy

C. Substitutions: The Owner will consider comparable products from the following manufacturers: Sherwin-Williams, Ameron, Porter Paints, Valspar, and Tnemec

Contractor shall indicate weight of VOC per gallon as well as per cent of zinc in dry film thickness on substitutions. (11HS primer contains 84% zinc. Any substitution should have a minimum of 79% zinc).

2.02 MATERIALS

A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily an uniformly dispersed to a homogeneous coating.

B. Coatings: Spray and brush properties; capable of drying or curing free of streaks or sags.

C. Accessory Materials: Thinners and other materials not specifically indicated but required to achieve the finishes specified. All accessory materials must be supplied by the coatings manufacturer.

2.03 FINISHES

A. Refer to schedule at end of Section for surface finish and color schedule.

PART 3 - EXECUTION

3.01 INSPECTION

A. Thoroughly examine surfaces scheduled to be painted prior to commencement of work. Report in writing to Engineer, any condition that may potentially affect proper application. Do not commence until such defects have been corrected.

B. Correct defects and deficiencies in surfaces which may adversely affect work of this Section.

C. Shop finish new structural steel, except around field welded connections.

D. Upon delivery of steel to the site, all surfaces shall be free of defects. Surfaces shall be inspected by the Construction Supervisor upon receipt and unloading at Sioux Plant. If defects are found, the Construction Supervisor shall determine the extent of the touch-up work will be done at the Contractor's expense.

E. For field touch-up work the Contractor shall notify the Construction Supervisor and allow him to inspect surfaces after cleaning and before primer or paint is applied.

3.02 PREPARATION FOR SHOP PAINTING

A. Correct minor defects and clean surfaces which affect work of this Section.

B. Remove grease, rust, scale, dirt, and dust form steel surfaces. Remove oil and grease with solvents, in compliance with Solvents, in compliance with SSPC-SP1-82. Prepare surfaces to be painted with a Commercial Blast Cleaning, SSPC-SP-6. Ensure steel surfaces are at the specified preparation level immediately prior to paint application.

3.03 PREPARATION FOR FIELD PAINTING

A. Correct minor defects and clean surfaces which affect work of this Section.

B. Remove grease, rust, scale, dirt, and dust form steel and iron surfaces. Remove oil and grease with solvents, in compliance with Solvents, in compliance with SSPC-SP1-82, Solvent Cleaning. Prepare surfaces to be field painted to a hand or power tool cleaning in accordance with SSPC-SP-2 or 3. Ensure steel surfaces are at the specified preparation level immediately prior to paint application.

3.04 PROTECTION

A. Protect elements surrounding the work of this Section from damage or disfiguration.

B. Repair damage to other surfaces caused by work of this Section.

C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

D. Remove empty paint containers from site.

3.05 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform finish.

D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

E. Allow applied coat to dry before next coat is applied.

F. Contractor shall notify Union Electric one day prior to applying the primer and each coat of paint. Union Electric shall have the Construction Supervisor and/or a Technical representative from the painting manufacture inspect the application of each coat of paint.

3.06 CLEANING

A. As work proceeds, promptly remove paint where spilled, splashed, or spattered.

3.07 PAINT SCHEDULE
Shop Painting

AREAS & ITEMS TO BE PAINTED	PRIME COAT	FINISH COAT	COLOR
All new structural steel, including: connection angles, misc. plates, hanger angles, toe plates @ openings.	11HS 2-3 Mils DFT	801 Epoxy 4-6 Mils DFT	Gray - Match existing structural steel
Grating	MFG STD Bituminous		Black
Checkered Pl.	11HS 2-3 Mils DFT	801 Epoxy 4-6 Mils DFT	Gray - Match existing struct. steel
Ladders/Cages	11HS 2-3 Mils DFT	801 Epoxy 4-6 Mils DFT	Gray - Match existing struct. steel
All new handrails & kickplates	11HS 2-3 Mils DFT	801 Epoxy 4-6 Mils DFT	Gray - Match existing struct. steel

Note: All numbers used are based on Carboline Paint.

3.08 PAINT SCHEDULE - FIELD TOUCH-UP

AREAS & ITEMS TO BE PAINTED	PRIME COAT	FINISH COAT	COLOR
Touch-up for field welded connections		801 Epoxy 6-8 MILS DFT	Match color of the existing structural steel
Touch-up for welded connections of grating		801 Epoxy 6-8 MILS DFT	Match color of new structural steel

Note: All numbers are based on Carboline Paint.

APPENDIX A

UNION ELECTRIC COMPANY
CONTRACT WORK LIMITATIONS - POWER PLANTS

WORK LIMITATIONS

A. No explosives may be used without written permission from the Company.

B. Care must be exercised at all times to maintain safe clearances and safe working practices, both for equipment and personnel, in order to avoid injury or service interruption. With a recognition of this condition, no serious construction space limitation is foreseen. All job personnel must be made thoroughly acquainted with hazards involved. It shall be the Contractor's responsibility, working with the Construction Supervisor, to make this condition clear to all Contractor's personnel.

C. Perform all work to conform with the Company's safety practices and operating procedures. If outages are required, the Contractor shall obtain all outages and releases in accordance with the Company's "Workman's Protection Assurance Procedure for Construction Personnel" dated February 1, 1981. This procedure, based on the Operating Manual for the Union Electric System will be made available at the start of the construction phase of the job.

D. The following are a number of specific requirements that must be adhered to by the Contractor:

1. Job Working Rules - The Contractor will insure that all of his personnel will read and sign the document entitled "Job Working Rules" (a copy of which is included in the Appendix of this specification). Refusal to sign the document will automatically constitute revocation of that individual's permission to enter upon Company property. The Contractor will also be responsible for enforcing these work rules for the duration of the job.

2. Identification - The Contractor will provide each employee with an identification badge which will be inscribed with the Contractor's name and the employee's assigned number. The Contractor shall maintain a list of the employee's names and badge numbers, a copy of which will be given to the Construction Supervisor and gate watchman on a daily basis. Identification badges will be worn permanently on each employee's outer jacket while on the job site and when entering the Construction personnel gate.

In addition to the badges, the Contractor will provide all of his employees with hard hats of the same color and marked with the Contractor's name or trade mark. Also, the employee's name and badge number will be affixed to the

front of the hard hat, above the visor, in 1/2" or larger letters. The badge number shall be placed above the name. (Adhesive plastic label tape will be satisfactory for this service.) Hard hats must be worn by each employee while on the job site and when entering the Construction personnel gate.

