

Procurement Specification Cover Sheet

Proc. Ref. E7, 2.14

1. Title Saltstone Disposal Site - SDU 6 (U) Project SDU6				(Total Pages: 301)	
2. Specification No. C-SPP-Z-00008		3. Revision 3		4. Page 1 of 4	
5. Functional Classification Production Support		6. Requester Department Design Services		7. Requester Division PD&CS	
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INDEX OF DOCUMENTS AND DRAWINGS**SECTION 01004****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. List of documents and drawings associated with Saltstone Disposal Cell 6.

1.2 DOCUMENTS

1. C-ESR-Z-00006, Rev. 0, Comprehensive Stormwater Pollution Prevention Plan (SWPPP)
2. K-CLC-Z-00024, Rev. 0, Bearing Capacity and Static Settlement Calculations for Saltstone Disposal Unit 6
3. OSR 45-4 Form, Supplier Deviation Disposition Request

1.3 DRAWINGS

NOTE: Titles for Drawings that begin with C-CG-Z- are preceded with "Z Area Saltstone Disposal Site SDU6 Site Preparation" and all other Drawings are preceded with "Z Area Saltstone Disposal Site SDU6 Tank Design".

1. C-C2-Z-00002, Rev.1, Cover Sheet
2. C-C2-Z-00004, Rev. 1, Abbreviations
3. C-C2-Z-00005, Rev. 0, General Structural Notes
4. C-C2-Z-00007, Rev. 0, Statement of Special Inspections
5. C-C2-Z-00008, Rev. 0, Statement of Special Inspections
6. C-C2-Z-00009, Rev. 0, Statement of Special Inspections
7. C-CC-Z-00039, Rev. 1, Foundation Plan
8. C-CC-Z-00040, Rev. 1, Overall Roof Plan and Partial Plan
9. C-CC-Z-00041, Rev. 1, Partial Roof Plan
10. C-CC-Z-00042, Rev. 1, Wall and Column Section and Details
11. C-CC-Z-00043, Rev. 0, Typical Roof Sections
12. C-CC-Z-00044, Rev. 0, Concrete Section and Details
13. C-CC-Z-00045, Rev. 0, Concrete Details
14. C-CC-Z-00046, Rev. 1, Concrete Details
15. C-CC-Z-00049, Rev. 1, Roof Embed and Nozzle Location Plan
16. C-CG-Z-00037, Rev. 2, Z-Area Saltstone Disposal Cells 3 & 5 Mudmat Marker Cells 3 & 5 Section and Details
17. C-CG-Z-00038, Rev. 0, Z-Area Saltstone Disposal Cells 3 & 5 Settlement Marker Cells 3 & 5 Section and Details
18. C-CG-Z-00039, Rev. 0, Vicinity Map
19. C-CG-Z-00041, Rev. 1, Overall Site Plan
20. C-CG-Z-00047, Rev. 1, Grading and Erosion and Sediment Control Plan (Phase 2) – Excavation Area
21. C-CG-Z-00048, Rev. 1, Excavation Grading Plan
22. C-CM-Z-00013, Rev. 1, Stair and Handrail Details
23. C-CM-Z-00014, Rev. 0, Stair Tower Plan, Section and Elevations

- 24. C-CM-Z-00019, Rev. 0, Miscellaneous Steel Details
- 25. C-CM-Z-00020, Rev. 1, Stair Tower Details
- 26. C-CY-Z-00005, Rev. 1, HDPE/GCL, Leakage Detection and Settlement Monitoring Plan
- 27. C-CY-Z-00006, Rev. 1, Leakage Detection System Sections and Details
- 28. C-CY-Z-00007, Rev. 1, Leakage Detection and Settlement Monitoring Sections and Details

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

SECTION END

SUMMARY OF WORK

SECTION 01100

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. References
- B. Definitions
- C. Location of the Work
- D. Project Summary
- E. Work by Others
- F. Work Sequence
- G. General Requirements
- H. Site Requirements
 - I. Existing Conditions
- J. Administration
- K. Acceptance and Inspection

1.2 RELATED SECTIONS

- A. All Sections in this Specification

1.3 REFERENCES:

- A. Code / Standard Editions:
 - 1. When a design Code references a Required Code or Standard, use the document edition referenced within that Code.
- B. Required Codes / Standards
 - 1. American Association of State Highway and Transportation Officials (AASHTO)
 - a. T 237, 2005, Standard Method of Test for Testing Epoxy Resin Adhesive
 - b. T 260, 1997, Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials
 - c. T 277, 2007, Standard Method of Test for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
 - 2. American Concrete Institute (ACI)
 - a. 117, 2010, Specifications for Tolerances for Concrete Construction and Materials
 - b. 211.1, 1991 (R 2009), Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - c. 301, 2010, Specifications for Structural Concrete
 - d. 305.1, 2006, Specification for Hot Weather Concreting
 - e. 306.1, 1990 (R 2002), Standard Specification for Cold Weather Concreting
 - f. 318, 2008, Building Code Requirements for Structural Concrete
 - g. 347, 2004, Guide to Formwork for Concrete
 - h. 350.1, 2010, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures

- i. 506.2, 1995, Specification for Shotcrete
 - j. SP-66, 2004, ACI Detailing Manual
- 3. American Galvanizers Association (AGA)
 - a. Inspection of Products Hot-Dip Galvanized After Fabrication, 2001
 - b. Quality Assurance Manual, 2002
- 4. American Institute of Steel Construction (AISC)
 - a. 325, Steel Construction Manual – 14th Edition
- 5. American Ladder Institute (ALI)
 - a. Deleted
- 6. American Petroleum Institute (API)
 - a. SPEC 5L, 2007, Specification for Line Pipe
- 7. American Society of Mechanical Engineers (ASME)
 - a. B16.5, 2009, Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
 - b. B16.21, 2011, Nonmetallic Flat Gaskets for Pipe Flanges
 - c. Deleted
 - d. B31.3, 2008, Process Piping
 - e. Boiler and Pressure Vessel Code, 2007 Edition with 2008 Addenda
 - i. Section V, Nondestructive Examination
 - ii. Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators
 - f. NQA-1, 2008 / 2009, Quality Assurance Requirements for Nuclear Facility Applications
 - g. Y14.38, 2007, Abbreviations and Acronyms
 - h. B16.9, 2012, Factory-Made Wrought Buttwelding Fittings
- 8. American Society for Nondestructive Testing Inc. (ASNT)
 - a. SNT-TC-1A, 2012, Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing
- 9. American Society for Testing and Materials (ASTM)
 - a. A 36/A 36M, 2008, Standard Specification for Carbon Structural Steel
 - b. A 53/A 53M, 2012, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - c. A 82/A 82M, 2007, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
 - d. A 90/A 90M, 2011, Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
 - e. A 105/A 105M, 2011, Standard Specification for Carbon Steel Forgings for Piping Applications
 - f. A 108, 2007, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
 - g. A 123/A 123M, 2009, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

- h. A 143 /A 143M, 2007, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
- i. A 153/A 153M, 2009, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- j. Deleted
- k. Deleted
- l. A 185/A 185M, 2007, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
- m. Deleted
- n. Deleted
- o. Deleted
- p. A 307, 2010, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
- q. A 325, 2009, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- r. A 384/A 384M, 2007, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
- s. A 385/A 385M, 2011, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
- t. A 416/A 416M, 2010, Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
- u. A 489, 2012, Standard Specification for Carbon Steel Lifting Eyes
- v. A 500/A 500M, 2010, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- w. Deleted
- x. A 563 REV A, 2007, Standard Specification for Carbon and Alloy Steel Nuts
- y. A 615/A 615M, 2012, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- z. A 653/A 653M, 2011, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- aa. A 722/A 722M, 2012, Standard Specification for Uncoated High-Strength Steel Bars for Prestressing Concrete
- bb. A 780, 2009, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- cc. A 992/A 992M, 2011, Standard Specification for Structural Steel Shapes
- dd. A 1011/A 1011M, 2012, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
- ee. B 6, 2012, Standard Specification for Zinc
- ff. C 31/C 31M, 2010, Standard Practice for Making and Curing Concrete Test Specimens in the Field
- gg. C 33/C 33M, 2011, Standard Specification for Concrete Aggregates
- hh. C 348, 2008, Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars

- ii. C 39/C 39M, 2012, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- jj. C 40/C 40M, 2011, Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
- kk. C 42/C 42M, 2012, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- ll. C 78/C 78M, 2010, Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
- mm. C 94/C 94M, 2012, Standard Specification for Ready-Mixed Concrete
- nn. C 109/C 109M, 2011, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
- oo. C 117, 2004, Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
- pp. C 136, 2006, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- qq. C 142/C 142M, 2010, Standard Test Method for Clay Lumps and Friable Particles in Aggregates
- rr. C 143/C 143M, 2010, Standard Test Method for Slump of Hydraulic - Cement Concrete
- ss. C 150/C 150M, 2011, Standard Specification for Portland Cement
- tt. C 157/C 157M, 2008, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
- uu. C 173/C 173 M, 2010, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- vv. C 231/C 231 M, 2010, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- ww. C 233/C 233 M, 2011, Standard Test Method for Air-Entraining Admixtures for Concrete
- xx. C 260/C 260 M, 2010, Standard Specification for Air-Entraining Admixtures for Concrete
- yy. C 457/C 457M, 2011, Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete
- zz. C 469/C 469M, 2010, Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
- aaa. C 494/C 494M, 2011, Standard Specification for Chemical Admixtures for Concrete
- bbb. C 496/C 496M, 2011, Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
- ccc. C 531, 2000, Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes
- ddd. C 566, 1997 (R 2004), Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
- eee. C 618, 2012, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

- fff. C 666/C 666M, 2003 (R 2008), Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
- ggg. C 805/C 805M, 2008, Standard Test Method for Rebound Number of Hardened Concrete
- hhh. C 881/C 881M, 2010, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - iii. C 882/C 882M, 2012, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
 - jjj. C 939, 2010, Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
- kkk. C 989/C 989M, 2011, Standard Specification for Slag Cement for Use in Concrete and Mortars
 - III. C 1012/C 1012M, 2012, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution
- mmm. C 1077, 2011, Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
- nnn. C 1107/C 1107M, 2011, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- ooo. C 1116/C 1116M, 2010, Standard Specification for Fiber-Reinforced Concrete
- ppp. C 1202, 2012, Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
- qqq. C 1240, 2011, Standard Specification for Silica Fume Used in Cementitious Mixtures
 - rrr. C 1315, 2011, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
- sss. C 1583/C 1583M, 2004 (E 2008), Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
 - ttt. C 1602/C 1602M, 2012, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
- uuu. D 75 /D 75 M, 2009, Standard Practice for Sampling Aggregates
- vvv. Deleted
- www. D 422, 1963 (R 2007), Standard Test Method for Particle-Size Analysis of Soils
- xxx. D 570, 1998 (R 2010) (E 2010), Standard Test Method for Water Absorption of Plastics
- yyy. D 638, 2010, Standard Test Method for Tensile Properties of Plastics
- zzz. D 648, 2007, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
- aaaa. D 695, 2010, Standard Test Method for Compressive Properties of Rigid Plastics
- bbbb. D 792, 2008, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- cccc. D 882, 2010, Standard Test Method for Tensile Properties of Thin Plastic Sheeting
- dddd. D 1004, 2009, Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
- eeee. D 1056, 2007, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

- ffff. D 1330, 2004 (R 2010), Standard Specification for Rubber Sheet Gaskets
- gggg. D 1505, 2010, Standard Test Method for Density of Plastics by the Density-Gradient Technique
- hhhh. D 1557, 2009, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³(2,700 kN-m/m³))
- iiii. Deleted
- jjjj. D 1621, 2010, Standard Test Method for Compressive Properties of Rigid Cellular Plastics
- kkkk. D 2000, 2012, Standard Classification System for Rubber Products in Automotive Applications
- llll. D 2240, 2005 (R 2010), Standard Test Method for Rubber Property-Durometer Hardness
- mmmm. D 2487, 2011, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- nnnn. D 2842, 2006, Standard Test Method for Water Absorption of Rigid Cellular Plastics
- oooo. D 3034, 2008, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- pppp. D 3350, 2012, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- qqqq. D 3740, 2012, Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- rrrr. D 3895, 2007, Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
- ssss. D 4258, 2005 (R 2012), Standard Practice for Surface Cleaning Concrete for Coating
- tttt. D 4259, 1988 (R 2012), Standard Practice for Abrading Concrete
- uuuu. D 4263, 1983 (R 2005), Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
- vvvv. D 4318, 2010, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- wwww. D 4491, 1999 (R 2009), Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- xxxx. D 4632, 2008, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- yyyy. D 4643, 2008, Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating
- zzzz. D 4716, 2008, Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
- aaaa. D 4832, 2010, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
- bbbb. D 4833, 2007, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
- cccc. D 5035, 2011, Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)

- ddddd. D 5199, 2012, Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
- eeee. D 5261, 2010, Standard Test Method for Measuring Mass per Unit Area of Geotextiles
- ffff. D 5397, 2007, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- ggggg. D 5641, 1994 (R 2011), Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber
- hhhhh. D 5721, 2008, Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
- iiii. D 5885, 2006, Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry
- jjjj. D 5887, 2009, Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter
- kkkkk. D 5890, 2011, Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
- llll. D 5891, 2002, Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
- mmmmm. D 5993, 1999 (R 2009), Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners
- nnnnn. D 6392, 2008, Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
- oooo. D 6496, 2004 (R 2009), Standard Test Method for Determining Average Bonding Peel Strength Between Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners
- ppppp. D 6693, 2004 (R 2010), Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- qqqqq. D 6768, 2004 (R 2009), Standard Test Method for Tensile Strength of Geosynthetic Clay Liners
- rrrrr. D 7179, 2007, Standard Test Method for Determining Geonet Breaking Force
- sssss. E 96/E 96M, 2010, Standard Test Methods for Water Vapor Transmission of Materials
- tttt. E 329, 2011, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
- uuuuu. F 436, 2011, Standard Specification for Hardened Steel Washers
- vvvvv. F 593, 2002 (R 2008) (E 2012), Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- wwwww. F 594, 2009, Standard Specification for Stainless Steel Nuts
- xxxxx. F 714, 2012, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- yyyyy. F 844, 2007, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
- zzzzz. F 1554, 2007, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

- aaaaaa. F 1869, 2011, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- bbbbbb. Deleted
- cccccc. F 2170, 2011, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
- dddddd. F 2620, 2011, Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
- eeeeee. A 513/A 513M, 2012, Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
- fffff. B 26/B 26M, 2012, Standard Specification for Aluminum-Alloy Sand Castings
- gggggg. C 227, 2010, Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
- hhhhh. C 1260, 2007, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
- iiiiii. C 1293 REV B, 2008, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
- jjjjj. C 1567, 2010, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
- kkkkkk. D 1709, 2009, Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method
- lllll. D4218, 1996 (R 2008), Standard Test Method Determination of Carbon Black Content In Polyethylene Compounds By the Muffle-Furnace Technique
- mmmmm. D 4873, 2002 (R 2009), Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
- nnnnn. D 6241, 2004 (R 2009), Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe
- ooooo. D 6938, 2010, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- ppppp. E 84, 2010, Standard Test Method for Surface Burning Characteristics of Building Materials
- qqqqq. E 1745, 2011, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
- rrrrr. F 912, 2011, Standard Specification for Alloy Steel Socket Set Screws
- sssss. F 1249, 2006 (R 2011), Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
- ttttt. A 234/A 234M REV A, 2011, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
- uuuuu. ASTM A 513/A 513M, 2012, Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
- vvvvv. C 1064/C 1064M, 2012, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
- wwwww. F 1249, 2006 (R 2011), Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

10. American Welding Society (AWS)
 - a. A2.4, 2012, Standard Symbols for Welding, Brazing, and Nondestructive Examination
 - b. A3.0/A3.0M, 2010, Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying
 - c. D1.1/D1.1M, 2010, Structural Welding Code
 - d. QC1, 2007, Standard for AWS Certification of Welding Inspectors
11. American Water Works Association (AWWA)
 - a. Deleted
12. US Army Corps of Engineers (COE)
 - a. CRD-C 572, 1974, Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop
13. Concrete Reinforcing Steel Institute (CRSI)
 - a. Manual of Standard Practice, 2009
 - b. PRB, 2011, Placing Reinforcing Bars
14. Federal Geographic Data Committee (FGDC)
 - a. STD-007.4, 2002, Geospatial Positioning Accuracy Standard, Part 4, Standards for Architecture, Engineering, Construction (A/E/C) and Facility Management
15. International Code Council (ICC)
 - a. ES AC 193, 2012, Acceptance Criteria For Mechanical Anchors In Concrete Elements
 - b. IBC, 2009, International Building Code
16. International Concrete Repair Institute (ICRI)
 - a. 310.2, 1997, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
17. National Association of Architectural Metal Manufacturers (NAAMM)
 - a. MBG 531, 2009, Metal Bar Grating Manual
18. National Association of Corrosion Engineers (NACE)
 - a. SP0188, 2006, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
19. National Institute for Certification in Engineering Technologies (NICET)
 - a. 1030-12-95, 2nd edition, Certification in the Field of Geosynthetic Materials Installation Inspection
20. National Fire Protection Association
 - a. 101, 2009, Life Safety Code
21. United States Navy (NAVY)
 - a. MIL-P-21035B, 1991, Paint High Zinc Dust Content, Galvanizing Repair (Metric)
22. National Geodetic Society (NGS)
 - a. Vertical Datum of 1929
23. National Ready-Mixed Concrete Association (NRMCA)
 - a. QC-3, 2002, Quality Control Manual, Section 3, Plant Certification Checklist
24. Precast/Prestressed Concrete Institute (PCI)
 - a. MNL-120, 2010, PCI Design Handbook

25. Plastics Pipe Institute, Inc. (PPI)
 - a. Deleted
 - b. TR-33, 2012, Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe
26. Society for Protective Coatings (SSPC)
 - a. PA 2, 2004, Measurement of Dry Coating Thickness with Magnetic Gages
 - b. PA Guide 10, 2008, Guide to Safety and Health Requirements for Industrial Painting Projects
 - c. SP 1, 2004, Solvent Cleaning
 - d. SP 2, 2004, Hand Tool Cleaning
 - e. SP 3, 2004, Power Tool Cleaning
 - f. SP 5, 2007, White Metal Blast Cleaning
 - g. SP 6, 2007, Commercial Blast Cleaning
 - h. SP 7, 2007, Brush-off Blast Cleaning - NACE No. 4
 - i. SP 10, 2007, Near-White Metal Blast Cleaning
 - j. SP 11, 2012, Power Tool Cleaning to Bare Metal
 - k. SP 12, 2002, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating - NACE NO. 5
 - l. SP 13, 2003, Surface Preparation of Concrete - NACE No. 6

C. Regulations

1. Deleted
2. 49 CFR PT 192.285, Plastic Pipe: Qualifying Persons to Make Joints
3. SC R.72-300, Standards for Storm Water Management and Sediment Reduction
4. SCR 100000, NPDES Storm Water General Permit

D. Documents

1. None Specified in this Section

E. Drawings

1. C-CG-Z-00041, Rev. 0, Overall Site Plan
2. C-CG-Z-00047, Rev. 0, Grading and Erosion and Sediment Control Plan – Excavation Area
3. C-CG-Z-00048, Rev. 0, Excavation Grading Plan

1.4 DEFINITIONS

A. See individual sections for definitions related to scope of work in the section.

B. Acronyms common to all sections of this Specification

1. CLI Component Location Indicator
2. EDR Engineering Document Requirements
3. Deleted
4. SDDR Supplier Deviation Disposition Request (OSR 45-4)
5. SQAPR Supplier Quality Assurance Program Requirements
6. SRR Savannah River Remediation, LLC
7. SRS Savannah River Site
8. STR SRR Subcontract Technical Representative

1.5 LOCATION OF THE WORK

- A. The work is located in Z-Area of the Savannah River Site, a Department of Energy site south of Aiken, South Carolina.
- B. See Drawings C-CG-Z-00041, C-CG-Z-00047, and C-CG-Z-00048.

1.6 PROJECT SUMMARY

A. Overview:

- 1. Subcontractor scope includes, but is not limited to, excavation, mud mats, watertight tank construction, hydrostatic testing, below slab HPDE liner and leakage detection system, backfill, drain water collection sleeves installation, and site finishing.
- 2. The objective of these scope activities is for SRR to deliver to the Department of Energy, a water tight disposal system that will provide safe containment of low level radioactive waste to protect the environment. The containment system includes specific materials of construction, unique design features and relies upon quality workmanship and demonstrated performance to provide a system that will satisfy State and Federal regulations.

B. Scope includes:

- 1. Installation of interim erosion and storm water controls.
- 2. Minor local excavation for thickened mud mat installation and leakage water perimeter collection area.
- 3. Stockpiling of excess soil.
- 4. Maintenance of all erosion and storm water controls.
- 5. Construction of concrete mud mats, liner, and leakage detection system below the tank.
- 6. Watertight Tank construction.
- 7. Perform tank water tightness test.
- 8. Apply internal coatings.
- 9. Installation of tank top penetrations.
- 10. Installation of HDPE Liner and Leakage Detection System.
 - a. Under the tank foundation prior to tank construction.
 - b. Over tank foundation after tank construction.
 - c. Tank walls and tank top liners (HDPE) is excluded – Future installation by others.
 - d. Installation of a system located beneath the cell and above the HPDE Liner and Leakage Detection System to sample liquids on SDU 6.
- 11. Backfill after tank construction and above foundation liner installation.
- 12. Site finish grading for erosion control including grassing.
- 13. Furnishing and installing all embeds and sleeves for Balance of Plant (BOP) interface.
- 14. Installation and monitoring of Settlement markers.
- 15. Erection of a Stairtower.
- 16. Fabrication of Tank Top Crossover Stairs.
- 17. Installation of a Wall insulation system.

1.7 WORK BY OTHERS

- A. Clearing of working area in preparation for construction.
- B. Temporary benchmarks and heave marker installation.

- C. Installation of Sedimentation Pond at marked location.
- D. Installation of initial storm water management and sediment/erosion control measures.
- E. Installation of Process Grout line, electrical power, instrumentation and drain water return after tank construction.

1.8 WORK SEQUENCE

- A. The following sequence is anticipated to coordinate the earthwork (excavation and backfill) and erosion control with the tank construction. Steps # 7 and 8 may not be performed in reverse order.
 - 1. Installation and maintenance of erosion and storm water controls.
 - 2. Gravel road maintenance.
 - 3. Excavation (including surveys) for tank foundation
 - 4. Preparation of foundation including mud mats and sub-base liners and materials prior to tank construction.
 - 5. Tank Construction
 - a. Installation of tank top penetrations.
 - 6. Perform tank water tightness test.
 - 7. Complete liner installation around tank foundation after tank construction.
 - 8. Finish grade, and seeding.
 - 9. Deleted

1.9 GENERAL REQUIREMENTS

- A. Requirements in Division 1 of this Specification apply to all sections of this Specification.
- B. Maintain an on-site copy of the latest design documents, drawings and specifications for the duration of the project at all times.
- C. Perform excavation, erosion / storm water control, and construction activities in accordance with governing codes, regulations, technical and functional requirements set forth in the Subcontract Documents.
- D. Confirm and coordinate all aspects of the work including;
 - 1. Work by subtier contractors,
 - 2. Fabrication processes,
 - 3. Methods and sequences of construction.
 - 4. SRR Special Inspection coordination.
 - 5. Sharing access corridors with other subcontractors and SRR construction.
- E. Provide required testing as identified in the Subcontractor Documents.