3. Gate Security - All of the Contractor's employees and visitors will enter the project site through the Construction personnel gate. Upon entering and leaving site, employees will open all lunch boxes, packages, etc., for inspection by the gate watchman.

   Alcoholic beverages, drugs which are illegal to possess, firearms or other weapons will be prohibited from being brought on site.

   Any tools or materials brought on or off the site must be accompanied by a pass, on an approved form, listing the materials or tools being transferred. The form must be signed by the Contractor's Superintendent. The passes will be collected by the gate watchman.

   All employees entering the site at times other than the beginning or end of a shift, will be required to sign the gate register. A copy of the previous day's gate register will be forwarded to the Contractor's Superintendent each day. The Contractor will station responsible supervision at gate during shift changes to enforce gate security.

   All visitors of the Contractor will be held at the gate until cleared by the Contractor's Superintendent. At that time, each visitor will be issued a visitor's badge and hard hat.

   No Contractor's vehicles will be brought on the site except for work vehicles approved by the Construction Supervisor. All work vehicles leaving through the vehicle gate will be inspected by the watchman and must have a manifest listing all cargo and tools which are on board. All of the manifests must be signed by the Contractor's Superintendent and will be collected by the watchman.

   Upon entering the site, if a work vehicle does not have a pass, it will be held at the gate until cleared by the Construction Supervisor.

   All work vehicle drivers will sign the register at the vehicle gate and all persons entering site on work vehicles will be subject to same badge regulations as the Construction personnel gate.

4. Parking - All of the Contractor's employees and visitors will park on the construction parking lot outside of the Construction personnel gate.

Upon entering Company property, the Contractor's personnel will drive on roads which are specifically designated as being for Construction use only.

5. Use of Plant Facilities - Contractor will instruct his employees not to use plant cafeteria facilities, locker rooms, toilet and wash facilities, telephones, tools or equipment.

APPENDIX B
UNION ELECTRIC COMPANY
CONSTRUCTION JOB WORKING RULES - POWER PLANTS

PROJECT_____

1. Working hours will be established by the Project's requirements. All employees are to be at their work station during their assigned work periods.
2. All employees will be supplied a hard hat with their last name in 1/2-inch letters taped on the front and the contractor's name on either side. This is a HARD HAT JOB -- wear them at all times.
3. All employees will be required to wear safety glasses with side shields when on plant premises except in exempted areas such as parking lots and offices.
4. All employees will be required to sign in daily at the Guard House. When signing in they will be issued a Badge. The Badge is to be worn while on the job site and turned in to Guard when your shift is over.
5. All employees must check in and out of Project with their immediate Foreman or General Foreman and enter and leave through the construction gate and on the road posted for construction or contractor's employees. Unauthorized absence from jobsite will result in loss of pay for such time absent.
6. No automobile or other vehicle other than commercial and contract carriers will be permitted on the project unless specifically required to conduct the work. Those required will be issued a gate pass by Union Electric.
7. All Lunch Boxes, Bags, Tool Boxes, Coolers, Cartons and other similar items will be opened for inspection by the Gate Guard on entering or leaving the job.
8. At times, certain areas within the Project, to include Plant Cafeteria, Locker Rooms and Washrooms, will be posted as off-limits, or limited admittance. All employees shall honor these notices.
9. The use of plant phones, other than public pay phones, plant equipment and tools without written permission from Union Electric is prohibited.
10. No alcoholic beverages will be carried onto or consumed on the jobsite.
11. No firearms permitted on the job.
12. Drugs, Stimulants, "Pep Pills", Tranquilizers and similar materials shall not be used on the job unless prescribed by a doctor.
13. No gambling permitted.
14. Horseplay, wrestling and fighting are strictly prohibited.
15. Damaging, mutilating or willful misuse of equipment or tools is not permitted.
16. Willful violation of safety rules or safe working practices are strictly prohibited.
17. We want this to be a Safe Job. YOU CAN HELP. Report all unsafe conditions to your supervisor.

I, the undersigned, have read and understand all of the above rules, and have read the "Workman's Protection Assurance Procedure," and acknowledge that a violation of any of these provisions will be grounds for removal from the Project.

EMPLOYEE'S SIGNATURE_____ DATE_____

CONTRACTOR_____

Appendix "C"

LINER PROPERTIES	TEST METHOD	THICKNESS (Minimum) 40 mil	60 mil
Density g/cc (Min)	ASTM D1505	0.94	0.94
Melt Flow Index g/10 min (Max)	ASTM D1238 Condition E (190 C, 2.16 kg)	0.30	0.30
Tensile Properties (Typical)	ASTM D 638 Type IV		
1. Tensile Strength At Break (Pounds/inch width)	Dumb-bell at 2 ipm	160	240
2. Tensile Strength At Yield (Pounds/inch width)		95	140
3. Elongation at Break (Percent)		700	700
4. Elongation at Yield (Percent)		13	13
Tear Resistance Initiation lbs (Typical)	ASTM D1004 Die C	30	45
Low Temperature Brittleness Deg F (Typical)	ASTM D746 Procedure B	-112	-112
Dimensional Stability % Change Each Direction (Max)	ASTM D1204 212 Deg F 1 Hr	+- 2	+- 2
Resistance To Soil Burial Percent change in original value. (Typical)	ASTM D3083 using ASTM D638 Type IV		
Tensile Strength at Break & Yield	% Change	+- 10	+- 10
Elongation at Break & Yield	% Change	+- 10	+- 10
Environmental Stress Crack Hours (Min)	ASTM D1693 (10% Igepal, 50 Deg C)	1500	1500
Puncture Resistance Pounds (Min)	FTMS 101 Method 2065	52	80
Coefficient of Linear Thermal Expansion	ASTM D696	1.2	1.2
Thermal Stability Oxidative Induction Time, Minutes (Min)	ASTM D3895 130 Deg C, 800 psi	2000	2000
Ozone Resistance	ASTM D1149 7 Days 100 pphm, 104 Deg F	No Cracks	No Cracks
	Magnification	1000	1000

February 1, 1981

Procedure Issued By Power Service
Power Operations

UNION ELECTRIC COMPANY

POWER PLANTS
WORKMAN'S PROTECTION ASSURANCE
PROCEDURE FOR CONSTRUCTION PERSONNEL
(Based on the Operating Manual
for the Union Electric System)

Throughout the construction of new system equipment it is necessary to assure the safety of personnel and equipment. The following is a brief outline of procedures and definitions designed to guide construction personnel in dealing with Union Electric operating authorities for Workman's Protection Assurances.

NOTE: A Union Electric operating authority is the dispatcher or operator who has authority over the operation of system equipment and as such issues all Workman's Protection Assurances on equipment under his authority.

DEFINITION

Workman's Protection Assurance is the operating authority's assurance to the person obtaining Workman's Protection Assurance that either 1) the equipment covered by the Workman's Protection Assurance has been completely isolated from energy sources (see Out of Service below), or 2) the equipment is placed in a special status requested by the person receiving the Workman's Protection Assurance (see Local Control below). The operating authority records all pertinent data concerning each Workman's Protection Assurance, and orders the equipment covered tagged in order to make known its status. The status of equipment under a Workman's Protection Assurance can only be changed after the Workman's Protection Assurance is removed.

EQUIPMENT COVERED BY WORKMAN'S PROTECTION ASSURANCES

All system equipment under the jurisdiction of an operating authority must be covered by Workman's Protection Assurance when it is to be worked on or tested.

The only equipment that can be covered by Workman's Protection Assurance is equipment under an operating authority's jurisdiction.

NOTE: Equipment connected to energy sources but not released to the jurisdiction of an operating authority can only be protected by Workman's Protection Assurance on the isolating device (or devices) between the energy source and the equipment. In this case it is only possible for the operating authority to assure the person receiving Workman's Protection Assurance that the particular isolating device (or devices) connecting the new equipment to his energy sources is protected and he cannot assure the person receiving the Workman's Protection Assurance that the equipment is completely isolated. Therefore, it is better for all new equipment to be released to the jurisdiction of an operating authority as soon as possible.

TYPES OF WORKMAN'S PROTECTION ASSURANCES

The following two types of Workman's Protection Assurances are issued during construction.

1. Out of Service

Purpose - To provide the person (or persons) to whom Workman's Protection Assurance is issued the operating authority's assurance that the equipment has been properly isolated from all known energy sources and that this isolation will continue until the Out of Service is released. This does not relieve the person obtaining the protection of the responsibility of making prescribed tests or observations to assure himself that the equipment is safe to work on.

Persons Covered - Any eligible person may obtain an Out of Service. A supervisor's Out of Service will cover all persons working on the job he directs. As many Out of Service's can be issued on a piece of equipment as necessary.

Tags - All points of isolation for the equipment covered will be tagged by the Out of Service - Construction tag (Form 1780).

2. Local Control

Purpose - To delegate to one person the authority to operate or direct the operation of a given piece of system equipment (subject to the limitations imposed by the operating authority) for trial or test.

Persons Covered - Only one person may obtain a Local Control at a time. While this person holds a Local Control no other Workman's Protection Assurance may be issued.

Tags - All control locations for the equipment covered will be tagged by the Local Control - Construction tag (Form 1781).

Time Limitation - The Local Control must be released by the holder before he goes off duty.

EXCEPTION: If the equipment in question is in the process of being tested prior to the initial acceptance by the company operating forces and the test requires more than one working shift, the Local Control may be held overnight or as required until the test is concluded.

Equipment Condition - The person taking the Local Control must specify the status he wishes the equipment to be in when the Local Control is issued to him.

PERSONS ELIGIBLE FOR WORKMAN'S PROTECTION ASSURANCES

Only those qualified persons (as mutually agreed by Union Electric Company and the Contractor) may receive Workman's Protection Assurance. A list of all persons eligible to receive Workman's Protection Assurance (both Contractor and Union Electric Company personnel) must be presented by the Union Electric Company Construction Supervisor to the supervisors of all operating authorities who will issue Workman's Protection Assurance.

OBTAINING AND RELEASING WORKMAN'S PROTECTION ASSURANCE

A person receiving a Workman's Protection Assurance will obtain from and release his Workman's Protection Assurance to the same operating authority. The Union Electric Company Construction Supervisor will furnish the Contractor with information on what operating authorities to contact for Workman's Protection Assurances.

The person who obtains the Workman's Protection Assurance must release it.

EXCEPTION: If a person holding Workman's Protection Assurance on a piece of equipment is not available and it is necessary because of plant or system emergency to place that piece of equipment in service, the Workman's Protection Assurance can be released to the operating authority by the Supervisor of the holder of the Workman's Protection Assurance provided 1) every attempt has been made to contact the holder of the Workman's Protection Assurance and, 2) a thorough examination by the person releasing the equipment reveals the equipment to be in proper operating order.

FILLING OUT TAGS

All construction tags are serial numbered and are provided with stubs. When Workman's Protection Assurance is issued, the person to whom it is issued will receive the stub portion. When the Workman's Protection Assurance is released, the stub, signed by the person to whom the Workman's Protection Assurance was issued (or his Supervisor as provided for in the EXCEPTION above), must be returned to the operating authority.

Approved by H N McCoy
H. N. McCoy
Director
Engineering & Construction

Approved by E J Telthorst
E.J. Telthorst
Vice-President
Power Operations

Approved by _____
G. J. Haven
Vice-President
Transmission & Distribution

PROJECT: U. E. LABADIE PLANT NEW ASH POND NO. 1953.01.1111

Surface Elevation 468 Datum MSL | Completion Date 10-2-91

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES
	Medium stiff, brown, very silty CLAY, trace sand - (CL)		SS
5	Medium stiff, tan, sandy SILT - ML 59 and 57 percent finer than 0.074 mm (#200) at 3.5 to 5 and 6 to 7.5 feet, respectively.		SS
			SS
10	Loose to medium dense, tan, fine to medium SAND, trace silt - SP		SS
			SS
15			SS
			SS
20	Boring terminated at 20 feet		
25			
30			
35			

SHEAR STRENGTH, tsf
△-UU/2 ○-QU/2 ◇-SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE (ASTM D 1586)
▲- BLOWS PER FOOT

WATER CONTENT, %
PL LL
10 20 30 40 50

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

GROUNDWATER DATA

ENCOUNTERED AT 11.5 FEET
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
____ FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

____ AUGER 3 3/4" HOLLOW STEM
____ WASH BORING FROM ____ FEET
CC DRILLER TK LOGGER
CME 55 DRILL RIG

REMARKS: N5460 E9660

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

LOG OF BORING

B-1

GEOTECHNOLOGY
ENGINEERING AND ENVIRONMENTAL SERVICES
SAINT LOUIS, MISSOURI

PLATE 1

PROJECT: U. E. LABADIE PLANT NEW ASH POND NO. 1953.01.1111

Surface Elevation 468 Datum MSL | Completion Date 10-2-91

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES
	Medium stiff, tan and gray, silty CLAY, trace sand - (CL)		ST
5	Loose, tan, silty SAND, trace clay - SM 40 percent finer than 0.074 mm (#200) at 3.5 to 5 feet.		SS
	Loose to medium dense, tan, fine SAND - SP		SS
10			SS
			SS
15			SS
	Loose, blue and gray, fine SAND with silt - SP or SM		SS
20	Boring terminated at 20 feet		
25			
30			
35			