1.10 SITE REQUIREMENTS

- A. General Provisions, Special Provisions, and Subcontract Field Conditions, are described in the procurement documents.

1.11 EXISTING CONDITIONS

- A. Verify existing conditions, utilities, dimensions, and details affecting the work prior to performing other field activities.
- B. Report any discrepancies or deviations from Subcontract Documents to SRR as soon as conditions are identified using a Request for Information or Supplier Deviation Disposition Request in accordance with Section 01330 – Submittal Procedures.

- C. Reference in this specification to patented processes by trade name or by make; e.g. Post Tensioning, Form Work, Crane Placement, etc.; shall be regarded as establishing as a standard of quality and shall not be construed as limiting competition of 'or equal' processes.
 - 1. Provide with the proposal, a list and process description of alternate processes.

1.12 ADMINISTRATION

- A. The SRR Subcontract Technical Representative for this effort will be identified at award of the subcontract.
- B. The Subcontract Technical Representative is the SRR representative responsible for all administrative and technical communication and direction between SRR and the Subcontractor.
- C. All technical correspondence shall be directed to the Subcontract Technical Representative with a transmittal copy to the Procurement Representative.

1.13 ACCEPTANCE AND INSPECTION

- A. Prior to final acceptance, each phase of work will be inspected and accepted by SRR for conformance to Subcontract Document requirements.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

CHANGE PROCEDURES**SECTION 01250****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Request for Information
- B. Supplier Deviation Disposition Request
- C. Change Notice

1.2 RELATED SECTIONS

- A. Division 1 - All Sections

1.3 REFERENCES

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

- A. Required National Codes / Standards

- 1. None Specified in this Section

- B. Regulations

- 1. None Specified in this Section

- C. Documents

- 1. OSR 45-4 Form

- D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. Minor Change: Change to the project or clarifications of the Subcontract Documents in which the change does not impact the subcontract, including cost and schedule.

- 1. Changes are initiated by the SRR Subcontract Technical Representative or the Subcontractor's Point of Contact.

- 2. Level of quality shall be maintained with a minor change.

- B. Deviation: Subcontractor initiated change for which the scope, cost and/or schedule of the Subcontract may be impacted.

- C. Subcontractor Authorized Representative: Individual within Subcontractor's organization authorized to receive change documents and responsible for informing others in Subcontractor's employ or Subtier contractors of changes to the Work Scope.

1.5 SUBMITTALS

- A. Submit the following Engineering Documents in accordance with Section 01330 and 01400.

- 1. None Specified in this Section

- B. Deleted

1.6 REQUEST FOR INFORMATION (RFI)

- A. Identify questions needing clarification or request services from SRR using a Request for Information (RFI).

- 1. RFI forms will be available from the SRR Subcontract Technical Representative (STR).

- B. Transmit the RFI to the SRR STR.

- C. RFI issues which, at any time during the course of the subcontract, result in changes to or deviations from the technical or quality requirements or otherwise impact the cost / schedule require the use of an SDDR prior to continuing the affected work.
- D. Maintain a tracking log of RFI documents.

1.7 SUPPLIER DEVIATION DISPOSITION REQUEST (SDDR)

- A. Prepare a Supplier Deviation Disposition Request for Subcontractor proposed deviations from the technical or quality requirements of this procurement.
- B. Applies to proposed deviations that are not Minor Changes after award of subcontract.
 - 1. RFI issues subsequently determined to be non-minor changes to the technical or quality requirements or otherwise impact the cost / schedule require implementation and completion of the SDDR process prior to continuing.
- C. For each deviation:
 - 1. Identify the following, as applicable:
 - a. Specification and revision number
 - b. Affected drawing number, revision number, section or detail.
 - 2. Identify criteria that cannot be met by item and specification section number.
 - 3. Present explanation for the deviation.
 - 4. Present proposal for resolution of the deviation.
 - 5. Present price and schedule adjustment for the proposed resolution of the deviation.
- D. Nonconforming Conditions
 - 1. Nonconforming conditions are subcontractor installed conditions which do not meet the technical or quality requirements of this subcontract.
 - 2. Document nonconforming conditions on a Supplier Deviation Disposition Request.
 - a. Include supporting technical justification when requesting acceptance of a "Use-As-Is" or "Repair" disposition.
- E. Transmit Supplier Deviation Disposition Request for review and disposition in accordance with Section 01330 - Submittal Procedures.
 - 1. Proposed deviations shall be identified promptly and transmitted to SRR to allow for adequate review and approval durations without impacting the subcontract schedule. (If possible, a minimum of 7 calendar days should be allowed)
- F. Do not perform work on affected scope or make delivery of any item for which a SDDR is submitted until a written disposition of the SDDR is received from SRR.
 - 1. Continue the work in accordance with the written SRR disposition of the SDDR.

1.8 CHANGE NOTICE

- A. SRR will issue a Change Notice to identify additional scope, including a detailed description of proposed change with supplementary or revised drawings and/or specifications.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SITE SURVEYS**SECTION 01320****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Site survey services in support of construction
- B. Temporary Bench Marks

1.2 RELATED SECTIONS

- A. All Sections in this Specification

1.3 REFERENCES

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes / Standards

- 1. American Society for Testing and Materials (ASTM)
 - a. D 3034
- 2. Federal Geographic Data Committee (FGDC)
 - a. STD-007.4
- 3. National Geodetic Society (NGS)
 - a. Vertical Datum of 1929

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. Deleted
- 2. Deleted
- 3. C-CY-Z-00005
- 4. C-CY-Z-00006
- 5. C-CY-Z-00007

1.4 DEFINITIONS

- A. See Section 01100.

1.5 QUALITY ASSURANCE

- A. Perform survey work under the direction of a Professional Land Surveyor registered and licensed to practice in the state of South Carolina.
- B. Survey drawings, reports and any other official documents submitted shall be in accordance with the laws and regulations governing the practice of land surveying in the State of South Carolina.
- C. SRR reserves the right to perform independent surveys as needed.
- D. See Section 01400 for general requirements.

1.6 NOTIFICATION AND COORDINATION

- A. Coordinate required surveys through the STR.
- B. Deleted
- C. Contact SRR at least 6 weeks prior to installation of mud mat or settlement markers.

1.7 SUBMITTALS

- A. Maps and Drawings
 - 1. Provide hard copies for submittals as ANSI D size, 22-inch by 34-inch sheets.
- B. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. Settlement Data, 3.11 E. 1.
 - 2. Final Survey Map / Drawing, 3.11 E. 2.
- C. Deleted

1.8 TEMPORARY BENCH MARKS

- A. SRR will provide and install temporary bench marks in strategic locations (as determined by the STR) adjacent to the work area after general site preparation is complete.
- B. Mud Mat Markers and Settlement Markers
 - 1. SRR will materially provide mud mat markers and settlement markers as indicated on Drawings C-CY-Z-00006 and C-CY-Z-00007.

1.9 PERFORMANCE REQUIREMENTS

- A. Maintain sufficient equipment, materials, parts, tools, and supplies to meet the requirements of the work.
 - 1. Inspect and calibrate surveying equipment at intervals specified by the manufacturer.

1.10 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and survey work as it progresses.
 - 1. This log shall be available for review by SRR upon request.

PART 2 PRODUCTS

2.1 BRONZE SURVEY MARKERS

- A. Survey Markers for Concrete:
 - 1. 3-½ inch diameter dome top, Berntsen No. C35DB, or approved equal.
 - 2. Pre-stamp "GEOTECHNICAL ENGINEERING SETTLEMENT MARKER, SAVANNAH RIVER SITE, DO NOT DISTURB".
 - 3. Deleted

2.2 MARKERS

- A. SRR will materially provide mud mat markers and settlement markers per Drawings C-CY-Z-00005, C-CY-Z-00006, and C-CY-Z-00007.

2.3 MUD MAT MARKERS

- A. Stainless Steel Rod:
 - 1. 4 feet long 9/16 inch stainless steel rod monument with thread and 9/16 inch stainless steel cone-shaped point.

2. Berntsen No. MSS91604, or approved equal.
3. Berntsen No. MSS12, or approved equal.
- B. Polyvinyl Chloride (PVC) Pipe: 6 inch diameter, schedule 40 pipe, ASTM D 3034.
- C. Bronze Domed Cap:
 1. Dome top, 3-¼ inch diameter for 9/16 inch rod, Berntsen No. RBS325BR, or approved equal.
 2. Pre-stamp "GEOTECHNICAL ENGINEERING SETTLEMENT MARKER, SAVANNAH RIVER SITE, DO NOT DISTURB".
 3. Deleted
- D. Bench Mark Access Cover for 6 inch PVC Pipe:
 1. Recessed hinge.
 2. Berntsen No. BMAC6 or approved equal.
- E. Construct mud mat markers for monitoring settlement at locations shown on Drawings.

2.4 ADHESIVE ANCHOR WITH DOMED CAP

- A. Adhesive Anchor: As specified for concrete drilled anchors in Section 05500.
- B. Bronze Domed Cap:
 1. Dome top, 3-¼ inch diameter for 9/16 inch rod, Berntsen No. RBS325BR, or approved equal.
 - a. BP1-SM Copper cap with imprinted "Survey Mark" may be set at time of floor placement if provided by STR.
 2. Pre-stamp "GEOTECHNICAL ENGINEERING SETTLEMENT MARKER, SAVANNAH RIVER SITE, DO NOT DISTURB".
 - a. Applies to Berntsen No. RBS325BR only.
 3. Deleted

PART 3 EXECUTION

3.1 ACCURACY

- A. Use Third Order/Class I survey accuracy as specified in FGDC STD-007.4 by the Federal Geographic Data Committee.
 1. As-built survey shots shall be recorded to the nearest 0.01 feet.
- B. Indicate the degree of accuracy of submitted data and the latest calibration date of equipment used on survey drawings, or submitted in a certified report.
 1. Certify by a Professional Land Surveyor registered in the State of South Carolina.

3.2 PREPARATION

- A. Use the SRR temporary bench marks for the survey data.
- B. Resolve any discrepancies noted on the topographic surveys prior to initiation of construction activities.
- C. Locate and protect survey control and reference points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report, in writing, to SRR the loss or destruction of any reference point or relocation required due to changes in grades or other reason.

3.3 PROTECTION

- A. Install three guard posts with reflective paint striping adjacent to temporary benchmarks in high traffic areas to prevent vehicular damage.
 - 1. Inform SRR, in writing, if Subcontractor considers a temporary benchmark not to be in a high traffic area (i.e. guard posts are not installed).

3.4 CONSTRUCTION LAYOUT

- A. Perform pre-construction survey to set lines, grades, and/or any other survey controls to aid in locating the proposed construction areas.
 - 1. This includes physical layout for the equipment and structure locations, roads, drainage, grading, etc.
- B. Where location tolerances for structure and yard articles are not specified on Drawings, use tolerance of ± 0.10 feet in horizontal and vertical direction.

3.5 MEASUREMENT OF QUANTITIES

- A. Survey work required, to determine in-progress quantities and field measurement, includes topographic surveys, field measurements of drainage areas, etc.
- B. Place survey controls for future extensions of the survey where portions of a completed section require measurement during construction.

3.6 AS-BUILT SURVEY CRITERIA

- A. Perform final topographic surveys, measurements, and recording required to document construction.
 - 1. Include as-built locations and elevations of all disturbed areas and features such as cover boundaries, channels, drainage structures, utilities, high points, change in slope, etc.

3.7 REFERENCE ELEVATION MONUMENTS

A. Temporary Bench Marks

- 1. Temporary bench marks will be installed by SRR and will be set in strategic locations (as determined by the STR) adjacent to the work area after general site preparation is complete.
 - a. The bench marks will be similar to those used by the United States Geological Survey (USGS) with the bench mark component location indicator number (provided by SRR) punched on brass caps embedded in concrete.
 - b. The base datum Mean Sea Level (MSL) will be indicated on the bench marks.
- 2. Use the NGS Vertical Datum of 1929 to reference the temporary bench mark elevations.
- 3. The elevation of the temporary bench marks will be set from the nearest bench mark established by the National Geodetic Society (NGS), USGS, or other nationally acceptable surveying standard or agency.
- 4. All temporary bench marks shall be protected from damage.
- 5. Temporary bench marks shall be checked against the NGS, USGS, or SRS accepted bench marks at 2-month intervals during construction.
 - a. A complete elevation survey closing at the starting point shall be made.
 - b. The maximum permissible error shall be $\pm 0.013 \text{ ft} \sqrt{\text{distance in miles}}$ (First order Class I leveling, Ref. FGDC-STD-007.4).

3.8 SETTLEMENT AND MUD MAT MARKERS

- A. Settlement and mud mat markers are elevation references placed on major structural elements such as columns, walls, chimneys, foundations, or foundation soils.
- B. Two types of settlement markers will be used:
 - 1. Deleted
 - 2. Mud Mat Marker
 - a. Install per manufacturer's instructions.
 - 3. Settlement Marker
 - a. Adhesive Anchor with Domed Cap:
 - i. Place on outside of perimeter footing at locations shown after tank wrapping is complete and prior to liquid tightness test or at the STR direction.
 - b. Bronze Survey (Cast In Place) Markers:
 - i. Install on interior column footing and roof slab at locations shown.
 - ii. Cast-in-place during concrete placement.
 - c. Install per manufacturer's instructions.
 - 4. All markers shall be identified in the field with a unique facility Component Location Indicator (CLI) number supplied by SRR.
 - a. CLI tags will be provided by SRR.
 - b. The tags shall be affixed adjacent to the marker for the period of time the marker is being monitored.
 - c. The only "permanent" markers will be the tank roof and footing bronze survey markers.
 - d. The CLI tags for those will be epoxied to the roof after elastomeric coating is applied.
 - 5. Any marker that is destroyed, damaged, or becomes inaccessible shall be replaced or relocated in the same area where possible, before the next scheduled survey.
 - a. The elevation of a replaced or relocated marker shall be tied to that of the old marker, if possible.
 - b. An adjusted initial elevation shall be established for the new marker so that an uninterrupted settlement observation of the marker can be maintained.
 - 6. It may be necessary to establish temporary settlement markers for facilities under construction, and/or relocate permanent settlement markers during construction activities due to interferences or for ease of survey.
 - a. New markers should be installed and monitored prior to removal or relocation of the old marker to maintain a constant settlement record. (New markers will be provided by SRR.)
- C. Record horizontal and vertical coordinates for all new markers added and submit to the STR.

3.9 DELETED

3.10 FREQUENCY OF MONITORING

- 1. After the initial settlement marker elevation is established, surveys shall be scheduled at weekly intervals during construction.

3.11 Recording Of Data

- A. A complete set of field notes (hard copy and/or electronic files) shall be kept and maintained for the following:
 - 1. Descriptive location of settlement markers.
 - 2. Records of elevation and settlement each time a survey is made.
 - 3. Relocation of settlement markers.
 - 4. Location and elevation of bench marks and control monuments.
- B. After installing the settlement markers, the initial elevations and date shall be recorded as soon as possible.
 - 1. A complete elevation survey closing at the starting point (i.e., control monument) shall be made and repeated the same day to establish initial marker elevations.
 - 2. The maximum permissive error shall be $\pm 0.013 \text{ ft} \sqrt{\text{distance in miles}}$ (First Order Class I Leveling, Ref. FGDC-STD-007.4).
- C. In addition to elevation data, the following information shall also be recorded for each survey:
 - 1. Date and time;
 - 2. Survey crew names;
 - 3. Equipment used (including identification numbers and calibration date);
 - 4. Weather conditions;
 - 5. Temperature;
 - 6. Description of any unusual conditions or damage of a marker/monument;
 - 7. Relocation of settlement markers;
 - 8. Deleted
 - 9. During placement of concrete, total weight of concrete computed per design, and an estimate of cumulative amount of concrete placed;
 - 10. After placement of concrete, any major equipment and commodity loads and estimated percentage of total foundation load;
 - 11. Current construction operations or any other unusual conditions.
- D. Depending on the settlement results, a re-survey may be necessary.
 - 1. This will be determined by SRR following review of settlement data.
- E. Transmittal of Settlement Data and Survey Map / Drawing
 - 1. Submit Settlement Data
 - a. All settlement data shall be transmitted within 7 days after each survey.
 - 2. Submit a Final Survey Map / Drawing showing finish grades, final settlement marker elevations, key tank locations and elevations, etc.
 - a. Furnish electronic CADD files and electronic copy of survey shots in ASCII text format.

END OF SECTION

SUBMITTAL PROCEDURES**SECTION 01330****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Requirements for submittal of information for SRR review and/or acceptance.

1.2 RELATED SECTIONS

- A. All Sections in this Specification

1.3 REFERENCES

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

- A. Required National Codes / Standards

- 1. None Specified in this Section

- B. Regulations

- 1. None Specified in this Section

- C. Documents

- 1. None Specified in this Section

- D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Required Submittals:

- 1. Specified in the individual specification sections and listed on the Engineering Document Requirements (EDR) form, Attachment 01330-A.
 - 2. Review prior to submission.
 - 3. Certify conformance of documents to specification requirements by signature of the Subcontractor's Authorized Engineering Representative.
 - 4. List the following on each submittal transmittal cover letter:
 - a. Document category number, and applicable specification Section and Article number (Ref. Columns 1 and 2 of Attachment 01330-A).
 - b. Document description

- B. Correspondence letters, submittals and Supplier Deviation Disposition Request forms:

- 1. Uniquely identify with a control number
 - 2. Reference the following Information:
 - a. Subcontractor Name,
 - b. Subcontractor's Order Reference Number,
 - c. SRR Purchase Order No.: (Defined on Award),
 - d. SRR Project Number and Title: (SDU6, Saltstone Disposal Unit 6),

- e. Date of transmittal,
 - f. Sequence page number and total number of pages on each page.
- 3. Transmit with a completed Transmittal Letter.
- C. Transmit Adobe Acrobat Portable Document Format (PDF) files of EDR submittals, Request For Information, and Supplier Deviation Disposition Request forms to (unless directed otherwise by the STR): **vendordocuments@srs.gov**.
 - 1. When paper copies are required, transmit to (unless directed otherwise by the STR):
Savannah River Remediation
Document Control Center
Building 704-1N
Aiken, SC 29808
Project: Saltstone Disposal Site – SDU 6
- D. Transmit a copy of correspondence letters, submittals, Supplier Deviation Disposition Request forms, and Request For Information forms to:
Subcontract Technical Representative.
Name: (Defined on Award)
Savannah River Site
Building / Room: (Defined on Award)
Aiken, SC 29808
- E. Transmit correspondence and a copy of all transmittal letters to:
Procurement Representative
Name: (Defined on Award)
Savannah River Site
Location: (Defined on Award)
Aiken, SC 29808
- F. Mark "RESUBMITTAL" on resubmitted documents and include the previous submittal document number provided with submittal review comments.
- G. Electronic Submittals: Submittals shall, unless specifically accepted otherwise, be made in electronic format.
 - 1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
 - 2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
 - 3. PDF files shall be set to open "Bookmarks and Page" view.
 - 4. Add general information to each PDF file, including title, subject, author, and keywords.
 - 5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
 - 6. Submit new electronic files for each resubmittal.
 - 7. STR will reject submittal that is not electronically submitted, unless specifically accepted due to specific content.
 - 8. Provide STR with authorization to reproduce and distribute each file as many times as necessary for Project documentation.
 - 9. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference.
 - 10. Paper submittals with less than 25% recycled content are acceptable.

11. Durations provided for submittal and review cycles are calendar days.
12. Where duration "after award" is provided, duration is measured in calendar days after notification of award is given for this Subcontract, rather than any subtier subcontracts.

1.7 REVIEW, ACCEPTANCE AND STATUS OF SUBMITTALS

- A. Submit documents listed on the Engineering Document Requirements form, Attachment 01330-A, on or before the submittal schedule identified in column 5.
- B. Provide an 8 x 3 inch blank space for status review stamp on the first page of each EDR submittal.
- C. Unless noted otherwise, EDR submittals will be statused and returned to the Subcontractor within 14 days of receipt with status as follows:
 1. Status 1: Work may proceed.
 2. Status 2: Submit final documentation. Work may proceed.
 3. Status 3: Revise and resubmit. Work may proceed subject to resolution of indicated comments.
 4. Status 4: Revise and resubmit. Work may not proceed.
 5. Status 5: Permission to proceed not required.
- D. Incorporate changes as required in accordance with SRR comments.
 1. Clearly indicate revisions on all resubmitted documents.
 2. Resubmit corrected Engineering Documents for review within 21 days of the date of receipt.
- E. Assignment of Status 1 or Status 5 to the Engineering Documents by SRR does not relieve the Subcontractor of any part of their obligation to meet all requirements of this Specification or their responsibility for the correctness of such Engineering Documents, and the adequacy and suitability of material and equipment represented thereon for the intended function.
- F. Do not change previously accepted, Status 1 or Status 5, documents without notification to the Subcontract Technical Representative

1.8 QVDR SUBMITTALS

- A. Deleted.

1.9 ATTACHMENTS

- A. 01330-A: Engineering Document Requirements, with Instructions
- B. 01330-B: Deleted

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

Engineering Document Requirements

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1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. Permission to Proceed Required		5. Submittal Schedule	6. Quantity Required		7. Kind of copies	8. Remarks
			Yes	No		Init	Final		
8.0	01320 3.11 E. 1.	Settlement Data	Y		Within 7 Days After Each Survey		1	Repro	
8.0	01320 3.11 E. 2.	Final Survey Map / Drawing	Y		2 Weeks After Final Walkdown		1	Repro	
6.0	01400 1.5 A. 3.	Approved Subcontractor Quality Program Manual or Procedures	Y		2 Weeks After Award		1	Repro	
28.0	01400 3.5 D. 3.b.	QC Manager Letter of Authority	Y		Prior to Initiating Any Work		1	Repro	
28.0	01400 3.5 D. 3.c.	QC Representative Letters of Direction	Y		Prior to Initiating Any Work		1	Repro	
6.0	01400 3.5 G.	Subcontractor Quality Control Plan	Y		Prior to Initiating Any Work		1	Repro	
28.0	01450 1.10 A.	Inspection and Testing Laboratory Business Information	Y		Prior to Initiating Any Work		1	Repro	
-	01810 1.10 F. 1.	Subcontractor's Statement of Responsibility Form(s)	Y		Prior to Initiating Any Work		1	Repro	
11.0	02240 2.1 B. 2.	Product Data for Liquid Soil Stabilizer	Y		2 Weeks Prior to Use		1	Repro	
-	02240 3.1 F. 3.	Erosion and Sediment Control Stormwater Co- Permittee Agreement	Y		2 Weeks Prior to Any Land Disturbance		1	Original	
	02315 2.1 A. 1.	Manufacturer's Data Sheet for Roller	Y		2 Weeks Prior to Use		1	Repro	If used for Proof Rolling
-	02315 2.1 B. 2.	Certified Load Ticket for Tandem or Tri-axle Dump Truck	Y		2 Weeks Prior to Use		1	Repro	If used for Proof Rolling
10.2	02316 2.1 B. 1.a.	ASTM C 33 #57 Stone Sample	Y		2 Weeks Prior to Use		1	Repro	
8.0	02316 2.1 C.	Controlled Low Strength Material Mix Design	Y		2 Weeks Prior to Use		1	Repro	
11.0	02316 2.8 B.	Manufacturer's Data Sheets for Compaction Equipment	Y		2 Weeks Prior to Use		1	Repro	
	02316 2.9 A. 1.	Manufacturer's Data Sheet for Proof Roller	Y		2 Weeks Prior to Use		1	Repro	If used for Proof Rolling
-	02316 2.9 B. 2.	Certified Load Ticket for Tandem or Tri-axle Dump Truck	Y		2 Weeks Prior to Use		1	Repro	If used for Proof Rolling
11.0	02371 2.1 F.	Geotextile Manufacturer Material Specifications And Product Literature	Y		4 Weeks Prior to Use		1	Repro	
10.2	02371 2.1 G.	Geotextile Samples	Y		4 Weeks Prior to Use		1	Repro	
4.1	02371 3.3 B.	Proposed Method Of Geotextile Deployment	Y		4 Weeks Prior to Use		1	Repro	
	02373 1.7 B. 1.	Deleted							
	02373 2.1 C.	Deleted							

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			Yes	No		Init	Final		
	02373 2.5 A.	Deleted							
	02373 2.6 A.	Deleted							
	02373 3.6 A. 6.	Deleted							
11.0	02510 2.1 G.	HDPE Pipe and Fittings Catalog Information	Y		4 Weeks Prior to Use		1	Repro	
1.3	02510 2.1 H.	HDPE Pipe and Fittings Drawings	Y		4 Weeks Prior to Use		1	Repro	
	02510 2.1 I. 1.	Deleted							
28.0	02661 1.7 A. 2.	HDPE Geomembrane Manufacturer Qualifications	Y		4 Weeks Prior to Use		1	Repro	
28.0	02661 1.7 B. 2.	HDPE Geomembrane Installer Qualifications	Y		4 Weeks Prior to Use		1	Repro	
28.0	02661 1.7 C. 2.	HDPE Geomembrane Field Supervisor or Superintendent Resume and References	Y		4 Weeks Prior to Use		1	Repro	
28.0	02661 1.7 D. 2.	HDPE Geomembrane Field Crew Resumes and References	Y		4 Weeks Prior to Use		1	Repro	
28.0	02661 1.7 E.3.	Independent Quality Control Inspector Resume and References	Y		8 Weeks Prior to Installation		1	Repro	
28.0	02661 1.7 F.3.	Independent Testing Agency Qualifications	Y		8 Weeks Prior to Installation		1	Repro	
11.0	02661 2.3 H.	HDPE Geomembrane Manufacturer's Specifications, Literature For Each Geomembrane	Y		8 Weeks Prior to Installation		1	Repro	
4.0	02661 2.6 B.	HDPE Geomembrane Installation Plan	Y		8 Weeks Prior to Installation		1	Repro	
4.0	02661 2.7 B.	HDPE Geomembrane Quality Control And Inspection Plan	Y		8 Weeks Prior to Installation		1	Repro	
28.0	02667 1.7 A. 2.	Geosynthetic Clay Liner Manufacturer Qualifications	Y		4 Weeks Prior to Use		1	Repro	
28.0	02667 1.7 B. 2.	Geosynthetic Clay Liner Installer Qualifications	Y		4 Weeks Prior to Use		1	Repro	
28.0	02667 1.7 C. 2.	Geosynthetic Clay Liner Field Supervisor or Superintendent Resume and References	Y		4 Weeks Prior to Use		1	Repro	
28.0	02667 1.7 D. 2.	Geosynthetic Clay Liner Field Crew Resumes and References	Y		4 Weeks Prior to Use		1	Repro	
28.0	02667 1.7 E.3.	Independent Quality Control Inspector Resume and References	Y		8 Weeks Prior to Installation		1	Repro	

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			Yes	No		Init	Final		
11.0	02667 2.3 J.	Geosynthetic Clay Liner Manufacturer's Specifications, Literature	Y		8 Weeks Prior to Use		1	Repro	
4.0	02667 2.6 B.	Geosynthetic Clay Liner Installation Plan	Y		8 Weeks Prior to Use		1	Repro	
4.0	02667 2.7 B.	Geosynthetic Clay Liner Quality Control And Inspection Plan	Y		8 Weeks Prior to Use		1	Repro	
1.1	02667 3.9 A. 7.	Geosynthetic Clay Liner As-Built Drawing(s) Geomembrane Layout	Y		2 Weeks After Completion		1	Repro	
10.2	03100 2.1 F. 6.	Form Tie Sample	Y		2 Weeks Prior to Use		1	Repro	
1.3	03100 2.2 A.	Shop Drawings	Y		2 Weeks Prior to Use		1	Repro	
8.0	03100 2.2 A. 4.	Certification of Structural Calculations	Y		2 Weeks Prior to Use		1	Repro	
1.3	03210 2.2 E.	Reinforcing Steel Shop Drawings	Y		2 Weeks Prior to Use		1	Repro	
11.0	03210 2.2 F.	Reinforcing Steel Material Test Reports	Y		2 Weeks Prior to Use		1	Repro	
4.0	03210 2.2 G.	Reinforcing Steel Manufacturer's Fabrication and Installation Instructions	Y		2 Weeks Prior to Use		1	Repro	
-	03215 1.5 A. 1.b.	Concrete Doweling Installer's Qualifications	Y		2 Weeks Prior to Use		1	Repro	
11.0	03215 2.1 A. 9.	Concrete Doweling Adhesive Manufacturer's Catalog Product Data	Y		2 Weeks Prior to Use		1	Repro	
11.0	03215 2.1 B. 2.	Concrete Doweling Reinforcing Dowel Manufacturer's Catalog Product Data	Y		2 Weeks Prior to Use		1	Repro	
8.0	03215 2.1 C.	Concrete Doweling ICC Evaluation Service Report(s)	Y		2 Weeks Prior to Use		1	Repro	
4.1	03215 2.1 D.	Concrete Doweling Manufacturer's Instructions	Y		2 Weeks Prior to Use		1	Repro	
11.0	03230 2.1 C.	Lateral Cable Certified Material Test Report	Y		4 Weeks Prior to Use		1	Repro	
11.0	03230 2.1 D.	Lateral Cable Manufacturer's Certificate of Compliance	Y		4 Weeks Prior to Use		1	Repro	
4.1	03230 2.2 D.	Lateral Cabling Details of Sponge Rubber Sleeve	Y		4 Weeks Prior to Use		1	Repro	
11.0	03230 2.3 A.	Lateral Cabling Manufacture's Catalog Product Data	Y		4 Weeks Prior to Use		1	Repro	
4.1	03230 2.4 B.	Lateral Cabling Fabrication and Installation Instructions		N	4 Weeks Prior to Use		1	Repro	
-	03251 1.5 B. 2.	Installer's Qualifications	Y		2 Weeks Prior to Use		1	Repro	

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			Yes	No		Init	Final		
1.3	03251 2.1 A.	Shop Drawings	Y		2 Weeks Prior to Use		1	Repro	
10.2	03251 2.2 A.	Concrete Joint and Accessories Samples	Y		2 Weeks Prior to Use		1	Repro	
4.0	03251 2.3 D.	Waterstop Manufacturer's Instructions	Y		2 Weeks Prior to Use		1	Repro	
11.0	03255 2.2 A.	Product Data	Y		2 Weeks Prior to Use		1	Repro	
4.1	03255 3.1 A. 4.a.	Manufacturer's Splicing Instructions	Y		2 Weeks Prior to Use		1	Repro	
8.0	03255 3.1 A. 5.h.i.	Proposed Method for Holding Waterstop	Y		2 Weeks Prior to Use		1	Repro	
-	03300 1.5 C. 4.	Preinstallation Conference Minutes		N	2 Weeks Prior to Use		1	Repro	
4.1	03300 2.2 A. 6.	Manufacturer's Application Instructions for Bonding Agent	Y		2 Weeks Prior to Use		1	Repro	
4.1	03300 2.2 B. 4.	Manufacturer's Application Instructions for Bond Breaker		N	2 Weeks Prior to Use		1	Repro	
8.0	03300 2.3 A. 2.f.	Proportions Of Materials And Admixtures To Be Used For Type II Mix Design	Y		2 Weeks Prior to Use		1	Repro	
8.0	03300 2.3 A. 2.g.	Documentation Of Average Strength For Proposed Type II Mix Design	Y		2 Weeks Prior to Use		1	Repro	
11.0	03300 2.3 A. 2.j.	Admixtures Manufacturer's Catalog Cut Sheets And Product Data Sheets	Y		2 Weeks Prior to Use		1	Repro	
4.1	03300 3.1 J. 3.	Detailed Plan For Hot Weather Placements	Y		2 Weeks Prior to Use		1	Repro	
4.1	03300 3.1 K. 5.	Detailed Plan For Curing And Protection Of Concrete Placed And Cured In Cold Weather	Y		2 Weeks Prior to Use		1	Repro	
26.0	03300 3.12 C. 10.	Detailed Plan for Liquid Tightness Test Procedures	Y		2 Weeks Prior to Use		1	Repro	
28.0	03314 1.5 A. 3.	Statement of Qualifications for each Shotcrete Nozzleman and Gunman	Y		2 Weeks Prior to Use		1	Repro	
11.0	03314 2.3 C.	Epoxy Grout Manufacturer's Product Data	Y		2 Weeks Prior to Use		1	Repro	
11.0	03314 2.7 E. 1.	Manufacturer's Information Certifying the Insulation	Y		2 Weeks Prior to Use		1	Repro	
1.3	03314 2.7 E. 2.	Insulation Shop Drawings	Y		2 Weeks Prior to Use		1	Repro	With sample and literature
8.0	03314 2.7 E. 3.	Certified Insulation Calculations	Y		2 Weeks Prior to Use		1	Repro	

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1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. Permission to Proceed Required		5. Submittal Schedule	6. Quantity Required		7. Kind of copies	8. Remarks
			Yes	No		Init	Final		
1.0	03314 3.1 A. 1.	Design Data for Prestressing and Post-Tensioning	Y		8 Weeks Prior to Use		1	Repro	
8.0	03314 3.1 A. 2.	Design Calculations for Prestressing and Post-Tensioning	Y		8 Weeks Prior to Use		1	Repro	
4.0	03314 3.1 A. 3.	Prestressed Tank Vertical Post-Tensioning Instructions	Y		8 Weeks Prior to Use		1	Repro	With Design Calculations and Mix Design
11.0	03314 3.3 A. 1.	Proposed Grouting Equipment Information for Grouting Tendon Ducting	Y		8 Weeks Prior to Use		1	Repro	
11.0	03370 2.1 A. 3.	Curing Compound Manufacturer's Product Data		N	2 Weeks Prior to Use		1	Repro	
11.0	03370 2.1 B. 3.	Evaporation Retardant Manufacturer's Product Data	Y		2 Weeks Prior to Use		1	Repro	
4.1	03370 3.1 C.	Curing Methods Proposed for Each Type of Element	Y		2 Weeks Prior to Use		1	Repro	
11.0	03600 2.2 A. 7.	Nonshrink Grout Category I Product Data	Y		2 Weeks Prior to Use		1	Repro	
11.0	03600 2.2 B. 9.	Nonshrink Grout Category II Product Data	Y		2 Weeks Prior to Use		1	Repro	
4.1	03600 2.2 D.	Nonshrink Grout Installation Instructions	Y		2 Weeks Prior to Use		1	Repro	
11.0	03720 2.9 A.	Product Data Sheets For Each Material Supplied	Y		2 Weeks Prior to Use		1	Repro	
4.1	03720 2.9 B.	Mesh Manufacturer's Installation Instructions and Allowable Load Criteria	Y		2 Weeks Prior to Use		1	Repro	
4.1	03720 2.9 C.	Repair Mortar System - Manufacturer's Preparation and Installation Instructions	Y		2 Weeks Prior to Use		1	Repro	
26.0	03720 2.9 D.	Repair Mortar System Manufacturer's Proposed Modified Test Procedures	Y		2 Weeks Prior to Use		1	Repro	
14.0	03720 2.9 G.	Written Description of Equipment Proposed for Concrete Removal and Surface Preparation	Y		2 Weeks Prior to Use		1	Repro	
1.0	03720 3.10 B.	Drawings Indicating Results of Sounding for Hollow Areas Including Location, Size, Estimated Quantity, of Hollow-Sounding Areas for Each Repair Location	Y		2 Weeks Prior to Use		1	Repro	

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1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. Permission to Proceed Required		5. Submittal Schedule	6. Quantity Required		7. Kind of copies	8. Remarks
			Yes	No		Init	Final		
11.0	03722 2.11 A.	Product Data Sheets For Each Material Supplied	Y		2 Weeks Prior to Use		1	Repro	
4.1	03722 2.11 C.	Repair Mortar System - Manufacturer's Preparation and Installation Instructions	Y		2 Weeks Prior to Use		1	Repro	
14.0	03722 2.11 F.	Written Description of Equipment Proposed for Concrete Removal and Surface Preparation	Y		2 Weeks Prior to Use		1	Repro	
1.0	03722 3.7 B.	Drawings Indicating Results of Sounding for Hollow Areas Including Location, Size, Estimated Quantity, of Hollow-Sounding Areas for Each Repair Location	Y		2 Weeks Prior to Use		1	Repro	
11.0	03740 2.5 A.	Epoxy Adhesive Manufacturer's Product Data	Y		2 Weeks Prior to Use		1	Repro	
4.0	03740 2.5 B.	Epoxy Adhesive Manufacturer's Recommended Surface Preparation Procedures and Application Instructions	Y		2 Weeks Prior to Use		1	Repro	
11.0	03740 2.5 D.	Manufacturer's Technical Data for Metering, Mixing, and Injection Equipment	Y		2 Weeks Prior to Use		1	Repro	
4.1	03740 2.5 E.	Installation Instructions for Repairing Core Holes	Y		2 Weeks Prior to Use		1	Repro	
28.0	05050 1.7 A.	Structural Welder/Welding Operator Performance Qualifications	Y		2 Weeks Prior to Use		1	Repro	
28.0	05050 1.7 B.	Process Piping Welder/Welding Operator Performance Qualifications	Y		2 Weeks Prior to Use		1	Repro	
28.0	05050 1.7 C. 2.	Certified Welding Inspector Credentials	Y		2 Weeks Prior to Use		1	Repro	
28.0	05050 1.7 D. 1.	Testing Agency: Personnel Credentials	Y		2 Weeks Prior to Use		1	Repro	
12.0	05050 2.2 A. 3.	Shop and Field Process Sleeve / Process Piping WPS with PQR	Y		2 Weeks Prior to Use		1	Repro	
25.0	05050 2.2 A. 4.	Process Sleeve / Process Piping NDT / NDE Procedure Specifications	Y		2 Weeks Prior to Use		1	Repro	
12.0	05050 2.2 A. 5.	Shop and Field Non Process Sleeve / Process Piping Welds WPS with PQR	Y		2 Weeks Prior to Use		1	Repro	

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			Yes	No		Init	Final		
28.0	05500 1.5 B. 1.a.	Adhesive Anchor Installer Certification	Y		2 Weeks Prior to Use		1	Repro	
11.0	05500 2.3 D. 1.	Anchor Manufacturer's Product Data	Y		2 Weeks Prior to Use		1	Repro	
4.1	05500 2.3 D. 2.	Anchor Manufacturer's Installation Procedures	Y		2 Weeks Prior to Use		1	Repro	
18.0	05500 2.3 D. 3.	Current Anchor Test Data or ICC-ES Evaluation Report	Y		2 Weeks Prior to Use		1	Repro	
1.3	05500 2.11 I.	Metal Fabrication Shop Drawings	Y		2 Weeks Prior to Use		1	Repro	
11.0	05520 2.3 A.	Metal Railings Manufacturer's Product Data	Y		2 Weeks Prior to Use		1	Repro	
4.1	05520 2.3 B.	Metal Railings Manufacturer's Installation Instructions	Y		2 Weeks Prior to Use		1	Repro	
1.0	05520 2.3 C.	Metal Railing Shop Drawings	Y		2 Weeks Prior to Use		1	Repro	
11.0	05530 2.5 A.	Manufacturer's Product Data for Metal Grating, Grating Clips, Anchors, Accessories, and Other Manufactured Products Specified	Y		2 Weeks Prior to Use		1	Repro	
4.1	05530 2.5 B.	Metal Grating Detailed Installation Instructions	Y		2 Weeks Prior to Use		1	Repro	
29.0	05530 2.5 C.	Metal Grating Special Handling and Storage Requirements	Y		2 Weeks Prior to Use		1	Repro	
28.0	09850 1.5 A. 1.	CRC Manufacturer's Qualifications	Y		2 Weeks Prior to Use		1	Repro	
28.0	09850 1.5 A. 2.	CRC Applicator Qualifications	Y		2 Weeks Prior to Use		1	Repro	
11.0	09850 2.1 D.	CRC Data Sheet	Y		2 Weeks Prior to Use		1	Repro	
15.0	09850 2.1 D. 4.	System Manufacturer's Installation Instructions	Y		2 Weeks Prior to Use		1	Repro	
1.3	09850 2.1 D. 5.	Scaled Detail Drawings - CRC Application,	Y		2 Weeks Prior to Use		1	Repro	
15.0	09850 3.4 N. 2.	Treatment of Penetrations Instructions	Y		2 Weeks Prior to Use		1	Repro	
15.0	09850 3.5 B.	System Manufacturer's Specific Cleaning and Preparation Procedures	Y		2 Weeks Prior to Use		1	Repro	
11.0	09900 2.6 A.	Paint System Data Sheet (PSDS)	Y		2 Weeks Prior to Use		1	Repro	
11.0	09900 2.6 B.	Painting and Coating Product Data Sheet	Y		2 Weeks Prior to Use		1	Repro	
11.0	09900 2.6 C.	Painting and Coating Detailed Chemical and Gradation Analysis for Each Proposed Abrasive Material	Y		2 Weeks Prior to Use		1	Repro	
4.1	09900 2.6 H.	Painting and Coating Manufacturer's Written Instructions	Y		2 Weeks Prior to Use		1	Repro	

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			Yes	No		Init	Final		
	09915 2.1 E.	Deleted							
	09915 2.2 B.	Deleted							
*25.0	01400 3.6 D.	Quality Control Reports		N	Weekly		1	Repo	
*13.0	02316 2.1 A. 2.c.	Gradation Test Reports		N	2 Weeks prior to first use and during production for every 1,500 tons produced.		1	Repro	
*26.1	02316 2.4 F.	Controlled Low Strength Material (CLSM): Certified Strength Test Results		N	2 Weeks Prior to use and for every 1,500 tons produced		1	Repro	
*28.0	02371 2.1 G. 3.	Letter of Certification from Each Geotextile Manufacturer		N	4 Weeks Prior to Use		1	Repro	
*28.0	02661 2.1 A.	HDPE Geomembrane Letter of Compliance for the Materials Delivered at Project Site		N	Prior to Use		1	Repro	
*28.0	02661 2.7 C.	HDPE Geomembrane Installer's Certification of Subsurface Acceptability		N	Prior to Placement		1	Repro	
*28.0	02661 3.7 B.	HDPE Geomembrane Manufacturer's Certificate of Proper Installation		N	2 Weeks After Installation		1	Repro	
1.0	02661 3.9 A. 14.	HDPE Geomembrane As-Built Drawing(s) Geomembrane Layout		N	2 Weeks After Installation		1	Repro	
*28.0	02667 2.1 A.	GCL Letter of Compliance for the Materials Delivered at Project Site		N	Prior to Use		1	Repro	
*28.0	02667 3.7 B.	GCL Manufacturer's Certificate of Proper Installation		N	2 Weeks After Installation		1	Repro	
*28.0	03100 3.3 C.	Certificate of Proper Installation		N	2 Weeks After Installation		1	Repro	
*26.1	03210 2.3 A.	Verification of Device Threads Reports		N	2 Weeks Prior to Use		1	Repro	
*28.0	03210 3.2 E. 2.a.	ICC Evaluation Service Report		N	2 Weeks Prior to Use		1	Repro	
*25.0	03230 2.1 E. 4.c.	Galvanized Cable Inspection Report		N	Prior to Use		1	Repro	
*26.1	03230 2.1 E. 5.c.	Certified Tension Test Report		N	Prior to Use		1	Repro	
*28.0	03300 1.5 B. 1.a.ii.	Statement of Qualification for Batch Plant NRMCA Certification		N	Prior to first use		1	Repro	

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1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. Permission to Proceed Required		5. Submittal Schedule	6. Quantity Required		7. Kind of copies	8. Remarks
			Yes	No		Init	Final		
*28.0	03300 1.5 B. 2.b.	Statement of Qualification for Mix Designer		N	Prior to Use		1	Repro	
*28.0	03300 1.5 B. 3.b.	Statement of Qualification for Testing Agency		N	Prior to First Use		1	Repro	
-	03300 1.7 A. 9.	Batch Tickets for Concrete Placed		N	Include with Weekly QC Report.		1	Repro	
*28.0	03300 2.1 A. 1.b.	Certificate of Compliance for Portland Cement		N	Prior to Use		1	Repro	
*17.0	03300 2.1 A. 1.c.	Cement Chemical Analysis		N	Prior to Use		1	Repro	
*28.0	03300 2.1 A. 2.a.i.	Certificate of Compliance for Fly Ash		N	Prior to Use		1	Repro	
*17.0	03300 2.1 A. 2.a.ii.	Fly Ash Test Report		N	Prior to Use		1	Repro	
*28.0	03300 2.1 A. 2.b.i.	Certificate of Compliance for Slag Cement		N	Prior to Use		1	Repro	
*17.0	03300 2.1 A. 2.b.ii.	Slag Cement Test Report		N	Prior to Use		1	Repro	
*28.0	03300 2.1 A. 2.c.i.	Certificate of Compliance for Silica Fume		N	Prior to Use		1	Repro	
*17.0	03300 2.1 A. 2.c.ii.	Silica Fume Test Report		N	Prior to Use		1	Repro	
*17.0	03300 2.1 A. 2.d.	Supplementary Cementitious Materials Chemical Analysis		N	Prior to Use		1	Repro	
*17.4	03300 2.1 A. 3.c.	Certificate of Compliance for Aggregates		N	Prior to Use		1	Repro	
*17.4	03300 2.1 A. 4.d.	Certificate of Compliance for Admixtures		N	Prior to Use		1	Repro	
*17.4	03300 2.2 A. 5.	Certificate of Compliance for Bonding Agent		N	Prior to Use		1	Repro	
*17.4	03300 2.2 B. 3.	Certificate of Compliance for Bond Breaker		N	Prior to Use		1	Repro	
*17.4	03300 2.3 A. 2.h.	Test Reports for Type II Mix Design		N	Prior to Use		1	Repro	
*17.4	03300 2.3 A. 2.i.	Aggregate Data for Type II Mix Design		N	Prior to Use		1	Repro	
*26.1	03300 3.12 B. 9.	Aggregate Test Results		N	Prior to Use		1	Repro	
*26.1	03300 3.12 B. 10.	Production Aggregate Testing Report		N	Submit monthly by including with QC Report		1	Repro	
*26.1	03300 3.12 C. 11.	Liquid Tightness Test Results		N	Prior to Internal Coating		1	Repro	
	03300 3.12 D. 3.e	Deleted							