SHEAR STRENGTH, tsf
△-UU/2 ○-QU/2 ◇-SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE (ASTM D 1586)
▲- BLOWS PER FOOT
WATER CONTENT, %
PL LL
10 20 30 40 50

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

GROUNDWATER DATA

ENCOUNTERED AT 12.5 FEET
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
____ FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

____ AUGER 3 3/4" HOLLOW STEM
____ WASH BORING FROM ____ FEET
CC DRILLER TK LOGGER
CME 550 DRILL RIG

REMARKS:
N5580 E9080

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

LOG OF BORING

B-2

GEOTECHNOLOGY
ENGINEERING AND ENVIRONMENTAL SERVICES
SAINT LOUIS, MISSOURI

PLATE 2

PROJECT: U. E. LABADIE PLANT NEW ASH POND NO. 1953.01.1111

Surface Elevation 468 Datum MSL

Completion Date 10-2-91

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES
	Medium stiff, brown, silty CLAY - (CL)		SS
5	Loose, tan, very fine SAND, some silt - SM 24 percent finer than 0.074 mm (#200) at 3.5 to 5 feet.		SS
	Medium dense, tan, fine SAND, trace clay - SP		SS
10			SS
			SS
15			SS
	Medium dense, brown, fine to medium SAND - SP		SS
20	Boring terminated at 20 feet		
25			
30			
35			

SHEAR STRENGTH, tsf
Δ-UU/2 O-QU/2 ◇-SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE (ASTM D 1586)
▲- BLOWS PER FOOT

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

GROUNDWATER DATA

ENCOUNTERED AT 11.0 FEET
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
____ FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

____ AUGER 3 3/4" HOLLOW STEM
____ WASH BORING FROM ____ FEET
CC DRILLER TK LOGGER
CME 550 DRILL RIG

REMARKS:
N4720 E9150

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

LOG OF BORING

B-3

GEOTECHNOLOGY
ENGINEERING AND ENVIRONMENTAL SERVICES
SAINT LOUIS, MISSOURI

PLATE 3

PROJECT: U. E. LABADIE PLANT NEW ASH POND NO. 1953.01.1111

Surface Elevation 468 Datum MSL | Completion Date 10-2-91

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES
	Medium stiff, brown, silty CLAY -CL		SS
			SS
-5-	Soft, brown and gray SILT with clay - ML		SS
			SS
-10-	Soft to medium stiff, gray SILT - (ML) 82 percent finer than 0.074 mm (#200) at 8.5 to 10 feet.		ST
			SS
-15-	Loose to medium dense, gray, medium SAND, some to trace silt - SP to SM		SS
			SS
-20-	Boring terminated at 20 feet		
-25-			
-30-			
-35-			

SHEAR STRENGTH, tsf
△-UU/2 ○-QU/2 ◇-SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE (ASTM D 1586)
▲- BLOWS PER FOOT
WATER CONTENT, %
PL ——— LL
10 20 30 40 50

NOTE: DEMARCATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

GROUNDWATER DATA

ENCOUNTERED AT 16.0 FEET
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
____ FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

____ AUGER 3 3/4" HOLLOW STEM
____ WASH BORING FROM ____ FEET
CC DRILLER TK LOGGER
CME 550 DRILL RIG

REMARKS:
N4880 E8450

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

LOG OF BORING

B-4

GEOTECHNOLOGY
ENGINEERING AND ENVIRONMENTAL SERVICES
SAINT LOUIS, MISSOURI

PLATE 4

PROJECT: U. E. LABADIE PLANT NEW ASH POND NO. 1953.01.1111

Surface Elevation 466 Datum MSL. Completion Date 10-2-91

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES
	Medium stiff, tan and brown, very silty CLAY - (CL)		SS
5	Medium stiff, brown SILT to silty SAND - (ML to SM) 37 percent finer than 0.074 mm (#200) at 8.5 to 10 feet.		SS
			SS
10	Soft, dark gray SILT, trace clay and fine sand - ML		SS
			SS
15	Soft, dark gray SILT, with organics and sand - ML		SS
	Medium dense, dark gray, silty SAND - SM		SS
20	Boring terminated at 20 feet		
25			
30			
35			

SHEAR STRENGTH, tsf
Δ-UU/2 O-QU/2 ◇-SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE (ASTM D 1586)
▲- BLOWS PER FOOT
WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

GROUNDWATER DATA

ENCOUNTERED AT 13.0 FEET
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
____ FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

____ AUGER 3 3/4" HOLLOW STEM
____ WASH BORING FROM ____ FEET
CC DRILLER TK LOGGER
CME 550 DRILL RIG

REMARKS: N4095 E8060

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

LOG OF BORING

B-5

GEOTECHNOLOGY
ENGINEERING AND ENVIRONMENTAL SERVICES
SAINT LOUIS, MISSOURI

PLATE 5

PROJECT: U. E. LABADIE PLANT NEW ASH POND NO. 1953.01.1111

Surface Elevation 466 Datum MSL | Completion Date 10-4-91

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES
	Medium stiff, brown SILT, with clay and sand - ML or CL		SS, SS
5	Medium stiff, tan, sandy SILT - ML or SM		SS
	Soft, brown CLAY, trace silt - (CH)		SS
10	Soft, gray, lean CLAY with very fine sand - (CL) 71 percent finer than 0.074 mm (#200) at 11 to 12.5 feet.		SS, SS, SS
20	Boring terminated at 20 feet		
25			
30			
35			

SHEAR STRENGTH, tsf
△-UU/2 ○-QU/2 ◇-SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE (ASTM D 1586)
▲- BLOWS PER FOOT
WATER CONTENT, %
PL ——— LL
10 20 30 40 50

70

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

GROUNDWATER DATA

ENCOUNTERED AT 14.0 FEET
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
____ FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