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1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. Permission to Proceed Required		5. Submittal Schedule	6. Quantity Required		7. Kind of copies	8. Remarks
			Yes	No		Init	Final		
*28.0	03314 1.8 B. 4.	Certificate of Successful Pre-shipment Inspection of Prestress Units		N	Prior to Use		1	Repro	
*28.0	03314 3.1 A. 5.	Manufacturer's Certificate of Compliance – Strand or Bar		N	Prior to Use		1	Repro	
*17.0	03314 3.1 A. 6.	Shotcrete Batch Tickets		N	Include with Weekly QC Report		1	Repro	
*17.4	03600 1.6 A. 2.	Test Report - Evaluation Of Nonshrink Grout		N	Prior to Use		1	Repro	
*26.1	03600 2.2 A. 3.c.	Category I ASTM C 1107 Test Report		N	Prior to Use		1	Repro	
*26.1	03600 2.2 B. 4.c.	Category II ASTM C 1107 Test Report		N	Prior to Use		1	Repro	
*28.0	03600 2.2 C.	Manufacturer's Certificate of Compliance		N	Prior to Use		1	Repro	
*28.0	03720 1.5 A. 1.c.	Statement of Qualification - Repair Applicator		N	Prior to Use		1	Repro	
*28.0	03720 1.5 A. 2.a.	Statement of Qualification - Repair Manufacturer's Representative		N	Prior to Use		1	Repro	
*28.0	03720 1.5 A. 3.a.	Current ACI Certification for Nozzleman		N	Prior to Use		1	Repro	
*28.0	03720 2.9 E.	Manufacturer's Certificate of Compliance - Repair Mortar Systems		N	2 Weeks Prior to Use		1	Repro	
*28.0	03720 2.9 F.	Manufacturer's Certificate of Compliance - Repair Mortar Systems Designed for Use on Horizontal Surfaces Exposed to Weather		N	2 Weeks Prior to Use		1	Repro	
*28.0	03722 1.5 A. 1.a.	Statement of Qualification - Repair Mortar System Applicator		N	Prior to Use		1	Repro	
*28.0	03722 1.5 A. 2.a.	Statement of Qualification - Repair Mortar System Manufacturer's Representative		N	Prior to Use		1	Repro	
*28.0	03722 2.11 B.	Manufacturer's Certificate of Compliance that Material Meets Requirements		N	Prior to Use		1	Repro	

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1. Document Category Number	2. Specification Paragraph Reference	3. Document Description	4. Permission to Proceed Required		5. Submittal Schedule	6. Quantity Required		7. Kind of copies	8. Remarks
			Yes	No		Init	Final		
*28.0	03722 2.11 D.	Manufacturer's Certificate of Compliance that Proposed Repair Mortar Systems Meet or Exceed Specified Performance Criteria		N	Prior to Use		1	Repro	
*28.0	03722 2.11 E.	Manufacturer's Certificate of Compliance that Repair Mortar Systems are Prepackaged, Shrinkage Compensated, Specially Designed for Use on Horizontal Surfaces Exposed to Weather		N	Prior to Use		1	Repro	
*28.0	03740 1.5 B.	Statement of Qualification for Site Representative		N	Prior to Use		1	Repro	
*28.0	03740 1.5 C.	Statement of Qualification for Injection pump operating technician		N	Prior to Use		1	Repro	
*28.0	03740 2.5 C.	Manufacturer's Certificate of Compliance with Certified Test Results		N	For each Batch		1	Repro	
*28.0	03740 2.5 F.	Statement of Qualification for Injection Applicator		N	Prior to Use		1	Repro	
*28.0	05500 2.11 E. 9.	Hot-Dip Galvanizing Certificate of Compliance		N	Prior to Installation		1	Repro	
	05500 2.12 B. 3.	Deleted							
*25.0	09850 3.7 C.	Field Inspection and Test Reports		N	2 Weeks After Completion		1	Repro	
*28.0	09850 3.8 C.	CRC System Manufacturer's Certificate of Proper Installation		N	2 Weeks After Completion		1	Repro	
*28.0	09900 2.6 D.	Painting and Coating Manufacturer's Certificate of Compliance		N	2 Weeks Prior to Use		1	Repro	
*28.0	09900 2.6 E.1	Painting and Coating Manufacturer's Certification Stating Factory Applied Coating System Meets or Exceeds Requirements		N	2 Weeks Prior to Use		1	Repro	
*28.0	09900 2.6 F.	Painting and Coating Manufacturer's Written Verification that Material is Suitable for the Intended Use		N	2 Weeks Prior to Use		1	Repro	

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Engineering Document Requirements Instructions

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Purpose The Engineering Document Requirements (EDR) form is prepared by the originator, establishes a basis for actions required of a Supplier and provides the schedule for the submittal of engineering documents by the Supplier.

Legend Entry

No.	Information Required
1	Document category number – see below.
2	Applicable specification number and appropriate paragraph.
3	Description corresponding to document category number.
4	Permission to proceed with fabrication or other specific processes is marked yes, if required.
5	List a milestone after award i.e., prior to fabrication, prior to test, prior to shipment, or with shipment that the listed document is to be submitted by Supplier.
6	Number of copies required for submittal.
7	Reproducible (Repro): PDF, Paper, Mylar, Vellum, etc.
8	Enter remarks when appropriate.

Document Category Number and Descriptions

- 1.0 Drawings
 - 1.1 Outline Dimensions, Services, Foundations and Mounting Details – Drawings providing external envelope, including lugs, centerline(s), location and size for electrical cable, conduit, fluid, and other service connections, isometrics and details related to foundations and mountings.
 - 1.2 Assembly Drawings – Detailed drawings indicating sufficient information to facilitate assembly of the component parts of an equipment item.
 - 1.3 Shop Detail Drawings – Drawings which provide sufficient detail to facilitate fabrication, manufacture, or installation. This includes pipe spool drawings, internal piping and wiring details, cross-section details and structural and architectural details.
 - 1.4 Wiring Diagrams – Drawings which show schematic diagram equipment, internal wiring diagrams, and interconnection wiring diagram for electrical items.
 - 1.5 Control Logic Diagrams – Drawings which show paths which input signals must follow to accomplish the required responses.
 - 1.6 Piping and Instrumentation Diagrams – Drawings which show piping system scheme and control elements.
- 2.0 Parts Lists and Costs – Sectional view with identified parts and recommended spare parts for one year's operation and specified with unit cost.
- 3.0 Complete SRS Data Sheets – Information provided by Supplier on data sheets furnished by SRS.
- 4.0 Instructions
 - 4.1 Erection/Installation – Detailed written procedures, instructions, and drawings required to erect or install material or equipment.
 - 4.2 Operations – Detailed written instructions describing how an item or system should be operated.
 - 4.3 Maintenance – Detailed written instructions required to disassemble, reassemble and maintain items or systems in an operating condition.
 - 4.4 Site Storage and Handling – Detailed written instructions, requirements and time period for lubrication, rotation, heating, lifting or other handling requirements to prevent damage or deterioration during storage and handling at jobsite. This includes shipping instruction for return.
- 5.0 Schedules: Engineering and Fabrication/Erection – Bar charts or critical path method diagram which detail the chronological sequence of activities, i.e., Engineering submittals, fabrication and shipment.
- 6.0 Quality Assurance Manual/Procedures – The document(s) which describe(s) the planned and systematic measures that are used to assure that structures, systems, and components will meet the requirements of the procurement documents.
- 7.0 Seismic Data Reports – The analytical or test report which provides information and demonstrates suitability of material, component or system in relation to the conditions imposed by the stated seismic criteria.
- 8.0 Analysis and Design Reports – The analytical data (stress, electrical loading, fluid dynamics, design verification reports, etc.) which demonstrate that an item satisfies specified requirements.
- 9.0 Acoustic Data Reports – The noise, sound and other acoustic vibration data required by the procurement documents.
- 10.0 Samples
 - 10.1 Typical Quality Verification Documents – A representative data package which will be submitted for the items furnished as required in the procurement documents.
 - 10.2 Typical Material Used – a representative example of the material to be used.
- 11.0 Material Descriptions – The technical data describing a material which a Supplier proposes to use. This usually applies to architectural items, e.g., metal siding, decking, doors, paints, coatings.
- 12.0 Welding Procedures and Qualifications – The welding procedure, specification and supporting qualification records required for welding, hard facing, overlaying, brazing and soldering.
- 13.0 Material Control Procedures – The procedures for controlling issuance, handling, storage and traceability of materials such as weld rod.
- *13.0 Material Verification Reports – Reports relative to material which confirm, substantiate or assure that an activity or condition has been implemented in conformance with code and material specifications imposed by the procurement documents.
- 14.0 Repair Procedures – The procedures for controlling materials removal and replacement by welding, brazing, etc., subsequent thermal treatments, and final acceptance inspection.
- 15.0 Cleaning and Coating Procedures – The procedures for removal of dirt, grease or other surface contamination, and preparation and application of protective coatings.
- 16.0 Heat Treatment Procedures – The procedures for controlling temperatures and time at temperature as a function of thickness, furnace atmosphere, cooling rate and methods, etc.
- *17.0 Material Property Reports
 - *17.4 Materials Certificate of Conformance – Documents which certify conformance to the requirements of the applicable material specification.
- 19.0 UT – Ultrasonic Examination Procedures – Procedures for detecting discontinuities and inclusions in materials by the use of high frequency acoustic energy.
- 20.0 RT – Radiographic Examination Procedures – Procedures for detecting discontinuities and inclusions in materials by x-ray or gamma ray expose of photographic film.
- 21.0 MT – Magnetic Particle Examination Procedures – Procedures for detecting surface or near surface discontinuities in magnetic materials by the distortion of an applied magnetic field.
- 22.0 PT – Liquid Penetrant Examination Procedures – Procedures for detecting discontinuities in materials by the application of a penetrating liquid in conjunction with suitable developing materials.
- 23.0 Eddy Current Examination Procedures – Procedures for detecting discontinuities in materials by distortion of an applied electromagnetic field.
- 24.0 Pressure Test – Hydro, Air, Leak, Bubble or Vacuum Test Procedures – Procedures for performing hydrostatic or pneumatic structural integrity and leakage tests.

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- 25.0 Inspection Procedures – Organized process followed for the purpose of determining that specified requirements (dimensions, properties, performance results, etc.) are met.
- *25.0 Inspection and Verification Reports – Documented findings resulting from an inspection.
- 26.0 Performance Test Procedures – Test performed to demonstrate that functional design and operational parameters are met.
 - 26.1 Mechanical Tests – e.g., pump performance, data, valve stroking, load, temperature rise, calibration, environmental, etc.
 - 26.2 Electrical Test – e.g., impulse, overload, continuity, voltage, temperature rise, calibration, saturation, loss, etc.
- *26.0 Performance Test and Verification Reports – Reports of Test Results
 - *26.1 Mechanical Test, e.g., pump, performance data, valve stroking, load, temperature rise, calibration, environment, etc.
- 27.0 Prototype Test Reports – Reports of a test which is performed on a standard or typical examination of equipment or item, and which is not required for each item produced in order to substantiate the acceptability of equal items. This may include tests which result in damage to the item(s) tested.
- 28.0 Personnel Qualification Procedures – Procedures for qualifying welders, inspectors and other special process personnel.
- *28.0 Certificate of Conformance – A document signed or otherwise authenticated by an authorized individual certifying the degree to which items or services meet specified requirements.
- 29.0 Supplier Shipping Preparation Procedures – Procedures used by a Supplier to prepare finished materials or equipment for shipment from its facility to the jobsite.

Quality Verification Document Requirements

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QUALITY REQUIREMENTS**SECTION 01400****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. General Quality Requirements.
- B. Site inspection and oversight requirements.

1.2 RELATED SECTIONS

- A. All Sections in this Specification

1.3 REFERENCES

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes / Standards

- 1. American Society of Mechanical Engineers (ASME)
 - a. NQA-1, 2008 / 2009
- 2. American Society for Testing and Materials (ASTM)
 - a. E 329

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. Subcontractor Quality Control (QC): The means by which Subcontractor ensures that the construction, to include that performed by sub-tier contractors and suppliers, complies with the requirements of the subcontract.

1.5 QUALITY ASSURANCE**A. Quality Program Requirements**

- 1. Perform work in the execution of this specification in accordance with an SRR approved Subcontractor's Quality Program that complies with the requirements defined in Attachment 01400-A.
 - a. The Quality Program may be documented in a single manual or may consist of individual procedures addressing the applicable elements defined in Attachment 01400-A.
- 2. Include the Subcontractor's Quality Program Manual or Procedures with the proposal.
 - a. SRR review and acceptance of the Subcontractor Quality Program Manual is required prior to award of the contract.
 - b. Subsequent revisions to the Subcontractor's Quality Program Manual shall be reviewed and accepted by SRR prior to its use in the execution of this specification.
- 3. Submit SRR Approved Subcontractor Quality Program Manual or Procedures.

- B. All work is subject to SRR quality assurance inspection and testing to ensure strict compliance with the terms of the Subcontract Documents.
 - 1. When subcontracting any portion of this contract or when procuring structures, systems, components, items and materials, the supplier is required to flow down the applicable QA program requirements to sub-tier supplier(s). SRR reserves the right, at any time, to verify that the applicable QA requirements have been correctly selected and imposed on supplier's sub-tier suppliers. Access to lower tier sub-supplier facilities will be requested through the supplier prior to access and may be performed jointly.
 - 2. The flow down of requirements encompasses verification that the sub tier supplier has been appropriately qualified for performance of activities complying with this procurement.
 - 3. The Supplier shall maintain objective evidence of the flow down of requirements to sub-tier suppliers, subsequent successful implementation of requirements, and provide such evidence to SRS upon request.
 - 4. The Supplier is furthermore responsible to flow down all commercial Terms and Conditions, including articles incorporated by reference, to all sub tier suppliers.
 - 5. This flow down is also required at all levels if the sub tier supplier to the prime supplier deems it necessary to further subcontract its parts of this SRS subcontract.
 - 6. Right of Access
 - a. SRS reserves the right to review aspects of the design, fabrication, inspection, examination and testing of the equipment to the extent necessary to ensure compliance to this specification and code requirements.
 - b. Review includes the right to access the Supplier's facilities, including sub-tier subcontractors, vendors, and suppliers, for the purpose of review, audit, surveillance, and witnessing of fabrication, inspection, examination, and testing activities.
- C. SRR quality assurance inspections and tests are for the sole benefit of SRR and do not:
 - 1. Relieve Subcontractor of responsibility for providing adequate quality control measures;
 - 2. Relieve Subcontractor of responsibility for damage to or loss of the material before acceptance;
 - 3. Constitute or imply acceptance;
 - 4. Affect the continuing rights of SRR after acceptance of the completed work.
- D. The presence or absence of a quality assurance inspector does not relieve Subcontractor from any subcontract requirement.
- E. Subcontractor Records
 - 1. Retain documents and other records generated in association with this specification during the course of the subcontract, to include but not limited to:
 - a. Subcontract documents, including this specification and associated SDDR's.
 - b. Documentation submittals.
 - c. Any document generated for this subcontract (e.g. procedures, reports, certifications, qualifications, letters, etc.) not required as a submittal (e.g. "in-process" quality assurance records).
 - 2. The records shall be accessible to SRR, upon request, during construction.
 - 3. Records pertaining to this specification shall be retained by the Subcontractor until contract closure.
 - a. Transmit all Retained Records to SRR upon contract closure.

1.6 NOTIFICATION AND COORDINATION

- A. Coordinate all SRS engineer approvals through STR.

1.7 SUBMITTALS

- A. Submit the following Engineering Documents in accordance with Section 01330 and 01400.

1. Approved Subcontractor Quality Program Manual or Procedures, 1.5 A. 3.
2. QC Manager Letter of Authority, 3.5 D. 3.b.
3. QC Representative Letters of Direction, 3.5 D. 3.c.
4. Subcontractor Quality Control Plan, 3.5 G.
5. Quality Control Reports, 3.6 D.

- B. Deleted

1.8 GENERAL REQUIREMENTS

- A. Perform inspections and tests as required by Codes and Standards and this specification.

1.9 SITE INSPECTION AND OVERSIGHT REQUIREMENTS

- A. See Section 01810.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION**3.1 GENERAL**

- A. Maintain an inspection system and perform inspections to ensure that the work conforms to the Subcontract Documents.
- B. Maintain complete inspection records and make them available at all times to SRR upon request from STR.
- C. Quality control shall consist of the following as necessary to produce an end product that complies with the Subcontract Documents:
 1. Plans,
 2. Procedures,
 3. Organization .
 4. Address all construction and demolition operations, both onsite and offsite including work by,
 - a. Sub-tier contractors,
 - b. Fabricators,
 - c. Suppliers,
 - d. Purchasing agents.
 5. Key to the proposed construction sequence.

3.2 COORDINATION MEETING

- A. After a Preconstruction Conference, but before start of construction, and prior to acceptance of the Quality Control (QC) Plan, schedule a meeting with SRR, through the STR, to discuss QC implementation.
- B. Develop a mutual understanding of the QC details including:
 1. Forms for recording;
 - a. QC operations,

- b. Control activities,
 - c. Testing,
 - d. Administration of QC for both onsite and offsite work.
2. Interrelationship of Subcontractor management and control with SRR Quality Assurance.

3.3 QUALITY CONTROL ORGANIZATION

A. QC Manager:

1. Designate an individual within Subcontractor's organization who will be responsible for overall management of QC and have the authority to act in QC matters for the Subcontractor.
2. QC Manager may not perform other duties on the project.
3. QC Manager shall be an experienced construction person, with a minimum of 5 years QC construction experience on similar type work.
4. QC Manager shall report to the Subcontractor's project manager or someone higher in the organization.
 - a. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the project.
5. QC Manager shall be onsite during construction.
 - a. Periods of absence may not exceed 2 weeks at any one time.
 - b. Identify an alternate QC Manager to serve with full authority during the Manager's absence.
 - c. Requirements for the alternate shall be the same as for designated QC Manager.

B. QC Staff:

1. Designate a QC staff, available at the Site at all times during Project, with complete authority to take any action necessary to ensure compliance with the subcontract.
 - a. QC staff members shall be subject to acceptance by SRR.
2. QC staff shall take direction from QC Manager in matters pertaining to Quality Control (QC).
3. Provide QC staff of sufficient size to ensure adequate QC coverage of work phases, work shifts, and work crews involved in the construction.
 - a. These personnel may perform other duties, but shall be fully qualified by experience and technical training to perform their assigned QC responsibilities and shall be allowed sufficient time to carry out these responsibilities.
4. The actual strength of the QC staff may vary during any specific work period to cover the needs of the project.
 - a. Add additional staff when necessary for a proper QC organization.

C. Obtain SRR acceptance before replacing any member of the QC staff.

1. Requests for changes shall include name, qualifications, duties, and responsibilities of the proposed replacement.

3.4 QUALITY CONTROL PHASING

A. QC shall include at least three phases of control to be conducted by QC Manager as follows:

1. Preparatory Phase:

- a. Notify STR at least 48 hours in advance of beginning any of the required action of the preparatory phase.

- b. This phase shall include a meeting conducted by the QC Manager and attended by the superintendent, other QC personnel (as applicable), and the foreman responsible for the definable feature.
 - i. The QC Manager shall instruct applicable QC staff as to the acceptable level of workmanship required in order to meet subcontract requirements.
 - c. Document the results of the preparatory phase meeting by separate minutes prepared by the QC Manager and attach to the QC report.
 - d. Perform prior to beginning work on each definable feature of work:
 - i. Review applicable Subcontract Specifications.
 - ii. Review applicable Subcontract Drawings.
 - iii. Verify that all materials and/or equipment have been tested, submitted, and approved.
 - iv. Verify that provisions have been made to provide required control inspection and testing.
 - v. Examine the work area to verify that all required preliminary work has been completed and is in compliance with the subcontract.
 - vi. Perform a physical examination of required materials, equipment, and sample work to verify that they are on hand, conform to approved Shop Drawing(s) or submitted data, and are properly stored.
 - vii. Review the appropriate activity hazard analysis to verify safety requirements are met.
 - viii. Review procedures for constructing the work, including repetitive deficiencies.
 - ix. Document construction tolerances and workmanship standards for that phase of the work.
 - x. Verify that the plan for the work to be performed, if so required, has been accepted by SRR.
2. Initial Phase:
- a. Accomplish at the beginning of a definable feature of work:
 - i. Notify STR at least 48 hours in advance of beginning the initial phase.
 - b. Perform prior to beginning work on each definable feature of work:
 - i. Review minutes of the preparatory meeting.
 - ii. Check preliminary work to verify compliance with subcontract requirements.
 - iii. Verify required control inspection and testing.
 - iv. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards.
Comparison with sample panels is appropriate.
 - v. Resolve all differences.
 - vi. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis.
 - vii. Review the activity analysis with each worker.
 - c. Separate minutes of this phase shall be prepared by the QC Manager and attached to the QC report.
 - i. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
 - d. Repeat the initial phase for each new crew to work onsite, or any time acceptable specified quality standards are not being met.
3. Follow-up Phase:
- a. Perform daily checks to verify continuing compliance with subcontract requirements, including control testing, until completion of the particular feature of work.

- b. Daily checks shall be made a matter of record in the QC documentation and shall document specific results of inspections for all features of work for the day or shift.
 - c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of work that will be affected by the deficient work.
 - i. Constructing upon or concealing nonconforming work is unacceptable.
 - 4. Additional Preparatory and Initial Phases:
 - a. Additional preparatory and initial phases shall be conducted on the same definable features of work as determined by SRR when;
 - i. The quality of ongoing work is unacceptable,
 - ii. There are changes in the QC staff,
 - iii. There are changes in the onsite production supervision or work crew,
 - iv. Work on a definable feature is resumed after a substantial period of inactivity,
 - v. Other problems develop.
- B. Three-phase quality control procedures shall be implemented for the following features of work:
 - 1. Initial Mobilization,
 - 2. Site Survey and Layout,
 - 3. Subgrade Preparation,
 - 4. Mudmat Construction,
 - 5. Geosynthetic Clay Liner Installation,
 - 6. HDPE Geomembrane Installation,
 - 7. Deleted,
 - 8. Tank Foundation Slab Formwork and Reinforcing Placement,
 - 9. Foundation Slab Concrete Placement,
 - 10. Tank Core Wall Base Joint Installation, Including Lateral Cables, Bearing Pads, and Waterstops,
 - 11. Tank Core Wall Construction,
 - 12. Tank Column and Footing Construction,
 - 13. Core Wall Vertical Post-tensioning and Upper Slab Connections,
 - 14. Tank Upper Slab Formwork and Reinforcing Placement,
 - 15. Upper Slab Embedments and Concrete Placement,
 - 16. Tank Horizontal Prestressing and Shotcrete Placement,
 - 17. Tank Insulation Installation,
 - 18. Tank Liquid Tightness Testing,
 - 19. Internal Coating
 - 20. Tank Backfill,
 - 21. Stair Tower Foundation Construction,
 - 22. Steel Stair Erection and Railing Installation,
 - 23. Deleted
 - 24. Demobilization.