____ AUGER 3 3/4" HOLLOW STEM
____ WASH BORING FROM ____ FEET
CC DRILLER TK LOGGER
CME 550 DRILL RIG

REMARKS: N3240 E7880

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

LOG OF BORING

B-6

GEOTECHNOLOGY
ENGINEERING AND ENVIRONMENTAL SERVICES
SAINT LOUIS, MISSOURI

PLATE 6

PROJECT: U. E. LABADIE PLANT NEW ASH POND NO. 1953.01.1111

Surface Elevation _____ Datum _____ Completion Date 10-4-91

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES
	BASE COURSE		
	FILL: Black CINDERS and SAND, with brown, silty clay - SM		SS
5	Medium stiff, brown, silty CLAY, with sand - CL		SS
	Loose, tan, medium SAND - SP		SS
	Stiff, brown SILT, with sand - ML to SM		SS
10	Loose, brown, fine SAND, with silt - SM		SS
15	Stiff, gray, SILT and medium dense, gray, fine SAND interbedded - SM to ML to SP		SS
	Medium dense to loose, brown, medium SAND - SP		SS
20	Medium dense, gray, fine SAND, with silt - SP		SS
25	Medium dense, gray, fine to medium SAND - SP		SS
30	Medium dense, gray, fine to medium SAND, with subrounded to rounded gravel - SP		SS
35			SS

SHEAR STRENGTH, tsf
Δ - UU/2 O - QU/2 ◇ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE (ASTM D 1586)
▲ - BLOWS PER FOOT

WATER CONTENT, %
PL LL
10 20 30 40 50

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

GROUNDWATER DATA

ENCOUNTERED AT 18.0 FEET
AT _____ FEET AFTER _____ HOURS
AT _____ FEET AFTER _____ HOURS
_____ FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

_____ AUGER 3 3/4" HOLLOW STEM
_____ WASH BORING FROM _____ FEET
CC DRILLER TK LOGGER
CME 750 DRILL RIG

REMARKS: _____

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

LOG OF BORING

B-7

GEOTECHNOLOGY
ENGINEERING AND ENVIRONMENTAL SERVICES
SAINT LOUIS, MISSOURI

PLATE 7

PROJECT: U. E. LABADIE PLANT NEW ASH POND NO. 1953. 01. 1111

CONTINUATION OF BORING B-7 | SURFACE ELEVATION _____

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES
	Medium dense, gray, fine to medium SAND, with subrounded to rounded gravel - SP		SS
45	Medium dense to dense, gray, fine and coarse SAND, with reverse grading - SW		SS
50			SS
	Dense, gray, fine to coarse SAND, with gravel - SP		SS
55			SS
	Medium dense to dense, gray, medium to coarse SAND, with subrounded to rounded gravel - SP		SS
60			SS
65			SS
70			SS
75			SS
80			SS
85			SS

SHEAR STRENGTH, tsf
Δ-UU/2 O-QU/2 ◇-SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE (ASTM D 1586)
▲- BLOWS PER FOOT
WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

GEOTECHNOLOGY
ENGINEERING AND ENVIRONMENTAL SERVICES
SAINT LOUIS, MISSOURI

PLATE 8

PROJECT: U. E. LABADIE PLANT NEW ASH POND NO. 1953-01, 1111

CONTINUATION OF BORING B-7 | SURFACE ELEVATION _____

DEPTH IN FEET	DESCRIPTION OF MATERIAL
95	Medium dense to dense, gray, medium to coarse SAND, with subrounded to rounded gravel - SP
100	
105	
110	
115	Very dense, gray, medium and coarse SAND - SP
120	Boring terminated at 118.7 feet due to cave in at 75 feet.
125	
130	
135	

UNIT DRY WEIGHT SPT VALUE

SAMPLES

SHEAR STRENGTH, tsf
△ - UU/2 ○ - QU/2 ◇ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE (ASTM D 1586)
▲ - BLOWS PER FOOT
WATER CONTENT, %
PL ILL
10 20 30 40 50

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

GEOTECHNOLOGY ENGINEERING AND ENVIRONMENTAL SERVICES SAINT LOUIS, MISSOURI

PLATE 9

BORING LOG: TERMS AND SYMBOLS

GENERAL NOTES

1. *Information on each boring log is a compilation of subsurface conditions based on soil or rock classifications obtained from the field as well as from laboratory testing of samples. The strata lines on the logs may be approximate or the transition between the strata may be gradual rather than distinct. Water level measurements refer only to those observed at the times and places indicated, and may vary with time, geologic condition or construction activity.*
2. *Relative composition and Unified Soil Classification designations are based on visual estimates and are approximate only. If laboratory tests were performed to classify the soil, the unified designation is shown in parenthesis.*
3. *Value given in Unit Dry Weight/SPT Column is either a unit dry weight in pounds per cubic foot, if adjacent to a ST sample designation, or blows per 6-inch increment if adjacent to a SS sample designation.*

ABBREVIATIONS

UU/2	Shear Strength from Unconsolidated - Undrained Triaxial Test (ASTM D2850)
QU/2	Shear Strength from Unconfined Compression Test (ASTM D2166)
SV	Shear Strength from Field Vane (ASTM D2573)
PL	Plastic Limit (ASTM D4318)
LL	Liquid Limit (ASTM D4318)

LEGEND

CS	Continuous Sampler
GB	Grab Sample Taken From Auger Cuttings Or Wash Water Return
NX 100/42	NX Rock Core with Percent Recovery/R.Q.D. Given in Adjacent Column
PST	Three Inch Diameter Piston Tube Sample
SS	Split Spoon Sample (Standard Penetration Test)
ST	Three Inch Diameter Shelby Tube Sample
*	Sample Not Recovered
SV	Field Vane Test

SPLIT - BARREL SAMPLER DRIVING RECORD

Blow Per Foot (N-Value)	Description
25	25 blows drove sampler 12 inches after initial 6 inches of seating.
75/10"	75 blows drove sampler 10 inches after initial 6 inches of seating.
50/3"	50 blows drove sampler 3 inches during initial 6 inch seating interval.

NOTES: 1. To avoid damage to sampling tools, driving is limited to 50 blows during any six inch interval.
2. N-Value (Blow Count) is the standard penetration resistance based on the total number of blows, using a 140-lb. hammer with 30-inch free fall, required to drive a split spoon the last two of three, 6 inch drive increments. (Example: 4/7/9, N = 7 + 9 = 16). Values are shown as a summation on grid plot and may be shown as 4/7/9 in Unit Dry Weight -SPT column.

RELATIVE COMPOSITION

Trace	0-10%
With/Some	11-35%
Soil modifier such as silty, clayey, sandy, etc.	) 35%

DENSITY OF GRANULAR SOILS

Descriptive Term:	N—Value
Very Loose	0-4
Loose	5-10
Medium Dense	11-30
Dense	31-50
Very Dense	) 50

STRENGTH OF COHESIVE SOILS

Consistency	Undrained Shear Strength Tons Per Sq. Ft.	Field Test	Approximate N-Value Range
Very Soft	less than 0.12	Thumb will penetrate soil more than 1".	0-1
Soft	0.13 to 0.25	Thumb will penetrate soil about 1".	2-4
Medium Stiff	0.26 to 0.50	Thumb will penetrate soil about ¼"	5-8
Stiff	0.51 to 1.00	Thumb hardly indents soil	9-15
Very Stiff	1.01 to 2.00	Thumb will not indent soil, but readily indented with thumbnail	16-30
Hard	greater than 2.00	Thumbnail will not indent soil	) 30

SOIL GRAIN SIZE

U.S. STANDARD SIEVE

12"	3"	¾"	4	10	40	200		
BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		
300	76.2	19.1	4.76	2.00	0.42	0.074	.002	

SOIL GRAIN SIZE IN MILLIMETERS

SOIL STRUCTURE

Calcareous — Having appreciable quantities of carbonate.

Fissured — Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.

Slickensided — Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the ease of breaking along these planes.

Layer — Inclusion greater than 3 inches thick.

Seam — Inclusion 1/8 inch to 3 inches thick extending through the sample.

Parting — Inclusion less than 1/8 inch thick.

Pocket — Inclusion of material of different texture that is smaller than the diameter of the sample.

Interlayered — Soil samples composed of alternating layers of different soil types.

Intermixed — Soil samples composed of pockets of different soil types and a layered or laminated structure is not evident.

Laminated — Soil sample composed of alternating partings or seams of different soil type.

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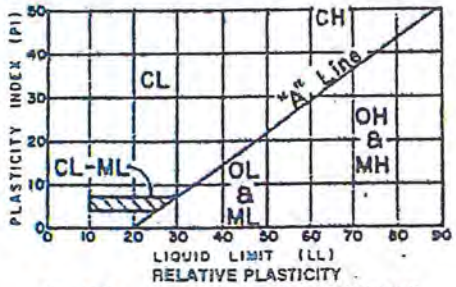
UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR	DIVISIONS	SYMBOL	DESCRIPTION
Coarse-Grained Soils (more than 50% Larger than No. 200 Sieve Size) — Gravel and Gravelly Soils	Clean Gravels Little or no Fines	GW	Well-Graded Gravel, Gravel-Sand Mixture
		GP	Poorly-Graded Gravel, Gravel-Sand Mixture
	Gravels with Appreciable Fines	GM	Silty Gravel, Gravel-Sand-Silt Mixture
		GC	Clayey Gravel, Gravel-Sand-Clay Mixture
Coarse-Grained Soils (more than 50% Larger than No. 200 Sieve Size) — Sand and Sandy Soils	Clean Sands Little or no Fines	SW	Well-Graded Sand, Gravelly Sand
		SP	Poorly-Graded Sand, Gravelly Sand
	Sands with Appreciable Fines	SM	Silty Sand, Sand-Silt Mixture
		SC	Clayey Sand, Sand-Clay Mixture
Fine-Grained Soils (more than 50% Smaller than No. 200 Sieve Size) — Silts and Clays	Liquid Limit Less than 50	ML	Silt, Clayey Silt, Silty or Clayey Very Fine Sand, Slight Plasticity
		CL	Clay, Sandy Clay, Silty Clay, Low to Medium Plasticity
		OL	Organic Silts or Silty Clays of Low Plasticity
	Liquid Limit More than 50	MH	Silt, Fine Sandy or Silty Soil with High Plasticity
		CH	Clay, High Plasticity
		OH	Organic Clay of Medium to High Plasticity
Highly Organic Soils		PT	Peat, Humus, Swamp Soil

PLASTICITY CHART



RELATIVE PLASTICITY

Nonplastic	Cannot Roll into Ball
Trace Plasticity	Barely Roll into Ball
Medium Plastic	Can be Rolled into Ball
Highly Plastic	No Rupture by Kneading

VISUAL DESCRIPTION CRITERIA*

TABLE 1: CRITERIA FOR DESCRIBING ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

TABLE 2: CRITERIA FOR DESCRIBING PARTICLE SHAPE

Description	Criteria
Flat	Particles with width/thickness X3
Elongated	Particles with length/width X3
Flat and Elongated	Particles meet criteria for both flat and elongated

TABLE 3: CRITERIA FOR DESCRIBING MOISTURE CONDITION

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

TABLE 4: CRITERIA FOR DESCRIBING REACTION WITH HCL

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

TABLE 6: CRITERIA FOR DESCRIBING CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

*NOTES: 1. Tables adapted from ASTM D 2488 "Description and Identification of Soils" (Visual-Manual Procedure)
2. Tables 5, 7 and 11 incorporated into other information on this plate

TABLE 8: CRITERIA FOR DESCRIBING DRY STRENGTH

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface
Very High	The dry specimen cannot be broken between the thumb and a hard surface

TABLE 9: CRITERIA FOR DESCRIBING DILATANCY

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

TABLE 10: CRITERIA FOR DESCRIBING TOUGHNESS

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

TABLE 12: IDENTIFICATION OF INORGANIC FINE-GRAINED SOILS FROM MANUAL TESTS

Soil Symbol	Dry Strength	Dilatancy	Toughness
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

APPENDIX G
MATERIAL SAFETY DATA SHEETS
CONTRACTOR AFFIDAVIT-PURCHASE ORDER NO.

As the responsible party for the firm of _____, I do here state that I have requested, received, read, understand, and will abide by and enforce the guidelines and conditions set forth in the Material Safety Data (MSD) Sheets provided by the product manufacturer for each hazardous chemical product delivered to and/or used in conjunction with the preparation and execution of this project.