3.5 QUALITY CONTROL PLAN

- A. Plan shall identify;
 - 1. Personnel,
 - 2. Procedures,

3. Control,
 4. Instructions,
 5. Inspections,
 - a. Include Subcontractor scope and SRR Special Inspection / Observation activities.
 6. Testing,
 - a. Include Subcontractor scope and SRR Special Inspection / Observation activities.
 7. Records,
 8. Forms and Reports to be used.
- B. Construction will be permitted to begin only after acceptance of the QC Plan applicable to the particular feature of work to be started.
- C. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a QC Plan containing the additional features of work to be started.
- D. Plan shall cover the intended QC organization for the entire subcontract and include the following, as a minimum:
1. Organization: Description of the quality control organization, including a chart showing lines of authority and acknowledgment that the QC staff will implement the three-phase control (see Paragraph Quality Control Phasing) for all aspects of the work specified.
 2. QC Staff: The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function.
 3. Letters of Authority: A copy of a letter to the QC Manager signed by an authorized official of the firm, describing the responsibilities and delegating sufficient authorities to adequately perform the functions of the QC Manager, including authority to stop work which is not in compliance with the subcontract.
 - a. The QC Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities.
 - b. Submit a copy of the QC Manager Letter of Authority.
 - c. Submit a copy of each QC Representative Letter of Direction.
 4. Submittals: Procedures for scheduling, reviewing, certifying, and managing submittals, including those of sub-tier contractors, offsite fabricators, suppliers and purchasing agents.
 5. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.
 6. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests, including documentation.
 7. Procedures for tracking deficiencies from identification through acceptable corrective action.
 - a. These procedures will establish verification that identified deficiencies have been corrected.
 8. Reporting procedures, including proposed reporting formats; include a copy of the QC report form.
- E. Acceptance of Plans: SRR Acceptance of the Subcontractor's basic and addendum QC plans is required prior to the start of construction.
1. Acceptance is conditional and will be predicated on satisfactory performance during the construction.

2. SRR reserves the right to require changes in the QC plan and operations including removal of personnel, as necessary, to obtain the quality specified.
- F. Notification of Changes: After acceptance of the QC plan, Subcontractor shall notify STR, in writing, a minimum of 7 calendar days prior to any proposed change.
 1. Proposed changes are subject to acceptance by SRR.
- G. Submit Subcontractor Quality Control Plan.

3.6 QUALITY CONTROL REPORT

- A. As a minimum, prepare a QC report for every 7 calendar days.
 1. Account for all days throughout the life of the subcontract.
 2. Reports shall be signed and dated by QC Manager.
 3. Include copies of test reports and copies of reports prepared by QC staff.
- B. Maintain current records of quality control operations, activities, and tests performed, including the work of sub-tier contractors and suppliers.
- C. Records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections with comparison of results to acceptance criterion / criteria, daily activities, tests, and other items, including but not limited to the following:
 1. Subcontractor / sub-tier contractor and their areas of responsibility.
 2. Operating plant/equipment with hours worked, idle, or down for repair.
 3. Work performed today, giving location, description, and by whom.
 - a. When a network schedule is used, identify each phase of work performed each day by activity number.
 4. Test and/or control activities performed with comparison of results to acceptance criterion / criteria and references to specifications/plan requirements.
 - a. Identify the control phase (Preparatory, Initial, Follow-up).
 - b. List deficiencies noted along with corrective action.
 5. Material received with statement as to its acceptability and storage.
 6. Identify submittals reviewed, with subcontract reference, by whom, and action taken.
 7. Offsite surveillance activities, including actions taken.
 8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
 9. List instructions given/received and conflicts in Drawings and/or Specifications.
 10. Indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered.
 11. These records shall cover both conforming and deficient features and shall include a statement as to whether or not equipment and materials incorporated in field work and workmanship comply with the subcontract.
- D. Submit Quality Control Reports weekly.

3.7 SUBMITTAL QUALITY CONTROL

- A. Submittals shall be as specified in Section 01330.
 1. The QC organization shall be responsible for certifying that all submittals are in compliance with the subcontract requirements.

3.8 TESTING QUALITY CONTROL

A. Testing Procedure:

1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to subcontract requirements.
2. Procure services of a licensed testing laboratory.
 - a. Refer to Section 01450 for Testing Laboratory qualifications and requirements.
3. Perform the following activities and record the following data:
 - a. Verify testing procedures comply with subcontract requirements.
 - b. Verify facilities and testing equipment are available and comply with testing standards.
 - c. Check test instrument calibration data against certified standards.
 - d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
 - e. Documentation:
 - i. Record results of all tests taken, both passing and failing, on the QC report for the date taken.
 - ii. Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.
 - iii. Actual test reports may be submitted later, if approved by STR, with a reference to the test number and date taken.
 - iv. Provide directly to STR an information copy of tests performed by an offsite or commercial test facility.
 - v. Test results shall be signed by an engineer registered in the state where the tests are performed.

3.9 COMPLETION INSPECTION

A. QC Manager shall conduct an inspection of the work at the completion of all work or any milestone established by a completion time stated in the subcontract.

B. Punchlist:

1. QC Manager shall develop a punchlist of items which do not conform to the subcontract requirements.
2. Include punchlist in the QC report, indicating the estimated date by which the deficiencies will be corrected.
3. QC Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify SRR.
4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

3.10 ATTACHMENTS

A. 01400-A: Supplier Quality Assurance Program Requirements

END OF SECTION

Supplier Quality Assurance Program Requirements

Attachment No. 01400-A
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Note to the CTF/CQF:

Level 1 - Procurements require verification of the supplier's quality program through the performance of an evaluation or audit that compares against the national or international consensus standard designated in Section A.

Level 2 - Procurements that invoke a supplier quality assurance program, may apply the same consensus standard verification process as designated in Section A, otherwise designate evaluation methods in Section C. (Ref. 1Q, 7-2q; 1Q, 18-3q; and 3E, 1.1)

Section A

National Consensus Standards for Supplier Quality Program Requirements are identified, but not limited, to the ones below:

- ☒ ASME/NQA -1 Part 1 - Nuclear Quality Assurance Program Requirements (Pages 2-4 must be completed)
- ☐ ISO 17025 (Calibration/Testing Standard)
- ☐ NQA-1, Part II
- ☐ ASME Section VIII Division I (Appendix 10)
- ☒ Other For Testing Laboratory Services, provide Quality Program as required by ASTM E 329, Section 8.
- ☒ Other See Section B of this Form.
- ☒ Other SRR will perform an Audit of the Quality Assurance Program prior to award.

Section B

Clarifications/Exceptions (as needed)

Other Equivalent Quality Program(s) that meet the requirements on Attachment 01400-A, Pages 12-14, are acceptable with SRR approval.

Section C

For Level 2 procurements, methods of evaluating supplier's quality assurance program are:

1. The supplier will provide a copy of their Quality Assurance Manual for an adequacy/concurrence review, and
2. One or more of the boxes marked below will also be applied.

- ☒ Performance of an audit as defined in Section A
- ☒ Document submittals identified on EDR document (e.g., process procedures, welder qualifications, etc.)
- ☐ Submittal of current applicable ASME certificate
- ☐ Supplier surveillance activities
- ☐ Receiving Inspection
- ☐ Other _____
- ☐ Other _____

Supplier Quality Assurance Program Requirements Additional Details

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<p><input checked="" type="checkbox"/> Requirement 1 – Organization</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 100 Basic <input checked="" type="checkbox"/> 200 Structure And Responsibility <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 201 General <input checked="" type="checkbox"/> 202 Delegation Of Work <input checked="" type="checkbox"/> 300 Interface Control <p><input checked="" type="checkbox"/> Requirement 2 – Quality Assurance Program</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 100 Basic <input checked="" type="checkbox"/> 200 Indoctrination And Training <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 201 Indoctrination <input checked="" type="checkbox"/> 202 Training <input checked="" type="checkbox"/> 300 Qualification Requirements <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 301 NDE <input checked="" type="checkbox"/> 302 Inspection And Test <input type="checkbox"/> 303 Lead Auditor <input type="checkbox"/> 304 Auditors <input checked="" type="checkbox"/> 400 Certification Of Qualification <input checked="" type="checkbox"/> 500 Records <p><input checked="" type="checkbox"/> Requirement 3 – Design Control</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 100 Basic <input checked="" type="checkbox"/> 200 Design Input <input checked="" type="checkbox"/> 300 Design Process <input checked="" type="checkbox"/> 400 Design Analyses <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 401 Use Of Computer Programs <input checked="" type="checkbox"/> 402 Documentation of Design Analysis <input checked="" type="checkbox"/> 500 Design Verification <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 501 Methods <input checked="" type="checkbox"/> 600 Change Control <ul style="list-style-type: none"> <input type="checkbox"/> 601 Configuration Management of Operating Facilities <input checked="" type="checkbox"/> 700 Interface Control <input type="checkbox"/> 800 Software Design Control <ul style="list-style-type: none"> <input type="checkbox"/> 801 Software Design Process <input type="checkbox"/> 802 Software Configuration Mgmt <input checked="" type="checkbox"/> 900 Documentation And Records <p><input checked="" type="checkbox"/> Requirement 4 – Procurement Document Control</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 100 Basic <input checked="" type="checkbox"/> 200 Content Of The Procurement Documents <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 201 Scope Of Work <input checked="" type="checkbox"/> 202 Technical Requirements <input checked="" type="checkbox"/> 203 QA Program Requirements <input checked="" type="checkbox"/> 204 Right Of Access <input checked="" type="checkbox"/> 205 Documentation Requirements <input checked="" type="checkbox"/> 206 Nonconformances <input checked="" type="checkbox"/> 207 Spare And Replacement Parts <input checked="" type="checkbox"/> 300 Procurement Document Review <input checked="" type="checkbox"/> 400 Procurement Document Changes <p><input checked="" type="checkbox"/> Requirement 5 – Instructions, Procedures, and Drawings</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 100 Basic <p><input checked="" type="checkbox"/> Requirement 6 – Document Control</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 100 Basic <input checked="" type="checkbox"/> 200 Document Control <input checked="" type="checkbox"/> 300 Document Changes <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 301 Major Changes <input checked="" type="checkbox"/> 302 Minor Changes 	<p>NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).</p> <p>Indoctrination and training as defined in each section of the specification.</p> <p>QC inspection Personnel and NDE personnel shall meet the requirements of section 300, 400 and 500</p> <p>NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).</p> <p>NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).</p> <p>Flow down of technical and quality requirements including required submittals to subtier supplies will be documented.</p> <p>NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).</p> <p>NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).</p>
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☒ **Requirement 7 - Control of Purchased Items and Services**

- ☒ 100 Basic
- ☒ 200 Supplier Evaluation And Selection
- ☒ 300 Bid Evaluation
- ☒ 400 Control Of Supplier Generated Documents
- ☒ 500 Acceptance Of Item Or Service
 - ☒ 501 General
 - ☒ 502 Methods Of Acceptance
 - ☒ 503 Certificate Of Conformance
 - ☒ 504 Source Verification
 - ☒ 505 Receiving Inspection
 - ☒ 506 Postinstallation Testing
 - ☒ 507 Acceptance Of Services Only
- ☒ 600 Control Of Supplier Nonconformances
- ☐ 700 Commercial Grade Items

☒ **Requirement 8 – Identification And Control Of Items**

- ☒ 100 Basic
- ☒ 200 Identification Methods
 - ☒ 201 Item Identification
 - ☒ 202 Physical Identification
- ☒ 300 Specific Requirements
 - ☒ 301 Identification And Traceability of Items
 - ☒ 302 Limited Life Items
 - ☒ 303 Maintaining Identification of Stored Items

☒ **Requirement 9 – Control Of Special Processes**

- ☒ 100 Basic
- ☒ 200 Process Control
 - ☒ 201 Special Processes
 - ☒ 202 Acceptance Criteria
 - ☒ 203 Special Requirements
- ☒ 300 Responsibility
- ☒ 400 Records

☒ **Requirement 10 – Inspection**

- ☒ 100 Basic
- ☒ 200 Inspection Requirements
- ☒ 300 Inspection Hold Points
- ☒ 400 Inspection Planning
 - ☒ 401 Planning
 - ☒ 402 Sampling
- ☒ 500 In-Process Inspection
- ☒ 600 Final Inspections
 - ☒ 601 Resolution Of Nonconformances
 - ☒ 602 Inspection Requirements
 - ☒ 603 Modifications, Repairs, or Replacements
- ☒ 700 Records

☒ **Requirement 11 – Test Control**

- ☒ 100 Basic
- ☒ 200 Test Requirements
- ☒ 300 Test Procedures (Other than for Computer Programs)
- ☐ 400 Computer Program Test Procedures
- ☒ 500 Test Results
- ☒ 600 Test Records

NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).

All Items will at a minimum have Receipt Inspection as the method of acceptance to include the attributes identified in Paragraph 505 and Suspect Counterfeit Items.

NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).

NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).

NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).

NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).

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<p><input checked="" type="checkbox"/> Requirement 12 – Control Of Measuring & Test Equipment</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 100 Basic <input checked="" type="checkbox"/> 200 Selection <input checked="" type="checkbox"/> 300 Calibration And Control <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 301 Calibration <input checked="" type="checkbox"/> 302 Control <input checked="" type="checkbox"/> 303 Commercial Devices <input checked="" type="checkbox"/> 400 Records <p><input checked="" type="checkbox"/> Requirement 13 – Handling, Storage, And Shipping</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 100 Basic <input checked="" type="checkbox"/> 200 Special Requirements <input checked="" type="checkbox"/> 300 Procedures <input checked="" type="checkbox"/> 400 Tools And Equipment <input type="checkbox"/> 500 Operators <input checked="" type="checkbox"/> 600 Marking Or Labeling <p><input checked="" type="checkbox"/> Requirement 14 – Inspection, Test, & Operating Status</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 100 Basic <p><input checked="" type="checkbox"/> Requirement 15 – Control Of Nonconforming Items</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 100 Basic <input checked="" type="checkbox"/> 200 Identification <input checked="" type="checkbox"/> 300 Segregation <input checked="" type="checkbox"/> 400 Disposition <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 401 Control <input checked="" type="checkbox"/> 402 Responsibility And Authority <input checked="" type="checkbox"/> 403 Personnel <input checked="" type="checkbox"/> 404 Disposition <input checked="" type="checkbox"/> 405 Reexamination <p><input checked="" type="checkbox"/> Requirement 16 – Corrective Action</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 100 Basic <p><input checked="" type="checkbox"/> Requirement 17 – Quality Assurance Records</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 100 Basic <input checked="" type="checkbox"/> 200 Generation Of Records <input checked="" type="checkbox"/> 300 Authentication Of Records <input checked="" type="checkbox"/> 400 Classification <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 401 Lifetime Records <input checked="" type="checkbox"/> 402 Nonpermanent Records <input type="checkbox"/> 500 Receipt Control And Retention Of Records <input type="checkbox"/> 600 Storage <input type="checkbox"/> 700 Disposition <input type="checkbox"/> 800 Maintenance Of Records 	<p>NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).</p> <p>NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).</p> <p>NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).</p> <p>NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).</p> <p>NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).</p> <p>NQA-1 Program or equivalent Quality standard as approved by SRR (Audit).</p> <p>Reference Basis document for Justification SRR-SDU-2012-00031</p>
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The following attachment pages define the flow down requirements, as they are required for each applicable section of the CSI specification. The attachment pages identify the flow down by specification section as they pertain to the installer and/or service provider as well as the procurement of materials used to construct the Tank.

Supplier Quality Assurance Program Requirements Flow Down Details

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Section	Title	Execution Provider Flow Down	Product Flow Down
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Division 1 - General Requirements

01004	Index Of Documents and Drawings		
01100	Summary Of Work		
01250	Change Procedures	A	
01320	Site Surveys	A	B
01330	Submittal Procedures Attachment 01330-A: Engineering Document Requirements Attachment 01330-B: Deleted	A	
01400	Quality Requirements Attachment 01400-A: Supplier Quality Assurance Program Requirements	A	
01450	Inspection and Testing Laboratory Services	C	
01600	Common Product Requirements		B
01640	Manufacturers' Field Services	A	
01810	Special Inspection Observation and Testing	A	

Division 2 - Site Work

02240	Errorsion and Sediment Control	A	B
02315	Excavation	A	B
02316	Fill And Backfill	A	B
02371	Geotextile	A	B
02373	Deleted		
02510	High-Density Polyethylene Pipe And Fittings	A	B
02661	High-Density Polyethelene Geomembrane	A	B
02667	Geosynthetic Clay Liner	A	B

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Section	Title	Execution Provider Flow Down	Product Flow Down
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Division 3 - Concrete

03100	Concrete Forming and Accessories	A	B
03210	Reinforcing Steel	A	B
03215	Concrete Doweling	A	B
03230	Lateral Cabling	A	B
03251	Concrete Joints and Accessories	A	B
03255	Concrete Wall Base and Top Joints	A	B
03300	Cast-in-Place Concrete	D	B
03314	Prestressed Tank Vertical Post-Tensioning	A	B
03370	Concrete Curing	A	B
03600	Nonshrink Grout	A	B
03720	Repair of Vertical and Overhead Concrete Surfaces	A	B
03722	Repair of Horizontal Concrete Surfaces	A	B
03740	Crack Repair Epoxy Injection Grouting	A	B

Division 5 - Metals

05050	Welding and NDE	A	B
05500	Metal Fabrications	A	B
05520	Metal Railings	A	B
05530	Metal Gratings	A	B

Division 9 - Finishes

09850	Chemical-Resistant Coatings (Optional)	A	B
09900	Painting and Coating	A	B
09915	Roof Coatings	A	B

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Legend - Required Quality Program and Specification Requirements

A	Sections identified with "A" requires the flow down of the QA Program as defined on Attachment 01400-A and this Specification requirements
B	Sections identified with "B" only require the flow down of this Specification requirements
C	Sections identified with "C" only require the flow down of this Specification requirements and compliance to E 329
D	Sections identified with "D" only require the flow down of this Specification requirements and compliance to NRMCA or approved equivalent program

NOTE: All materials received for permanent installation on the SDU 6 Tank shall be Receipt Inspected (RI) and the RI documented.

INSPECTION AND TESTING LABORATORY SERVICES**SECTION 01450****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Subcontractor Inspection and Testing Laboratory services.

1.2 RELATED SECTIONS

- A. All Sections in this Specification.

1.3 REFERENCES

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes / Standards**1. American Society for Testing and Materials (ASTM)**

- a. D 3740, Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- b. E 329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

- B. Conform to specified Codes / Standards requirements for testing of construction materials.

1.5 NOTIFICATION AND COORDINATION

- A. Notify the STR at least 48 hours prior to expected time for testing operations unless specified otherwise.

1.6 SUBMITTALS

- A. Submit the following Engineering Documents in accordance with Section 01330 and 01400.

- 1. Inspection and Testing Laboratory Business Information, 1.10 A.

- B. Deleted

1.7 LABORATORY PERFORMANCE REQUIREMENTS

- A. Provide Inspection and Testing Laboratory services from a firm authorized to operate in the State of South Carolina.
- B. Perform testing in accordance with the requirements specified in the individual sections and Drawings.
- C. Perform specified inspection, sampling, and testing of products in accordance with referenced codes, standards, and the requirements of this specification.

- D. Ascertain compliance of physical and chemical properties of materials in accordance with the requirements of the Subcontract Documents.
- E. Notify STR of observed irregularities or nonconformance of work or materials.
- F. Utilize testing equipment calibrated at intervals with devices traceable to either the National Institute of Standards and Technology (NIST) or accepted values of natural physical constants.
 - 1. As a minimum, calibrate equipment annually under normal use or semi-annually under heavy or dynamic use.
 - 2. Recalibrate or replace equipment in which the standard operating range has been exceeded, damaging physical or electrical conditions have occurred, or otherwise exposed to abnormal operating conditions.
 - 3. Display calibration sticker or certificate on equipment.
- G. Subcontractor shall process a Supplier Deviation Disposition Request (SDDR) immediately, in accordance with Section 01250, upon notification by the Inspection / Testing Laboratory of out of calibration equipment used to perform inspections and testing of the equipment and material used.

1.8 QUALIFICATIONS

- A. Staff:
 - 1. Maintain technical staff for review services experienced in the designated discipline.
 - 2. Technical staff shall have a minimum of five years experience on similar projects.
- B. Laboratory facilities, equipment, and personnel utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329 with accreditation by one or more of the following;
 - 1. American Association of Laboratory Accreditation (AALA),
 - 2. National Institute of Standards and Technology (NIST),
 - 3. National Voluntary Laboratory Accreditation Program (NVLAP),
 - 4. American Association of State Highway and Transportation Officials (AASHTO),
 - 5. Other SRR approved national accreditation authority.
- C. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

1.9 REPORTS

- A. After performance of an inspection or test, include laboratory test report in the QC Report, Section 01400.
- B. As a minimum, include the following information on each report:
 - 1. Date issued,
 - 2. SRR Project Title and Purchase Order Number,
 - 3. Name and signature of on-site inspection / sampling / testing personnel,
 - 4. Acceptability when acceptance criteria have been specified,
 - 5. Date and time of on-site inspection, sampling, or test,
 - 6. Identification of Specification number, section and paragraph,
 - 7. Inspection, sample or test location on the project work site,
 - 8. Type of inspection or test,

9. Any deviation from the test method or procedure specified, including technical justification of the deviation and how it meets or exceeds the original requirement,
10. Name and signature of laboratory inspector or test technician,
11. Measurement and date of laboratory test or inspection,
12. Result of laboratory inspection or test,
13. Observations, sketches, drawings, plots, etc. as required by test standards,
14. Standards used, including the date / revision designation,
15. Each criterion tested,
16. Specific acceptance criteria for each criterion tested,
17. Specific result of test for each criterion,
18. Identification and serial number of test apparatus used,
19. Certification of conformance with subcontract documents,
20. Name and Signature of individual checking / reviewing the inspection / test results.

1.10 RESPONSIBILITY

- A. Submit Inspection and Testing Laboratory Business Information including:
 1. Inspection / Testing Laboratory name, address, telephone number, and names of laboratory technicians and technical staff assigned to the Project and the responsible officer.
 - a. Include personnel resumes, qualifications, and certifications.
 2. Documentation of inspection made by a qualified national authority during the most recent tour of inspection with memorandums of deficiencies reported during the inspection tour and the corrective actions taken to resolve the deficiencies.
 3. Current accreditation document(s) received from the nationally recognized accreditation organization(s).
 4. Independent Inspection / Testing Laboratory Quality Assurance program details.
 5. Documentation of laboratory's authorization to operate in State in which the laboratory facilities are located.
 6. Current list of testing equipment and associated components with calibration documents for the two (2) most recent calibrations.
- B. Update business information for any changes in personnel.
- C. Employment of inspection and testing laboratory shall in no way relieve Subcontractor of any obligation to perform work in accordance with requirements of the Subcontract documents.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

COMMON PRODUCT REQUIREMENTS**SECTION 01600****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Products
- B. Substitutions
- C. Handling, shipping, and storage

1.2 RELATED SECTIONS

- A. All Sections in this Specification

1.3 REFERENCES

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

- A. Required Codes / Standards
 - 1. International Code Council (ICC)
 - a. IBC
- B. Regulations
 - 1. None Specified in this Section
- C. Documents
 - 1. None Specified in this Section
- D. Drawings
 - 1. None Specified in this Section

1.4 DEFINITIONS

- A. Products:
 - 1. New items for incorporation in the work, whether purchased by Subcontractor or SRR for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
 - 2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Subcontract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
 - 3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the subcontract award.
 - 4. Reference in this specification to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition of "or-equal" products.
- B. Substitutions
 - 1. Process Supplier Deviation Disposition Requests for the substitution of specified products in accordance with Section 01250 – Change Procedures.
 - 2. A substitution request represents that the Subcontractor has determined the proposed substitution:
 - a. Provides the same function as the specified product.