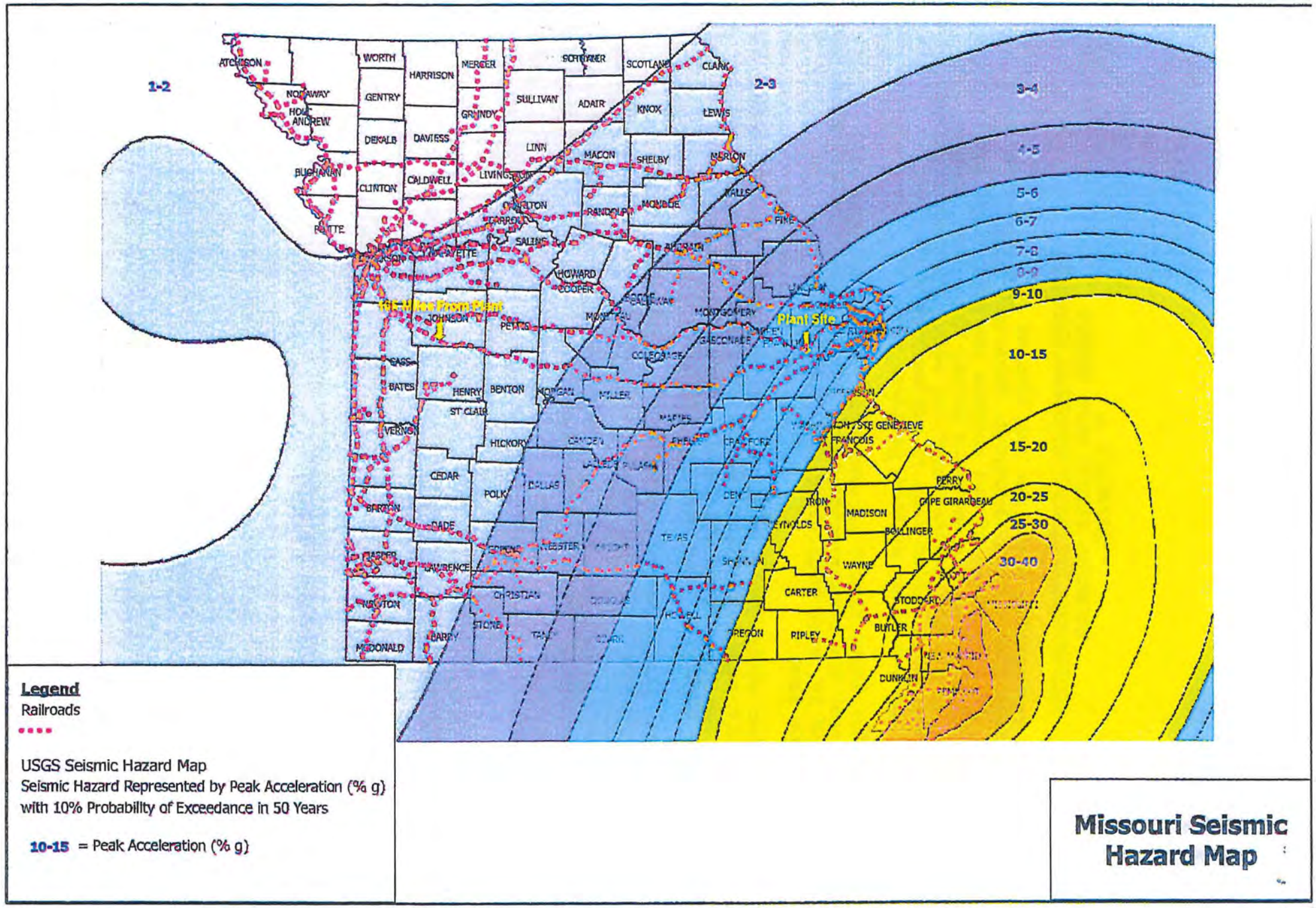
I further state that I am aware of, understand, and will fully implement the requirements of the OSHA Hazard Communication Standard (CFR 29, Part 1910.1200) and other worker's right-to-know laws.

I further state that I will maintain copies of the required MSD Sheets for each hazardous chemical in the workplace and will insure that the MSD Sheets are readily accessible during each workshift to employees when they are in their work areas.

I further state that the information contained within the MSD sheets has been disseminated to all parties who have a right or need to know, and that all workers and other effected parties have received adequate and appropriate training in the hazards, handling, and use of hazardous chemicals.