- b. Meets or exceeds the quality level of the specified product.
 - c. Provides the same or better warranty as the specified product.
 - i. Does not result in additional time extensions or additional costs to the project.
- 3. Provide documentation with the SDDR; such as product data, test reports, etc. including above representations; in support of substitution request.
 - a. Substitutions without formal substitution approval are unacceptable.

C. See Section 01100 for additional definitions.

1.5 QUALITY ASSURANCE

A. See Section 01400 for general requirements.

1.6 NOTIFICATION AND COORDINATION

A. Coordinate all SRS engineer approvals through STR.

1.7 SUBMITTALS

A. Submit the following Engineering documents in accordance with Section 01330 and 01400.

- 1. None Specified in this Section

B. Deleted

1.8 DELIVERY, STORAGE AND HANDLING

- A. Handle, store, and protect products in accordance with manufacturer's instructions, this Article, and any specific requirements identified in the individual Technical Sections.
- B. Require finished components and assemblies to be wrapped and / or crated at the factory to prevent damage or marring of surfaces during shipping and handling.
- C. Receive products in manufacturer's original containers, with seals and labels intact.
 - 1. The STR may reject as non-complying, any materials or products which do not bear product identification satisfactory to the STR as to manufacturer, grade, quality, or any additional product information required for product verification.
- D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- E. Provide equipment and personnel to handle products and store by methods to prevent soiling, discoloration, staining, disfigurement, or damage.
 - 1. Use of damaged items is unacceptable.
- F. Storage - General:
 - 1. Arrange storage of products to permit access for inspection.
 - 2. Periodically inspect to ensure products are not damaged and are maintained under specified conditions.
 - 3. Promptly remove damaged material and unsuitable items from the job site and replace with material meeting the specified requirements.
 - 4. Place on sloped supports.
 - 5. Above ground.
 - 6. Ensure drainage.
 - 7. Prevent entrance of debris.
 - 8. Cover products subject to deterioration or exposure to water vapor with impervious sheet covering.

9. Provide additional protection for materials sensitive to UV deterioration in accordance with manufacturer's instructions.
 10. Provide ventilation to prevent condensation and product degradation.
 11. Provide environments as recommended by the manufacturer.
 12. Stack pre-formed and pre-finished material to prevent twisting, bending, or abrasion per manufacturer's instructions.
 13. Neatly stack sheet materials lying flat to prevent sagging or damage to edges, ends, and surfaces.
 - a. All materials shall be stacked in such a manner as to allow safe management and maintenance of storage requirements and safe removal for use.
 - b. Where manufacturer's recommendations are available for stacking configurations (i.e., dunnage spacing, maximum safe stacking heights, etc.) they shall be utilized.
 14. Protect against dirt, water, chemical, mechanical damage, and construction traffic.
 15. Provide additional or specific storage requirements as required in technical specifications.
- G. See Section 01600 for general requirements.

1.9 DESIGN REQUIREMENTS

- A. Where Subcontractor, lower tier and specialty subcontractor or supplier design is specified or required, design of installation, systems, equipment, and components, including supports, anchorage and bracing, shall be in accordance with provisions of the ICC IBC.
1. See "General Structural Notes" sheet on Drawings for Subcontractor, lower tier and specialty subcontractors and supplier design criteria requirements for loadings including wind, seismic, soil properties, groundwater table, deflection, settlement, and related design parameters.
 - a. Project design criteria stated on the "General Structural Notes" sheet on Drawings shall control over baseline code and reference code criteria as well as less stringent load and load combinations contained elsewhere in the Subcontract Documents.
 2. Provide design for components and their anchorage as required by other specification sections for all code required load combinations that are applicable for the loads to the component.
 3. Provide design for temporary construction loads applied by Subcontractor's operation that will effect capacity requirements of structural and other systems.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 320 feet above sea level.
- B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of 0 to 110 degrees F.

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.
- B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.

- C. Manufacture, Supplier, and Product Data are representative of required level of quality or performance. Material or equipment proposed by Subcontractor that is functionally equal to named items and sufficiently similar so that no change in related work will be required may be submitted as an "or-equal" product.
 - 1. Alternate systems or components that will require evaluation and may change related work may be proposed as a Substitution.
- D. Like items of products furnished and installed in the work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.
- E. Do not use materials and equipment removed from existing premises, except as specifically permitted by Subcontract Documents.
- F. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.
- G. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.
- H. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.
- I. Equipment Finish:
 - 1. Provide manufacturer's standard finish and color, except where specific color is indicated.
 - 2. If manufacturer has no standard color, provide equipment with gray finish as approved by STR.
- J. Special Tools and Accessories: Furnish to SRR, upon acceptance of equipment, all accessories required to place each item of equipment in full operation.
 - 1. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), special tools, and other spare parts as required for maintenance.

2.2 FABRICATION AND MANUFACTURE

- A. General:
 - 1. Manufacture parts to U.S.A. standard sizes and gauges.
 - 2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
 - 3. Modify standard products as necessary to meet performance Specifications. upon SRR approval via an SDDR.

2.3 SOURCE QUALITY CONTROL

- A. Where Specifications call for testing to be witnessed by SRR, notify STR not less than 28 days prior to scheduled test date, unless noted or specified otherwise.
- B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).
- C. Factory Tests: Perform in accordance with SRR accepted test procedures and document successful completion.

PART 3 EXECUTION

3.1 INSPECTION

- A. Inspect materials and installation equipment for signs of pitting, rust decay, or other deleterious effects of storage.
 - 1. Do not install material showing such effects.
 - 2. Remove damaged material or installation equipment from the Site and expedite delivery of identical new material or installation equipment.

3.2 INSTALLATION

- A. Repaint painted surfaces that are damaged prior to equipment acceptance.
 - 1. Paint system shall be the same as the original, as directed by the manufacturer, or as approved by SRR.
- B. Do not cut or notch any structural member or surface without specific approval of STR.
- C. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified.
 - 1. Retain a copy of manufacturers' instruction at Site, available for review at all times.
- D. For material and equipment specifically indicated or specified to be reused in the work:
 - 1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed work.
 - 2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation

3.3 FIELD FINISHING

- A. In accordance with Section 09900 and individual specification sections.

END OF SECTION

MANUFACTURER'S FIELD SERVICES**SECTION 01640****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. References
- B. Definitions
- C. Submittals
- D. Qualification Of Manufacturer's Representative

1.2 RELATED SECTIONS

- A. All Sections in this Specification

1.3 REFERENCES

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

- A. Required Codes / Standards
 - 1. None Specified in this Section
- B. Regulations
 - 1. None Specified in this Section
- C. Documents
 - 1. None Specified in this Section
- D. Drawings
 - 1. None Specified in this Section

1.4 DEFINITIONS

- A. Quality Control (QC): The means by which Subcontractor ensures that the construction, to include that performed by sub-tier contractors and suppliers, complies with the requirements of the subcontract.
- B. See Section 01100.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 NOTIFICATION AND COORDINATION

- A. Coordinate all SRR approvals through STR.

1.7 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. None Specified in this Section
- B. Deleted

1.8 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

- A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective product, equipment, subsystem, or system, with full authority by the manufacturer to issue the certifications required of the manufacturer.
 - 1. Additional qualifications may be specified in the individual specification sections.

- B. Representatives are subject to acceptance by SRR.
 - 1. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Furnish manufacturers' services, when required by an individual specification section, to meet the requirements of this section.
- B. Where time is necessary in excess of that stated in the specifications for manufacturers' services, or when a minimum time is not specified, time required to perform specified services shall be considered incidental.
- C. Schedule manufacturer' services to avoid conflict with other onsite testing and inspection or other manufacturers' onsite services.
- D. Determine, before scheduling services, that conditions necessary to allow successful testing have been met.
- E. Only those days of service approved by STR will be credited to fulfill specified minimum services.
- F. When specified in individual specification sections, manufacturer's onsite services shall include:
 - 1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Subcontractor's assembly, erection, installation or application procedures.
 - 2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
 - 3. Providing, on a daily basis, copies of manufacturers' representative's field notes and data to STR.
 - 4. Revisiting the Site as required to correct problems and until installation is acceptable to STR.
 - 5. Resolution of assembly or installation problems attributable to or associated with respective manufacturer's products and systems.
 - 6. Assistance during functional and performance testing.

3.2 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

- A. When so specified, a Manufacturer's Certificate of Compliance, Attachment 01640-A, shall be completed in full, signed by entity supplying the product, material, or service, and submitted prior to shipment of product or material or execution of the services.
- B. SRR may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
- C. Such form shall certify proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.
- D. May reflect recent or previous test results on material or product, if acceptable to SRR.

3.3 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

- A. When so specified, a Manufacturer's Certificate of Proper Installation form, Attachment 01640-A, shall be completed and signed by product or equipment manufacturer's representative.
- B. Such form shall certify signing party is a duly authorized representative of manufacturer, is empowered by manufacturer to inspect, approve, and operate installation equipment and is authorized to make recommendations required to ensure product is complete and is properly installed to perform required purpose.

3.4 TRAINING

- A. General:
 - 1. Furnish manufacturers' representatives for hands-on training on installation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
 - 2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with SRR, and familiar with installation and maintenance information.
 - 3. Furnish complete training materials to be retained by each trainee.
- B. Training Schedule:
 - 1. List specified product and systems that require training services and show:
 - a. Respective manufacturer.
 - b. Estimated training dates.
 - c. Estimated dates for installation completion.
 - 2. Allow for multiple sessions when several shifts are involved.
- C. Adjust schedule to ensure training of appropriate personnel to allow full participation by manufacturers' representatives.
 - 1. Post-startup Training: If required in Specifications, furnish and coordinate

3.5 ATTACHMENTS

- A. Manufacturer's Certificate of Compliance Form.
- B. Manufacturer's Certificate of Proper Installation Form.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

Attachment No. 01640-A
Revision No. 3
Spec/Req'n No. C-SPP-Z-00008
Page 4 of 5

PROJECT NAME: SRR SDU6

PROJECT NO.: _____

PRODUCT, MATERIAL, OR SERVICE SUBMITTED: _____

Comments: _____

I hereby certify that the above-referenced product, material, or service called for by the subcontract for the named Project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the Contract requirements, and are in the quantity shown.

Date of Execution: _____, 20____

Manufacturer: _____

Manufacturer's Authorized Representative (*print*): _____

(Authorized Signature)

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

Attachment No. 01640-B
Revision No. 3
Spec/Req'n No. C-SPP-Z-00008
Page 5 of 5

PROJECT: SRR SDU6 EQPT SERIAL NO: _____

EQPT TAG NO: _____ EQPT/SYSTEM: _____

PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- ☐ Trained Subcontractor's personnel
- ☐ Installed in accordance with Manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants or adhesives.
- ☐ Electrical and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ Functional tests.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments: _____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate their equipment and (iii) authorized to make recommendations required to ensure equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20____

Manufacturer: _____

By Manufacturer's Authorized Representative: _____

(Authorized Signature)

SPECIAL INSPECTION, OBSERVATION, AND TESTING**SECTION 01810****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. References
- B. Definitions
- C. Submittals
- D. Summary
- E. Statement Of Special Inspections (Plan) Requirements

1.2 RELATED SECTIONS

- A. All Sections in this Specification

1.3 REFERENCES

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

- A. Required Codes / Standards
 - 1. International Code Council (ICC)
 - a. IBC
- B. Regulations
 - 1. None Specified in this Section
- C. Documents
 - 1. None Specified in this Section
- D. Drawings
 - 1. None Specified in this Section

1.4 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. Subcontractor's Statement of Responsibility Form(s), 1.10 F. 1.
- B. Deleted

1.5 DEFINITIONS

- A. Agencies and Personnel:
 - 1. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.
 - 2. Registered Design Professional in Responsible Charge: An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the Project is to be constructed.
 - 3. Special Inspector: Qualified person employed by SRR who will demonstrate competence to the satisfaction of SRR for inspection of a particular type of construction or operation requiring Special Inspection.
 - 4. Professional Observer: SRR Registered design professional or designee providing professional observation of the work for general conformance to the approved construction documents.

5. Building Official: The designated authority charged with the administration and enforcement of the International Building Code requirements, or a duly authorized representative, SRR will act as the Building Official as designated by DOE.
- B. Special Inspection:
 1. Special Inspection: Inspection required of materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved Contract Documents and referenced standards.
 2. Special Inspection, Continuous: Full-time observation of work requiring Special Inspection by an approved Special Inspector who is present in the area where the Work is being performed.
 3. Special Inspection, Periodic: Part-time or intermittent observation of work requiring Special Inspection by an approved Special Inspector who is present in the area where the Work has been or is being performed, and at the completion of the Work.
- C. Structural Systems and Components:
 1. Diaphragm: Component of structural lateral load resisting system consisting of roof, floor, or other membrane or bracing system acting to transfer lateral forces to vertical resisting elements of structure.
 2. Drag Strut or Collector: Component of structural lateral load resisting system consisting of a diaphragm or shear wall element that collects and transfers diaphragm shear forces to vertical force-resisting elements or distributes forces within diaphragm or shear wall.
 3. Seismic-Force-Resisting System: That part of structural lateral load resisting system that has been considered in the design to provide required resistance to seismic forces identified on Drawings.
 4. Shear Wall: Component of structural lateral load resisting system consisting of a wall designed to resist lateral forces parallel to the plane of the wall. Unless noted otherwise on Drawings, load-bearing walls with direct in-plane connections to roof and floors shall be considered to be shear walls.
 5. Wind Force Resisting System: That part of the structural system that has been considered in the design to provide required resistance to wind forces identified on Drawings.
- D. Professional Observation:
 1. Does not include or waive responsibility for required Special Inspection or inspections by SRR.
 2. Requirements are indicated on Statement of Special Inspections (Plan) provided on Drawings.
 3. Geotechnical Observation: Visual observation of selected subgrade bearing surfaces by a registered design professional for general conformance to Contract Documents.
 - a. Geotechnical observations will be provided by SRR.
 4. Structural Observation: Visual observation of structural system(s) by a registered design professional for general conformance to Subcontract Documents.
 - a. Structural observations will be performed by SRR.
 5. Statement of Special Inspections (Plan): Detailed written procedure contained on Drawings establishing systems and components subject to Special Inspection, Observation, and Testing during construction, type and frequency of testing, extent and duration of Special Inspection, and reports to be completed and distributed by Special Inspector.
- E. See Section 01100 for additional definitions.

1.6 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.7 NOTIFICATION AND COORDINATION

- A. Coordinate all SRR approvals through STR.

1.8 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330.
 - 1. Subcontractor's Statement of Responsibility Form(s), 1.10 F. 1.
- B. Submit the following Quality Verification documents in accordance with Sections 01330 and 01400:
 - 1. None Specified in this Section

1.9 SUMMARY

- A. This section covers requirements for Special Inspection, Observation, and Testing required in accordance with Chapter 17 of the 2009 International Building Code and is performed by SRR.

1.10 STATEMENT OF SPECIAL INSPECTIONS (PLAN) REQUIREMENTS

- A. Designated Systems for Inspection:
 - 1. Seismic-force-resisting systems designated under ICC IBC Section 1705 and subject to Special Inspection under Section 1707:
 - a. See Drawings for basic lateral load resisting systems for each structure and other designated seismic systems.
 - 2. Wind-force-resisting systems designated under ICC IBC Section 1705: None required.
 - 3. Architectural, Mechanical, and Electrical Components subject to Special Inspection and testing under ICC IBC Section 1707 for Seismic Resistance: None required.
- B. Statement of Special Inspections (Plan):
 - 1. As included in Drawings and in support of the building permit application, the Project specific plan was prepared by the registered design professional in responsible charge.
 - 2. The following identifies elements of the inspection, observation, and testing program to be followed in construction of the work:
 - a. Designated seismic systems and main seismic force resisting systems and components that are subject to Special Inspection and Structural Observation for lateral load resistance.
 - b. Special Inspection and testing required by ICC IBC Section 1704 and Section 1708, and other applicable sections and referenced standards therein.
 - c. Type and frequency of Special Inspection required.
 - d. Type and frequency of testing required.
 - e. Required frequency and distribution of testing and Special Inspection reports to be distributed by Special Inspector to STR, Subcontractor, and SRR.
 - f. Geotechnical Observation to be Performed: Required frequency and distribution of Geotechnical Observation reports by registered design professional to Subcontractor, STR, and SRR.
 - g. Structural Observations to be Performed: Required frequency and distribution of Structural Observation reports by registered design professional to Subcontractor, Special Inspector, STR, and SRR.

- C. Special Inspection and associated testing of shop fabrication and field construction will be performed by an approved accredited independent agency.
 - 1. SRR will secure the services of the agency to perform Special Inspection and associated testing.
- D. The code required Special Inspection with associated testing and Professional Observation, as provided in Statement of Special Inspections (Plan) on Drawings and further provided in this Section, does not:
 - 1. Relieve Subcontractor of responsibility for providing adequate quality control measures.
 - 2. Relieve Subcontractor of responsibility for damage to or loss of material before acceptance.
 - 3. Constitute or imply acceptance.
 - 4. Affect continuing rights of SRR after acceptance of completed Work.
- E. The presence or absence of code required Special Inspector and Professional Observer does not relieve Subcontractor from subcontract requirements.
- F. Subcontractor's Statement of Responsibility: Form, Attachment 01810-A, shall be completed by each subcontractor responsible for construction of a main seismic-force-resisting system or seismic-resisting component listed in Statement of Special Inspections (Plan).
 - 1. Submit Subcontractor's Statement of Responsibility Form(s).

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 GENERAL

- A. Provide access to shop or Site for Special Inspection and Testing and Professional Observation.
- B. Notify STR in advance of required Special Inspection and Professional Observation no later than 72 hours prior to date of Special Inspection and Professional Observation.
- C. Materials and systems, inclusive, shall be inspected during placement where Continuous Special Inspection is required.
- D. Materials and systems shall be inspected during or at completion of their placement where Periodic Special Inspection is allowed.
 - 1. Periodic Special Inspection shall be performed so that Work inspected after, but not during, its placement can be corrected prior to other related work proceeding and covering inspected work.
 - 2. Periodic Special Inspection does not allow sampling of a portion of the work. All work shall be inspected.

3.2 ATTACHMENT

- A. Subcontractor's Statement of Responsibility.

END OF SECTION

SUBCONTRACTOR'S STATEMENT OF RESPONSIBILITY

Attachment No. 01810-A
Revision No. 3
Spec/Req'n No. C-SPP-Z-00008
Page 5 of 5

(Project)

(Name of Contracting Company)

(Business Address)

(_____) (_____) _____
(Telephone) (Fax)

I, (We) hereby certify that I am (we are) aware of the Special Inspection and Testing and Professional Observation requirements contained in Contract Documents for this Project for seismic force-resisting systems as listed in Statement of Special Inspections (Plan) on Drawings, and that:

1. I, (We) are responsible for implementation of the Statement of Special Inspections (Plan) for the construction of the following systems:

Facility	Lateral Force-Resisting System
Saltstone Disposal Unit 6 (SDU 6)	Flat-bottom, Ground-supported, Prestressed Concrete Tank with Flexible Anchored Base
SDU 6 Stair Tower	Ordinary Steel Concentrically Braced Frames

2. Control of this Work will be exercised to obtain conformance with the Contract Documents approved by the building official.
3. Procedures to be used for exercising control of the Work, the method and frequency of reporting, and distribution of reports required under the Statement of Special Inspections (Plan) for this Project are attached.
4. I, (We) will provide 72-hour notification to STR and approved agency as required for structural tests and Special Inspection for this Project.
5. The following person is hereby identified as exercising control over the requirements of this section for the Work designated above:

Name: _____

Qualifications: _____

(Print name and official title of person signing this form)

Signed by: _____

Date: _____

Project Name: _____

EROSION AND SEDIMENT CONTROL
SECTION 02240

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Erosion and sediment control measures.
- B. Regulatory requirements.

1.2 RELATED SECTIONS

- A. Division 1 – All Sections

1.3 REFERENCE

- A. Required National Codes and Standards

- 1. International Code Council (ICC)
 - a. IBC

- B. Regulations

- 1. SC R.72-300
- 2. SCR 100000

- C. Documents

- 1. C-ESR-Z-00006

- D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. SWPPP, Stormwater Pollution Prevention Plan.
- B. NPDES, National Pollutant Discharge Elimination System.
- C. See Section 01100 for additional definitions.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 NOTIFICATION AND COORDINATION

- A. Coordinate all SRR approvals through STR.

1.7 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.

- 1. Product Data for Liquid Soil Stabilizer, 2.1 B. 2.
- 2. Erosion and Sediment Control Stormwater Co-Permittee Agreement, 3.1 F. 3.

- B. Deleted

1.8 DELIVERY, STORAGE AND HANDLING

- A. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 EROSION AND SEDIMENT CONTROL PRODUCTS

- A. As shown on the Drawings.

B. Liquid Soil Stabilizer

1. Refer to the Subcontract Drawings for product specifications.
2. Submit Product Data for Liquid Soil Stabilizer.

PART 3 EXECUTION

3.1 REGULATORY REQUIREMENTS

- A. The work to be performed under this Specification is covered under an existing Grading Permit and associated Stormwater Pollution Prevention Plan (SWPPP).
 1. Comply with the requirements of the SWPPP related to the Work associated with the subcontract.
 2. A copy of the approved SWPPP (C-ESR-Z-00006) is provided in the Subcontract Special Provisions.
- B. Manage storm water and implement erosion and sediment control measures in compliance with SCDHEC SC R.72-300 and NPDES SCR 100000.
- C. Implement necessary measures for the duration of construction to control erosion and to avoid silting of streams, wetlands, and impoundments.
- D. Maintain temporary control measures required for stabilization of the areas disturbed by the performance of the work as defined in this subcontract.
- E. As construction activities progress, relocate and/or provide additional temporary measures to account for variable and changing contours and drainage and to maintain control of erosion and sedimentation.
- F. Sign the copy of the Stormwater Co-Permittee Agreement for the NPDES SCR 100000 permit to acknowledge and accept the Subcontractor's responsibilities for compliance with the stormwater management and erosion and sediment control requirements.
 1. Prior to the start of any land disturbing activities.
 2. Obtain the signature of all sub tier subcontractors that will be performing land disturbing activities on the Co-Permittee Agreement.
 3. Submit a signed copy of the Erosion and Sediment Control Stormwater Co-Permittee Agreement.
- G. Maintain a copy of all permits at the construction site at all times.
- H. Refer to the Drawings for additional regulatory requirements.

3.2 SEQUENCE OF CONSTRUCTION

- A. Perform land disturbing activities in a manner that minimizes the amount of area disturbed at one time as much as possible.
 1. Refer to the SWPPP and the Drawings (Section 01100, 1.3 E.) for additional information.
- B. Maintain a dry work site.
 1. Do not allow standing water.

3.3 MAINTENANCE

- A. Unless otherwise specified on the Drawings, perform maintenance as follows;
 1. Maintain temporary erosion and sedimentation control devices until permanent erosion control measures are placed and accepted.

2. When temporary devices deteriorate such that their effectiveness is reduced, or when the natural contours and drainage runoff are altered by construction activities, install additional devices (silt fencing, check dams, seeding, etc.) to maintain necessary control of erosion and sedimentation.

3.4 INSPECTION / EXAMINATION / TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR Special Inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.
 1. Inspections will be conducted by the SRR Representative in the presence of (and in cooperation with) the Subcontractor's Field Superintendent as follows:
 - a. Inspect erosion and sediment control measures (new and existing) to determine condition and verify effectiveness once every 7 calendar days and following a storm event of 0.5 inches or greater during a 24 hour period.
 - i. Inspections after rain events shall be performed within 48 hours of the end of the rain event or before the next predicted rain event, whichever is less.
 - b. Inspect disturbed areas and areas used for storage of materials and/or equipment that are exposed to precipitation for evidence of, or the potential for, pollutants entering the stormwater drainage system or contaminating the environment.
 - c. Subcontractor shall correct deficiencies identified by these inspections within 48 hours of the inspection unless otherwise approved by the SRS engineer.
 2. Inspections will be documented on the SWPPP Inspection form provided by the SRR Inspector.
 - a. The inspection forms will address conditions/effectiveness of existing measures, installation, and/or removal of measures, maintenance activities needed or performed since last inspection, and other deficiencies as required.
 - b. Inspection forms will be signed by the inspector.
 - i. The inspector will contact the professional engineer assigned to this project for guidance in implementing the requirements of the SWPPP and signing all inspection forms as the "Delegated Authority", if the inspector is different from the Professional Engineer.
 - ii. Completed inspection forms shall be signed by the "Delegated Authority" at least monthly.
 - c. Completed inspection forms will be maintained at the SRR Construction Field office by the STR. Copies of these forms will be provided to the Subcontractor.

END OF SECTION

EXCAVATION
SECTION 02315

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 02316

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

- A. Required Codes and Standard
 - 1. International Code Council (ICC)
 - a. IBC
- B. Regulations
 - 1. None Specified in this Section
- C. Documents
 - 1. None Specified in this Section
- D. Drawings
 - 1. None Specified in this Section

1.4 DEFINITIONS

- A. Over Excavation: Removal of in-situ materials beyond the limits required by the Specification or as shown and not authorized in writing by SRR.
- B. Excavation Support: Install and maintain as necessary to support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed work.
- C. See Section 01100 for additional definitions.

1.5 QUALITY ASSURANCE

- A. Weather Limitations
 - 1. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.
 - 2. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.
- B. See Section 01400 for general requirements.

1.6 NOTIFICATION AND COORDINATION

- A. Coordinate all SRS engineer approvals through STR.

1.7 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. Manufacturer's Data Sheet for Roller, 2.1 A. 1.
 - 2. Certified Load Ticket for Tandem or Tri-axle Dump Truck, 2.1 B. 2.
- B. Deleted

1.8 DELIVERY, STORAGE AND HANDLING

- A. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 PROOF ROLLING EQUIPMENT

- A. Roller with operating mass of not less than 20 tons, or equivalent.
 - 1. Submit Manufacturer's Data Sheet for Roller.
- B. Pre-approved equivalent is a tandem or tri-axle dump truck loaded to a minimum total weight of 40,000 pounds.
 - 1. Total weight shall be tare weight of the empty truck plus cargo load (stone, rock, dirt, etc.).
 - 2. Submit a Certified Load Ticket for Tandem or Tri-axle Dump Truck.

PART 3 EXECUTION

3.1 GENERAL

- A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish work.
 - 1. Excavate to within tolerance of plus or minus 0.1 foot, except where dimensions or grades are shown or specified as maximum or minimum.
 - 2. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable.
 - 3. Trim to neat lines where concrete is to be deposited against earth.
- B. Do not over-excavate without written authorization of SRR.
- C. Maintain a smooth grade and provide positive drainage at all times.
- D. Remove or protect obstructions.
- E. Over excavation is not allowed, except for removal of unsuitable subgrade materials, as approved by SRR.

3.2 UNCLASSIFIED EXCAVATION

- A. Excavation is unclassified.
 - 1. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

3.3 TRENCH WIDTH

- A. Minimum Width of Trenches:
 - 1. Single Pipes: 18 inches.
 - 2. Increase trench widths by thicknesses of sheeting.
- B. Maximum Trench Width: Unlimited, unless noted otherwise, or unless excess width will cause damage to existing facilities, adjacent property, or completed work.

3.4 EMBANKMENT AND CUT SLOPES

- A. Shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections, with proper allowance for topsoil or slope protection.
 - 1. Remove stones and rock that exceed 3 inch diameter and that are loose and may roll down slope.
 - 2. Remove exposed roots from cut slopes.
- B. Round tops of cut slopes in soil to not less than a 6 foot radius, provided such rounding does not extend offsite or outside easements and rights-of-way, or adversely impact existing facilities, adjacent property, or completed work.

3.5 PROOF-ROLLING

- A. After completion of excavation and prior to placing specified materials on subgrade, notify STR and SRR Registered Design Professional Geotechnical Representative to observe the proof-rolling of subgrade surface.
- B. Proof-roll subgrade under tank and stair foundations prior to placement of structural fill, mud mats, or foundations to detect soft or loose subgrade or unsuitable material.
- C. For subgrade beneath structures, the Special Inspector and SRR Registered Design Professional Geotechnical Representative shall observe proof-rolling of subgrade.
- D. Proof roll with specified equipment, making a minimum of five passes, two in each of two directions at right angles.
- E. For areas not accessible to proof rolling, SRR Registered Design Professional Geotechnical Representative will observe subgrade surface to detect soft or loose subgrade or unsuitable material.

3.6 STOCKPILING EXCAVATED MATERIAL

- A. Stockpile excavated material that is suitable for use as fill or backfill in designated areas.
 - 1. Suitable materials shall meet the requirements for structural fill or Common Fill as specified in Section 02316 and shall be approved by STR.
- B. Stockpile excavated materials in areas as approved by STR.
- C. Do not intermix organic or deleterious materials with stockpiled materials intended for use.
- D. Stockpile excavated material in lifts by dumping.
 - 1. Spread and compact material.
- E. Prepare stockpiles with stable slopes and neat appearance.
 - 1. Grade stockpiles to prevent erosion and facilitate runoff.
 - 2. Install spray or matted seeding over unused stockpile areas during construction period.
- F. Confine stockpiles to within easements, rights-of-way, and approved work areas.
 - 1. Do not obstruct roads or streets.
- G. Do not stockpile excavated material adjacent to trenches and other excavations, unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads and location is approved by STR.
- H. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed work, if weight of stockpiled material could induce excessive settlement.

3.7 INSPECTION, EXAMINATION, TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

FILL AND BACKFILL

SECTION 02316

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fill
- B. Backfill

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Deleted
- C. Section 02315
- D. Section 02371
- E. Deleted
- F. Deleted
- G. Section 02661
- H. Section 02667
- I. Section 03300

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standard

1. American Society for Testing and Materials (ASTM)

- a. C 33/C 33M
- b. C 150/C 150M
- c. C 618
- d. D 75 /D 75 M
- e. D 422
- f. D 1557
- g. D 2487
- h. D 4318
- i. D 4832
- j. D 882
- k. D 1709
- l. D4218
- m. D 6938
- n. E 96/E 96M
- o. E 1745
- p. F 1249

2. International Code Council (ICC)

- a. IBC

- B. Regulations
 - 1. None Specified in this Section
- C. Documents
 - 1. None Specified in this Section
- D. Drawings
 - 1. None Specified in this Section

1.4 DEFINITIONS

- A. Bedding Material: Granular material upon which pipes, conduits, cables, or duct banks are placed.
- B. Borrow Material: Common Fill and Structural Fill Material from required excavations or from designated borrow areas on or near Site.
- C. Completed Course: A course or layer that is ready for next layer or next phase of work.
- D. Embankment Material: Fill materials required to raise existing grade in areas other than under structures.
- E. Geosynthetics: Geotextiles, geosynthetic clay liner (GCL) or geomembranes.
- F. Imported Material: Materials obtained from sources offsite, suitable for specified use.
- G. Influence Area: Area within planes sloped downward and outward at 60 degree angle from horizontal measured from:
 - 1. 1 foot outside outermost edge at base of foundations or slabs.
 - 2. 1 foot outside outermost edge at surface of roadways or shoulder.
 - 3. 0.5 foot outside exterior at spring line of pipes or culverts.
- H. Lift: Loose (uncompacted) layer of material.
- I. Optimum Moisture Content:
 - 1. Determined in accordance with ASTM D 1557 specified to determine maximum dry density for relative compaction.
 - 2. Determine field moisture content on basis of fraction passing $\frac{3}{4}$ inch sieve.
- J. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.
- K. Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable or duct bank.
- L. Prepared Trench Bottom: Graded trench bottom after excavation and installation of stabilization material, if required, but before installation of bedding material.
- M. Relative Compaction:
 - 1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D 1557.
 - 2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by STR.
- N. Well-Graded:
 - 1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.

2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
3. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

O. See Section 01100 for additional definitions.

1.5 QUALITY ASSURANCE

A. See Section 01400 for general requirements.

1.6 SEQUENCING AND SCHEDULING

- A. Complete applicable work specified in Section 02315 prior to placing fill or backfill.
- B. Backfill against concrete structures only after concrete has attained compressive strength, specified in Section 03300.
 1. Obtain STR's acceptance of concrete work and attained strength prior to placing backfill.
- C. Backfill around structures only after completion of satisfactory liquid tightness tests as specified in Section 03300.
 1. Obtain STR approval for initiation of backfill work.

1.7 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 1. Gradation Test Reports, 2.1 A. 2.c.
 2. ASTM C 33 #57 Stone Sample, 2.1 B. 1.a.
 3. Controlled Low Strength Material Mix Design, 2.1 C.
 4. Controlled Low Strength Material (CLSM): Certified Strength Test Results, 2.4 F.
 5. Manufacturer's Data Sheets for Compaction Equipment, 2.8 B.
 6. Manufacturer's Data Sheet for Proof Roller, 2.9 A. 1.
 7. Certified Load Ticket for Tandem or Tri-axle Dump Truck, 2.9 B. 2.
- B. Deleted

1.8 DELIVERY, STORAGE AND HANDLING

A. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

- A. Gradation Tests:
 1. As necessary to locate acceptable sources of imported material.
 2. During production of imported material, test as follows:
 - a. ASTM C 33/C 33M #57 Stone: 1,500 tons produced for Project.
 - b. Deleted
 - c. Submit Gradation Test Reports 2 weeks prior to use and during production for every 1,500 tons produced.

- B. Samples: Collected in accordance with ASTM D 75 /D 75 M :
1. During production of imported material, Submit Samples as follows:
 - a. ASTM C 33 #57 Stone Sample:
 - i. Collect at source before bringing to site.
 - ii. Minimum one.
 - b. Deleted
 - c. Samples shall be representative and be clearly mark to show material source, intended use, and respective specified material.
 2. SRR has right to enter facility to take samples at source.
- C. Submit Controlled Low Strength Material Mix Design.

2.2 COMMON FILL AND STRUCTURAL FILL

- A. Excavated material from segregated stockpiles that meets Common Fill and Structural Fill requirements.
1. Material shall be native Z Area soils.
- B. Well-graded sand (SW) or silty sand (SM) as defined by ASTM D 2487.
- C. Free from brush, weeds, sticks, roots, peat, sod, loam, other organic material, ice, snow, frozen soil, trash, litter, refuse or any deleterious or objectionable material.
- D. Free from rocks greater than 2 inches in diameter and greater than ½ inch at the exposed surface.
- E. For Structural Fill use plasticity index less than 15 percent as determined by ASTM D 4318.
- F. Gradation as determined in accordance with ASTM D 422 :

COMMON FILL

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
3/4 inch	100
3/8 inch	95 to 100
No. 4	85 to 100
No. 10	75 to 100
No. 20	50 to 100
No. 40	25 to 95
No. 60	15 to 80
No. 140	2 to 30
No. 200	0 to 25

STRUCTURAL FILL

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
3/8 inch	100
No. 4	95 to 100
No. 10	85 to 100
No. 20	70 to 95
No. 40	35 to 85
No. 60	15 to 70
No. 140	2 to 20
No. 200	0 to 15

2.3 ASTM C 33 #57 STONE

- A. Conform to the requirements of ASTM C 33.

2.4 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

- A. Select and proportion ingredients to obtain compressive strength between 50 psi and 150 psi at 28 days in accordance with ASTM D 4832.
- B. Materials:
 - 1. Cement: ASTM C 150/C 150M, Type I or Type II.
 - 2. Aggregate: ASTM C 33/C 33M, Size 7.
 - 3. Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C 618, except as modified herein:
 - a. ASTM C 618, Table 1, Loss on Ignition: Unless approved by STR, maximum 3 percent.
 - 4. Water: Clean, potable, containing less than 500 ppm of chlorides.
- C. Proportion CLSM to be flowable, nonsegregating, self-consolidating, low shrink slurry.
 - 1. Water content shall be 60 - 66 gallons per cubic yard unless authorized by the STR.
- D. Minimum Unit Weight: 95 pounds per cubic foot.
 - 1. Obtain Density Test in accordance With ASTM D 6938.
- E. As a construction option, CLSM may be used in lieu of Common Fill or Structural Fill.
- F. Submit Controlled Low Strength Material (CLSM): Certified Strength Test Results.
 - 1. Include material types and weight per cubic yard for each component of mix.

2.5 CONCRETE FOR MUD MAT

- A. As specified for Type II concrete mix design in Section 03300.

2.6 DELETED

2.7 NONWOVEN GEOTEXTILE

- A. As specified in Section 02371.

2.8 COMPACTION EQUIPMENT

- A. Vibratory Rollers:
 - 1. Vibratory rollers shall be equipped with smooth steel compaction drum.
 - 2. Vibratory rollers may be either towed or self-propelled and shall exert a minimum dynamic force of 16,000 pounds per impact and operate at a frequency of at least 1,000 vibrations per minute.
 - 3. Limit roller speed to no more than 1-1/2 miles per hour.
- B. Submit Manufacturer's Data Sheets for Compaction Equipment.

2.9 PROOF ROLLING EQUIPMENT

- A. Roller with operating mass of not less than 20 tons, or equivalent.
 - 1. Submit Manufacturer's Data Sheet for Proof Roller.
- B. Pre-approved equivalent is a tandem or tri-axle dump truck loaded to a minimum total weight of 40,000 pounds.
 - 1. Total weight shall be tare weight of the empty truck plus cargo load (stone, rock, dirt, etc.).
 - 2. Submit a Certified Load Ticket for Tandem or Tri-axle Dump Truck.

2.10 WATER FOR MOISTURE CONDITIONING

- A. Free of hazardous or toxic contaminants, or contaminants deleterious to proper compaction.

2.11 POLY SHEETING

- A. Meet or exceed ASTM E 1745, Class A, with the following properties:
 - 1. Water Vapor Permeance: 0.03 perm maximum when tested in accordance with ASTM E 96/E96M or ASTM F 1249.
 - 2. Tensile Strength: 45-foot-pounds per inch minimum, when tested in accordance with ASTM D 882.
 - 3. Puncture Resistance: 2,200 grams minimum, when tested in accordance with ASTM D 1709.
 - 4. Thickness: 10 mils minimum, in accordance with ACI 302.
- B. Fasteners, Tape, Adhesive, or Sealant: As recommended by vapor retarder manufacturer.
- C. Manufacturers and Products:
 - 1. Fortifiber Building Systems Group; Moistop Ultra 10.
 - 2. Reef Industries, Inc.; Griffolyn 10 mil Green.
 - 3. Stego Industries, LLC; Stego Wrap Class A Vapor Retarder.
 - 4. Or approved equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.
- B. Notify STR when:
 - 1. Tank is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
 - 2. Fill material appears to be deviating from Specifications.
- C. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts.
 - 1. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.
- D. During filling and backfilling, keep level of fill and backfill around each structure even.
- E. Do not place fill or backfill, if fill or backfill material that does not meet weather limitations as specified in Section 02315 or if surface upon which fill or backfill is to be placed does not meet weather limitations as specified in Section 02315.
- F. Deleted
- G. Tolerances:
 - 1. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown in the subcontract drawings or specified otherwise.
 - 2. Grade to establish and maintain slopes and drainage as shown in the subcontract drawings.
 - a. Reverse slopes are not permitted.

- H. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

3.2 SETTLEMENT MONITORING

- A. Settlement monitoring shall be in accordance with Section 01320.
- B. Deleted
- C. Provide access for SRR to measure movement of each mud mat marker, settlement marker, and brass survey marker.

3.3 LEAKAGE DETECTION SYSTEM DURING WRAPPING

- A. Deleted
- B. Bottom Mud Mat:
1. Construct bottom mud mat on approved subgrade to the lines and grades as shown in the subcontract drawings.
 - a. Proof Roll
 - i. Remove unsuitable soils and replace with compacted Structural Fill material per section in lifts no greater than 8 inches.
 - b. Pour mud mat in sections using one continuous pour.
 - c. No joints or reinforcing steel required.
 2. Install one HDPE embedment at location shown in the subcontract drawings and in accordance with manufacturer's recommendation.
 - a. Two HDPE embedments in thickened mud mat are optional, example lining connection types and location.
 - b. Provide equivalent connection types and locations in final design as required to install HDPE geomembrane.
 3. Install HDPE Leakage Detection Sump at locations shown in the subcontract drawings.
 - a. Deleted
 - b. Deleted
- C. Install Geosynthetic Clay Liner (GCL) as shown in the subcontract drawings and specified in Section 02667.
- D. Install HDPE Geomembrane as shown in the subcontract drawings and specified in Section 02661.
- E. Upper Mud Mat: Construct upper mud mat on HDPE geomembrane as shown in the subcontract drawings.
1. Pour concrete for upper mud mat while maintaining tension over the completed HDPE Geomembrane surface.
 - a. Tensioning is optional provided that the placement requirements per Section 02661 are met.
 2. Place mud mat at night (or during the coolest part of the day) to minimize thermal effects on the HDPE Geomembrane.
 3. Deleted
 4. No joints or reinforcing steel required.

- F. Place Common Fill adjacent to bottom mud mat as shown in the subcontract drawings.
 - 1. Place in lifts not exceeding 8 inches in un-compacted thickness.
 - 2. Compact each lift to 90% of the maximum density as determined in accordance with ASTM D 1557.
- G. Install poly sheeting as shown in the subcontract drawings and in accordance with manufacturer's instructions.
 - 1. After base for upper mud mat has been leveled and tamped, apply poly sheeting with roll width parallel to direction of concrete pour.
 - 2. **Overlap** joints 6 inches and seal with tape.
 - 3. Repair damaged areas with patches of poly sheeting, overlapping damaged area by 6 inches and sealing sides of patch with tape.
- H. Deleted
- I. After poly sheeting is installed over mud mat, place temporary plywood sheet to protect the HDPE membrane as shown in the subcontract drawings.
- J. Place ASTM C 33 #57 stone above plywood protection to lines and grades shown in the subcontract drawings.
 - 1. Place in one lift and compact lift with three passes of hand compaction equipment.
- K. Place temporary nonwoven geotextile as shown in the subcontract drawings to protect ASTM C 33 #57 stone.

3.4 LEAKAGE DETECTION SYSTEM PRIOR/ DURING LIQUID TIGHTNESS TEST

- A. After tank wrapping and prior to liquid tightness test, remove temporary geotextile, ASTM 33 #57 stone, and plywood to expose HDPE during liquid tightness test.

3.5 LEAKAGE DETECTION SYSTEM AFTER LIQUID TIGHTNESS TEST

- A. Install leakage detection sump cover.
- B. Place nonwoven geotextile above HDPE geomembrane.
- C. Place ASTM C 33 #57 stone and nonwoven geotextile above leakage detection sump to provide support for temporary HPDE geomembrane.
- D. Place sub-base; e.g. CLSM, Gravel, Lean Concrete, etc.; adjacent to footing for support for HDPE geomembrane.
- E. Extrusion fillet weld additional section of HDPE geomembrane to HDPE geomembrane beneath tank and to the HDPE embedment on perimeter footing.
- F. Place nonwoven geotextile above HDPE geomembrane.

3.6 BACKFILL AROUND TANKS

- A. Protect HDPE geomembrane with Common Fill to top of footing.
- B. Place Common Fill above nonwoven geotextile and around tank as shown in the subcontract drawings.
 - 1. Place in lifts not exceeding 8 inches in un-compacted thickness.
 - 2. Compact each lift to 90% of the maximum density as determined in accordance with ASTM D 1557.
- C. Install PVC access cover to protect leakage detection sump riser.
- D. Deleted

3.7 Deleted

3.8 Deleted

3.9 Deleted

3.10 REPLACING OVEREXCAVATED MATERIAL

- A. Replace excavation carried below grade lines shown in the subcontract drawings or established by STR as follows:
 - 1. Beneath Footings: Structural fill, as specified for concrete mud mat in Section 03300.
 - 2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
 - 3. Trenches: Overexcavation: CLSM.

3.11 PLACING COMMON FILL OVER GEOSYNTHETICS

- A. General:
 - 1. Place Common Fill over geosynthetics with sufficient care so as not to damage them.
 - 2. Place fill only by back dumping and spreading only.
 - 3. Dump fill only on previously placed fill.
 - 4. While operating equipment, avoid sharp turns, sudden starts or stops that could damage geosynthetics.
- B. Hauling: Operate hauling equipment on minimum of 3 feet of covering.
- C. Spreading:
 - 1. Spreading equipment shall be track mounted.
 - 2. Operate spreading equipment on minimum of 12 inches of fill over geosynthetics.
 - 3. Spread fill in same direction as unseamed overlaps to avoid separation of seams and joints.
 - 4. Never push fill downslope.
 - a. Spread fill over side slopes by pushing up from slope bottom.
 - b. Flatten wrinkles of geosynthetics in direction of spreading.
 - c. Correct wrinkles in geotextiles as specified in Section 02371.
 - 5. Correct wrinkles in geomembranes as specified in Section 02661.
 - 6. Maintain proper overlap of unseamed geosynthetics.
 - 7. Avoid overstressing geosynthetics and seams.
- D. Compaction: Compact fill only after uniformly spread to full thickness shown in the subcontract drawings.
- E. Geosynthetic Damage Repair:
 - 1. As specified in Sections 02667 and 02371.

3.12 PROOF-ROLLING

- A. Prior to placing specified materials on subgrade, notify STR and SRR Registered Design Professional Geotechnical Representative to observe the proof-rolling of subgrade surface.
- B. Proof-roll Structural subgrade under tank and stair foundations prior to placement of Structural Fill, mud mats, or foundations to detect soft or loose subgrade or unsuitable material.
- C. For subgrade beneath structures, the Special Inspector and SRR Registered Design Professional Geotechnical Representative shall observe proof-rolling of subgrade.

- D. Proof roll with specified equipment, making a minimum of five passes, two in each of two directions at right angles.
- E. For areas not accessible to proof rolling, SRR Registered Design Professional Geotechnical Representative will observe subgrade surface to detect soft or loose subgrade or unsuitable material.