_____ _____
Contractor's Representative/Title Date

_____
Notary Public Signature & Seal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3-4
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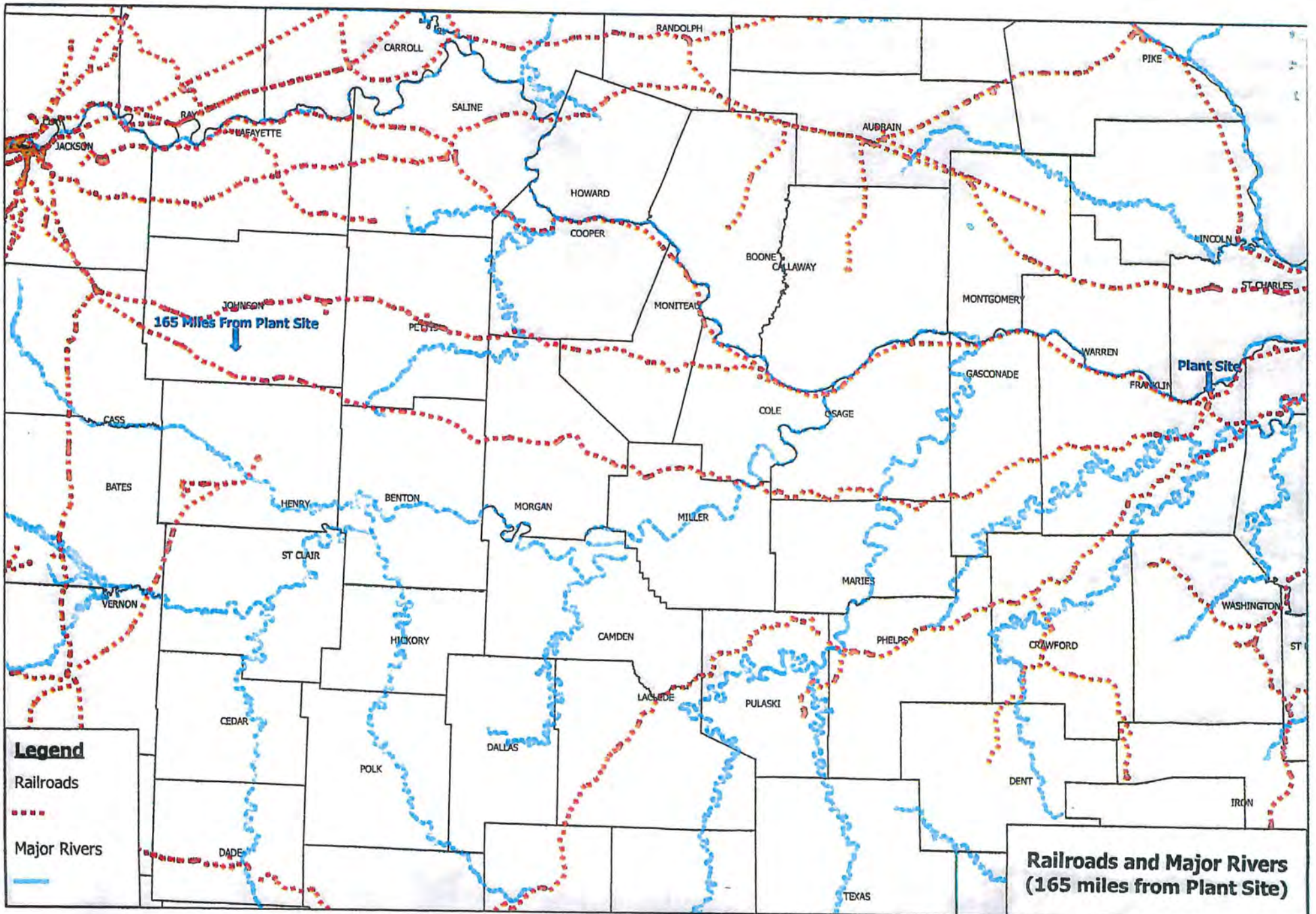
6-7
7-8
8-9
9-10
10-15
15-20
20-25
25-30
30-40
Plant Site
Legend
Railroads
USGS Seismic Hazard Map
Seismic Hazard Represented by Peak Acceleration (% g)
with 10% Probability of Exceedance in 50 Years
10-15 = Peak Acceleration (% g)
Missouri Seismic Hazard Map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LAFAYETTE
JACKSON
AUDRAIN
HOWARD
COOPER
BOONE
CALLAWAY
LINCOLN
ST CHARLES
MONTGOMERY
JOHNSON
165 Miles From Plant Site
MONITEAU
WARREN
Plant Site
GASCONADE
FRANKLIN
COLE
OSAGE
CASS
BATES
HENRY
BENTON
MORGAN
MILLER
ST CLAIR
MARIES
VERNON
WASHINGTON
HICKORY
CAMDEN
PHELPS
CRAWFORD
LACLEDE
PULASKI
CEDAR
DALLAS
POLK
DENT
IRON
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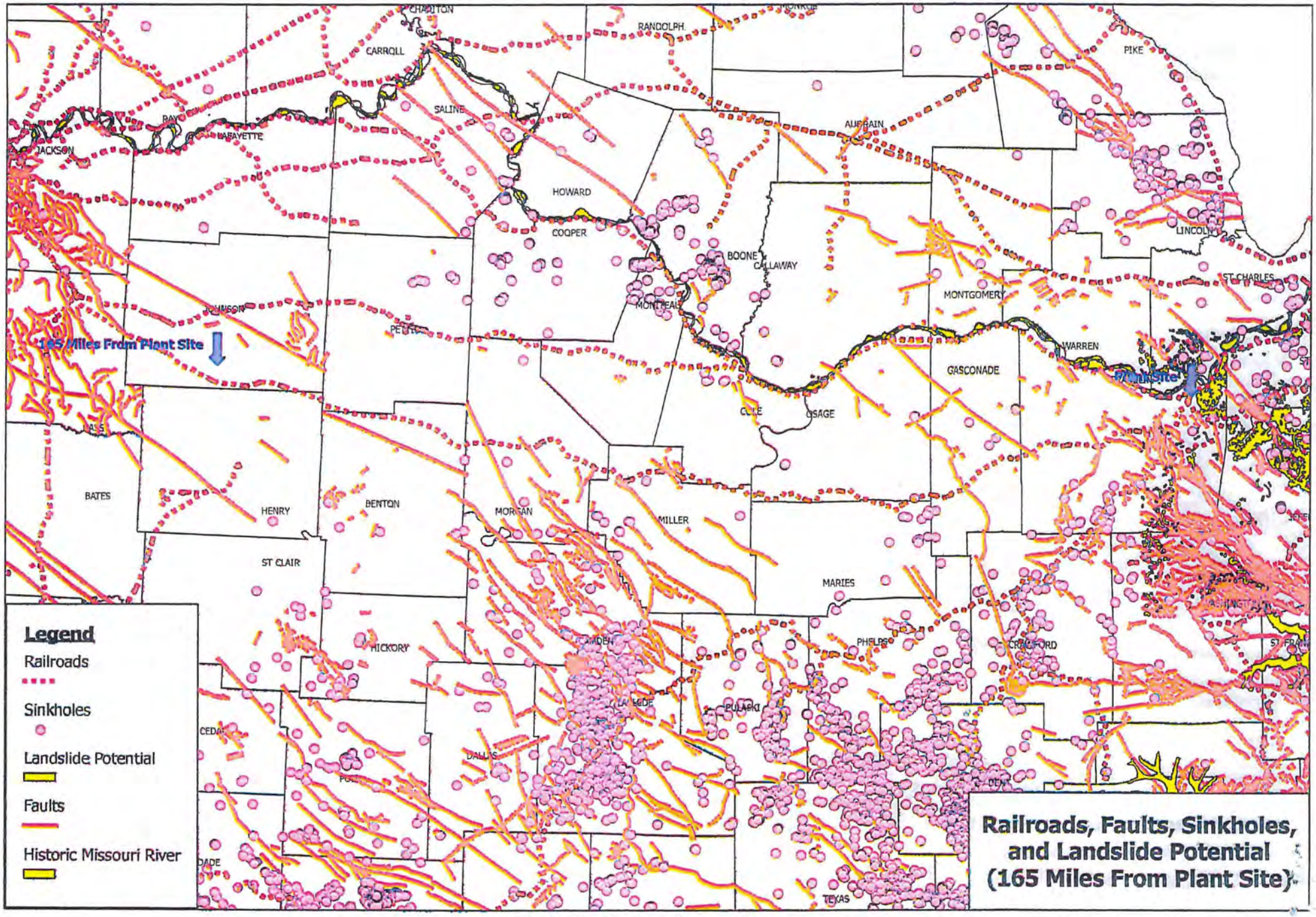
TEXAS
Legend
Railroads
Major Rivers
Railroads and Major Rivers
(165 miles from Plant Site)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CRAWFORD
LACLEDE
PULASKI
CEDAR
DALLAS
DADE
TEXAS
Legend
Railroads
Sinkholes
Landslide Potential
Faults
Historic Missouri River
Railroads, Faults, Sinkholes, and Landslide Potential (165 Miles From Plant Site)