3.13 INSPECTION, EXAMINATION, TESTING, AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

GEOTEXTILE
SECTION 02371

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Geotextile

1.2 RELATED SECTIONS

- A. Division 1 – All Sections

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standard

- 1. American Society for Testing and Materials (ASTM)

- a. D 4491
 - b. D 4632
 - c. Deleted
 - d. D 4873
 - e. D 6241

- 2. International Code Council (ICC)

- a. IBC

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.
- B. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile furnished.
- C. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile furnished.
- D. Nondestructive Sample: Sample representative of finished work, prepared for testing without destruction of work.
- E. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.
- F. See Section 01100 for additional definitions.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 SEQUENCING AND SCHEDULING

A. Notify STR prior to placing geotextiles.

1. Do not place geotextile without STR approval of underlying materials.

1.7 SUBMITTALS

A. Submit the following Engineering documents in accordance with Section 01330 and 01400.

1. Geotextile Manufacturer Material Specifications And Product Literature, 2.1 F.
2. Geotextile Samples, 2.1 G.
3. Letter of Certification from Each Geotextile Manufacturer, 2.1 G. 3.
4. Proposed Method Of Geotextile Deployment, 3.3 B.

B. Deleted

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver each roll with sufficient information attached to identify it for inventory and quality control.

B. Handle products in manner that maintains undamaged condition.

C. Do not store products directly on ground.

D. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure.

E. Store and handle geotextile material in accordance with ASTM D 4873.

F. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 NONWOVEN GEOTEXTILE

A. Pervious sheet of polyester, polypropylene, or polyethylene fabricated into stable network of fibers that retain their relative position with respect to each other.

1. Nonwoven geotextile shall be composed of continuous or discontinuous (staple) fibers held together through needle-punching, spun-bonding, thermal-bonding, or resin-bonding.

B. Geotextile Edges: Salvaged or otherwise finished to prevent outer material from pulling away from geotextile.

C. Unseamed Sheet Width: Minimum 12 feet.

D. Conform to the following Physical Property Requirements.

1. Water Permittivity: 0.7 sec^{-1} , MinARV
 - a. Test Method: ASTM D 4491 (Falling Head)
2. Grab Tensile Strength, Machine Direction: 380 lb/in, MinARV
 - a. Test Method: ASTM D 4632
3. Grab Elongation, Machine Direction: 50 percent, MaxARV
 - a. Test Method: ASTM D 4632
4. CBR Puncture: 1,000 lb, MinARV
 - a. Test Method: ASTM D 6241

- E. Manufacturers: The following manufacturers have reported physical properties that meet the requirements.
 - 1. Carthage Mills; FX-160HS.
 - 2. TenCate Geosynthetics; Mirafi 1160N.
 - 3. Propex Geosynthetics; Geotex 1601.
 - 4. Or approved equal.
- F. Submit Geotextile Manufacturer Material Specifications And Product Literature.
- G. Submit Geotextile Samples
 - 1. One-piece, minimum 18 inches long, taken across full width of roll of each type and weight of geotextile furnished for Project.
 - 2. Label each with brand name and furnish documentation of lot and roll number from which each Sample was obtained.
 - 3. Submit a Letter of Certification from Each Geotextile Manufacturer that furnished products meet specified property values.
 - a. Certified property values shall be either minimum or maximum average roll values, as appropriate, for geotextiles furnished.

PART 3 EXECUTION

3.1 LAYING GEOTEXTILE

- A. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

3.2 JOINTS

- A. Unseamed Joints:
 - 1. Overlapped.
 - 2. Overlap, 12 inches unless noted otherwise.

3.3 SECURING GEOTEXTILE

- A. Secure geotextile during installation as necessary with sandbags or other means approved by STR.
- B. Submit Proposed Method Of Geotextile Deployment.
 - 1. Include provisions for holding geotextile temporarily in place until permanently secured.

3.4 PLACING PRODUCTS OVER GEOTEXTILE

- A. Before placing material over geotextile, notify STR.
 - 1. Do not cover installed geotextile until after STR provides authorization to proceed.
- B. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile.
 - 1. Repair damage as specified in Article Repairing Geotextile.

3.5 REPAIRING GEOTEXTILE

- A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile.
- B. Repair Procedure:
 - 1. Place patch of undamaged geotextile over damaged area and at least 18 inches in all directions beyond damaged area.

2. Remove interfering material as necessary to expose damaged geotextile for repair.
3. Sew patches or secure them with heat fusion tacking or with pins and washers, as specified above in Article Securing Geotextile, or by other means approved by STR.

3.6 REPLACING CONTAMINATED GEOTEXTILE

- A. Protect geotextile from contamination that would interfere with its intended function.
 1. Remove and replace contaminated geotextile with clean geotextile.

3.7 INSPECTION / EXAMINATION / TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

COMPOSITE DRAINAGE NET

SECTION 02373

DELETED

END OF SECTION

HIGH-DENSITY POLYETHYLENE PIPE AND FITTINGS**SECTION 02510****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. High-Density Polyethylene (HDPE) Pipe and Sump Assembly

1.2 RELATED SECTIONS

- A. Division 1 – All Sections

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standard

- 1. Deleted
 - a. Deleted
- 2. American Society for Testing and Materials (ASTM)
 - a. Deleted
 - b. Deleted
 - c. Deleted
 - d. D 3350
 - e. F 714
 - f. Deleted
 - g. F 2620
- 3. Deleted
 - a. Deleted
- 4. Plastics Pipe Institute, Inc. (PPI)
 - a. Deleted
 - b. TR-33

B. Regulations

- 1. 49 CFR PT 192.285

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. See Section 01100 for additional definitions.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. HDPE Pipe and Fittings Catalog Information, 2.1 G.
 - 2. HDPE Pipe, Sump, and Fittings Drawings, 2.1 H.
 - 3. Deleted
- B. Deleted
- C. Qualifications
 - 1. Pipe Manufacturer: Listed with Plastic Pipe Institute.
 - 2. Persons fusing High-Density Polyethylene (HDPE) pipe shall be certified under 49 CFR PT 192.285, have minimum of 5 year(s) of experience with fusing HDPE pipe and shall have received a minimum of 20 hours of training for fusing HDPE pipe from pipe supplier or fusing equipment supplier.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Shipping: Do not cut, kink, or otherwise damage pipe during transportation.
- B. Storage:
 - 1. Deleted
 - 2. Where necessary, because of ground conditions, store assembly on wooden sleepers.
 - 3. Keep assembly shaded from direct sunlight prior to installation in trench.
- C. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Pipe, Sump, and Fittings:
 - 1. Conform to requirements of ASTM F 714.
 - 2. Resin:
 - a. Polyethylene resin shall meet or exceed requirements of ASTM D 3350 for PE 3608 material.
 - b. Deleted
 - 3. Pressure Rating: 110 psi and nominal DR of 15.5.
 - 4. Deleted
 - 5. Pipe fittings and sump connections to be joined by thermal butt-fusion shall be of a compatible resin mix for the fusion process.
 - 6. Deleted
- B. Deleted
- C. Deleted
- D. Joints: Thermal butt-fusion or electrofusion.
- E. Deleted
- F. Products that restrain HDPE pipe with wedges, machined serrations, or clamps are not acceptable.

- G. Submit HDPE Pipe and Fittings Catalog Information confirming pipe, fittings, and other materials conform to requirements of this section.
- H. Submit HDPE Pipe, Sump, and Fittings Drawings of specific connection details.
- I. Deleted
 - 1. Deleted
 - 2. Deleted

PART 3 EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Shop fabricate polyethylene sump assembly in conformance with PPI TR-33, ASTM F 2620, and manufacturer's recommendations.
 - 2. Joining: Fabricate pipes, sumps, and fittings in accordance with manufacturer's recommendations.
 - a. Deleted
 - 3. Deleted
 - 4. If HDPE pipe surface temperature is above 90 degrees F, as measured with infrared temperature gun, allow pipe to cool prior to making any connections to flanges, connecting pipes or embeds.
 - a. Deleted
 - 5. Deleted
- B. Deleted

3.2 INSPECTION, EXAMINATION, TESTING, AND OBSERVATION

- A. Perform Testing in accordance with Section 01400.
 - 1. Sump Hydrostatic Test:
 - a. Notify STR in writing 5 days in advance of testing.
 - i. Perform testing in presence of STR.
 - b. Furnish testing equipment and perform tests in manner satisfactory to STR.
 - i. Testing equipment shall provide observable and accurate measurements of initial service leak.
 - ii. Deleted
 - c. Deleted
 - d. Deleted
 - e. Deleted
 - f. Deleted
 - g. Deleted
 - h. Deleted
 - i. Deleted
 - j. Deleted
 - k. Deleted
 - l. If there is leakage, repair defective pipe section and repeat hydrostatic test.

- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

HIGH-DENSITY POLYETHYLENE GEOMEMBRANE

SECTION 02661

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. High-Density Polyethylene (HDPE) Geomembrane

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 02667
- C. Section 03300
- D. Section 05500

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standard

1. American Society for Testing and Materials (ASTM)

- a. D 638
- b. D 792
- c. D 882
- d. D 1004
- e. D 1505
- f. D 3895
- g. D 4833
- h. D 5199
- i. D 5397
- j. D 5641
- k. D 5721
- l. D 5885
- m. D 6392
- n. D 6693
- o. D 4873

2. International Code Council (ICC)

- a. IBC

3. Deleted

4. National Institute for Certification in Engineering Technologies (NICET)

- a. 1030-12-95

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. Film Tearing Bond: Failure in ductile mode of one bonded sheet, by testing, prior to complete separation of bonded area.
- B. Geomembrane: Essentially impermeable geosynthetic composed of one or more layers of polyolefin materials fusion bonded into single-ply integral sheet.
- C. Panel: Piece of geomembrane composed of two or more sheets seamed together.
- D. Registered Design Professional: Geotechnical registered design professional responsible for project design or designee for Geotechnical Observation during Construction as required by the Statement of Special Inspection Plan provided on the Drawings.
- E. Sheet: Seamless piece of geomembrane.
- F. Watertight: Geomembrane installation free of flaws and defects that will allow passage of water and gases, liquids, and solids to be contained under anticipated service conditions.
- G. See Section 01100 for additional definitions.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. HDPE Geomembrane Manufacturer Qualifications, 1.7 A. 2.
 - 2. HDPE Geomembrane Installer Qualifications, 1.7 B. 2.
 - 3. HDPE Geomembrane Field Supervisor or Superintendent Resume and References, 1.7 C. 2.
 - 4. HDPE Geomembrane Field Crew Resumes and References, 1.7 D. 2.
 - 5. Independent Quality Control Inspector Resume and References, 1.7.E.3.
 - 6. Independent Testing Agency Qualifications, 1.7.F.3
 - 7. HDPE Geomembrane Letter of Compliance for the Materials Delivered at Project Site, 2.1 A.
 - 8. HDPE Geomembrane Manufacturer's Specifications, Literature For Each Geomembrane, 2.3 H.
 - 9. HDPE Geomembrane Installation Plan, 2.6 B.
 - 10. HDPE Geomembrane Quality Control And Inspection Plan, 2.7 B.
 - 11. HDPE Geomembrane Installer's Certification of Subsurface Acceptability, 2.7 C.
 - 12. HDPE Geomembrane Manufacturer's Certificate of Proper Installation, 3.7 B.
 - 13. HDPE Geomembrane As-Built Drawing(s) Geomembrane Layout, 3.9 A. 14.
- B. Deleted

1.7 QUALIFICATIONS

- A. Manufacturer
 - 1. Successfully manufactured a minimum of 10 million square feet of each type of geomembrane material specified.
 - 2. Submit HDPE Geomembrane Manufacturer Qualifications.

B. Installer

1. Successfully installed in the last 5 years a minimum of two projects (one project for 100 mil HDPE) on no less than a combined total of 1 million square feet of HDPE geomembrane specified in applications similar to the Project.
2. Submit HDPE Geomembrane Installer Qualifications.

C. Field Supervisor or Superintendent

1. Successfully installed in the last 5 years a minimum of two projects (one project for 100 mil HDPE) on no less than a combined total of 1 million square feet of HDPE geomembrane specified in applications similar to the Project.
2. Submit HDPE Geomembrane Field Supervisor or Superintendent Resume and References.

D. Field Crew

1. Knowledgeable and skilled in HDPE Geomembrane installation methods and shall have installed, collectively, at least 2 million square feet of HDPE geomembrane.
2. Submit HDPE Geomembrane Field Crew Resumes and References.

E. Independent Quality Control Inspector

1. 5 years of experience in field of geomembrane testing and inspection.
2. Certified by the National Institute for Certification in Engineering Technologies (NICET) Level III, NICET 1030-12-95, for geosynthetic materials installation inspection or the Geosynthetic Certification Institute-Inspector Certification Program (GCI-ICP) for geosynthetics inspection.
3. Submit Independent Quality Control Inspector Resume and References.

F. Independent Testing Agency

1. Laboratory shall maintain calibrated instruments, equipment, and documented standard procedures for performing specified testing.
2. Certified by the Geosynthetic Accreditation Institute-Laboratory Accreditation Program (GAI-LAP) for geosynthetics material testing.
3. Submit Independent Testing Agency Qualifications.

1.8 COORDINATION MEETINGS

A. Meet at least once prior to commencing each of the following activities:

1. Submission of Submittals.
2. Manufacture of geomembrane sheets.
3. Fabrication of panels.
4. Installation of geomembrane.

B. Attendees:

1. Subcontractor's designated quality control representative.
2. STR.
3. Special Inspector.
4. Registered Design Professional Geotechnical Representative.
5. Representatives of geomembrane installer.
6. Others requested by STR.

- C. Topics:
 - 1. HDPE Geomembrane Installation Plan.
 - 2. Geomembrane Quality Control and Inspection Plan
 - 3. Submittal requirements and procedures.
 - 4. Schedule for beginning and completing geomembrane installation.
 - 5. Training for installation personnel.
 - 6. Installation crew size.
 - 7. Establishing geomembrane marking system, to include sheet identification, defects, and satisfactory repairs, to be used throughout work.
 - D. Seam Installation and Testing Demonstration: Performed by geomembrane installer, for each type of seam required.
- 1.9 DELIVERY, STORAGE AND HANDLING
- A. Geomembrane:
 - 1. Individually package each sheet and protect from damage during shipment.
 - 2. Mark each package with identification of material type, size, and weight.
 - B. Epoxy Adhesive:
 - 1. Storage Temperature:
 - a. Control temperature above 60 degrees F and dispose of cartridges if shelf life has expired.
 - b. If stored at temperatures below 60 degrees F, test adhesive prior to use to determine if adhesive meets specified requirements.
 - C. Store and handle geotextile material in accordance with ASTM D 4873.
 - D. See Section 01600 for general requirements.
- 1.10 ENVIRONMENTAL REQUIREMENTS
- A. Do not install geomembrane or perform seaming under the following conditions, unless it can be demonstrated to satisfaction of STR that performance requirements can be met under these conditions:
 - 1. Air temperature is less than 35 degrees F or more than 90 degrees F.
 - 2. Relative humidity is more than 90 percent.
 - 3. Raining, snowing, frost is in ground, or wind is excessive.
 - B. Do not place materials on geomembrane when ambient temperature is less than 35 degrees F, unless it can be demonstrated to satisfaction of STR that materials can be placed without damage.
- 1.11 SEQUENCING AND SCHEDULING
- A. Deleted
 - B. Before placing geomembrane on GCL, prepare GCL surface as specified in Section 02667, Geosynthetic Clay Liner (GCL).

PART 2 PRODUCTS

2.1 MANUFACTURING QUALITY CONTROL (MQC)

- A. Submit HDPE Geomembrane Letter of Compliance for the Materials Delivered at Project Site.
 - 1. Referenced to the batch, lot, and roll numbers and Manufacturing Quality Control (MQC) test data.

2.2 MANUFACTURERS

A. Geomembrane:

1. GSE Lining Technology, Inc., Houston, TX.
2. Poly-Flex, Inc., Grand Prairie, TX.
3. AGRU America, Georgetown, SC.
4. Or approved equal.

2.3 GEOMEMBRANE

A. Composition: High density polyethylene (HDPE) containing no plasticizers, fillers, extenders, reclaimed polymers, or chemical additives, except following:

1. Approximately 2 percent by weight of carbon black to resin for ultraviolet resistance per ASTM D 4218.
2. Antioxidants and heat stabilizers, not to exceed 1.5 percent total by weight, may be added as required for manufacturing.

B. Furnish in rolled single-ply continuous sheets with no factory seams.

C. Sheet Thickness: 100 mils, minimum values determined in accordance with ASTM D 5199.

D. Sheet Width: Minimum 22 feet.

E. Roll Length: Longest that will be manageable and reduce field seams.

F. Meet manufacturer's most recent published specifications and required Minimum Physical Properties for HDPE Geomembrane as follows:

1. Specific Gravity: 0.940 to 0.936, g/cc; not more than 15% greater than base resin density
 - a. Test Method: ASTM D 792, Method A 1 or ASTM D 1505
2. Smooth-Surface, HDPE Minimum Properties, Each Direction
3. Tensile Stress at Yield: 2.1 lb/in-width/mil thickness
 - a. Test Method: ASTM D 6693
 - i. Yield Strength - 210 lb/in
 - ii. Break Strength - 380 lb/in
 - iii. Yield Elongation - 12%
 - iv. Break Elongation - 700%
4. Elongation at Yield: 12% minimum
5. Thickness, Nominal, plus or minus 5%: 100 mil
 - a. Test Method: ASTM D 5199
6. Puncture Resistance: 1.8 lb/mil thickness
 - a. Test Method: ASTM D 4833
7. Tear Resistance, in.: 0.70 lb/mil thickness, min average
 - a. Test Method: ASTM D 1004, Die C
8. Modulus of Elasticity: 80,000 lb/sq in
 - a. Test Method: ASTM D 882, Method A or ASTM D 638
9. Bonded Seam Strength in Shear: 2 lb/in-width/mil thickness, min. and FTB
 - a. Test Method: ASTM D 6392
10. Bonded Seam Strength in Peel: 1.2 lb/in-width/mil thickness, min. and FTB
 - a. Test Method: ASTM D 6392

11. Stress Crack Resistance : 300 hours
 - a. Test Method: ASTM D 5397, Appendix
12. Oxidative Induction Time, Standard Pressure: 100 min. average
 - a. Test Method: ASTM D 3895, (50 C; O₂, 1 atm)
13. Oven Aging, Standard Pressure: 55 percent, min. average
 - a. Test Method: ASTM D 5721, (85 C; 1 atm), ASTM D 3895
14. Ultraviolet Resistance, High Pressure: 50 percent
 - a. Test Method: ASTM D 5885, (1600 hours)

G. Extrudate for Fusion Welding of HDPE Geomembranes: Formulated from the same resin as geomembrane and shall meet applicable physical property requirements.

H. Submit HDPE Geomembrane Manufacturer's Specifications, Literature For Each Geomembrane.

2.4 SEALANT CAULKING

- A. Two-component sealant formulated of 100 percent polyurethane elastomer, such as Elastuff 120 Mastic as supplied by United Paint and Coatings, Greenacre, WA, or approved equal.
- B. Butyl rubber sealant such as Butylgrip Sealant, supplied by the Biddle Company, St. Louis, MO, or approved equal.

2.5 CAST-IN-PLACE HDPE EMBEDMENT

- A. Properties: Compatible for attaching geomembrane materials by extrusion welding to provide watertight seal.
- B. Manufacturers:
 1. GSE Lining Technologies, Houston, TX: GSE Polylock.
 2. Poly-Flex, Inc., Grand View, TX: Polyethylene Embed Channel (PEC).
 3. AGRU America, Georgetown, SC: T-Lock.
 4. Or approved equal

2.6 GEOMEMBRANE INSTALLATION PLAN

- A. Prepare geomembrane installation plan addressing the following topics:
 1. Prepare installation drawings for overlap locations, penetration seals, splicing, panel layouts, placement, repairs, patching, seams, anchorage, and other necessary details to install HDPE Geomembrane.
 - a. Installation drawings shall be in accordance with manufacturer's recommendations.
 - b. HDPE geomembrane welds and HDPE embedments with cap shown on drawings - provide suggested guidelines for installation.
 - i. Provide equivalent performance in final design for welds and embedments.
 - c. Drawings shall be verified, reviewed, signed and sealed by Subcontractor's or Specialty Subcontractor's registered design professional engineer licensed in the State of South Carolina who is qualified to perform work based on previous design work of the same nature.
 2. Compensation allowance calculation and numerical values for temperature induced geomembrane expansion and contraction.

3. Design assumptions and calculations sealed by same registered design professional engineer who sealed drawings.
4. Production dates for geomembrane.
5. Storage and handling instructions.
6. Provide geomembrane sheet layout with proposed size, panel identification coding system, position, and sequence of sheet placement, and location of field seams.
7. Deployment of geomembrane, including equipment used, and coordination with GCL and concrete mud mat placement.
 - a. Provide precautions for use during installation to install a leak tight HDPE geomembrane layer.
 - b. Provide precautions to protect the GCL.
8. Repair procedures.

B. Submit HDPE Geomembrane Installation Plan

2.7 GEOMEMBRANE QUALITY CONTROL AND INSPECTION PLAN

A. Prepare quality control and inspection plan addressing the following topics:

1. Written description of geomembrane manufacturer's formal quality control programs for manufacturing and fabricating geomembrane.
2. Written description of geomembrane installer's formal quality control programs for handling, installing, seaming, testing, and repairing geomembrane.
3. Field quality control testing, inspection, and acceptance procedures.
4. Sample checklist for field inspection, including the following;
 - a. Inspection of HDPE geomembrane rolls delivered to the site for conformance with requirements of Specification.
 - b. Inspection of HDPE geomembrane for damage, such as cuts, tears, holes, blisters, undispersed raw material, and other deleterious conditions.

B. Submit HDPE Geomembrane Quality Control And Inspection Plan

C. Submit HDPE Geomembrane Installer's Certification of Subsurface Acceptability Attachment 02661-A.

PART 3 EXECUTION

3.1 PREPARATION

- A. Do not place geomembrane until condition of GCL installed is acceptable to STR.
 1. Maintain in smooth and uniform condition as specified in Section 02667 during installation of geomembrane.
- B. Concrete Surfaces in Contact with Geomembrane:
 1. As specified in Section 03300 unless noted otherwise.
 2. Provide smooth surface, free of projections, rough spots, voids, honeycomb, or other irregularities.
 - a. Grind uneven concrete surface to which geomembrane is to be attached, flat and smooth.
 - b. Round exposed edges of mud mat to minimum ½ inch radius.
 3. Clean contact surfaces of dirt, dust, oil, curing compounds, and other coatings.

3.2 WELDING UNITS

- A. Single or double hot-wedge fusion seam welding.
- B. Extrusion welding systems.
- C. Hot-air welding is not acceptable.

3.3 GEOMEMBRANE INSTALLATION

- A. Do not install geomembrane or seam unless Subcontractor can demonstrate successful performance and test results showing seams meet strength specifications.
- B. Protection:
 - 1. Do not use geomembrane surfaces as work area for preparing patches, storing tools and supplies, or other uses.
 - a. Use protective cover as work surface, if necessary.
 - 2. Instruct workers about requirements for protection of geomembrane, such as, handling geomembrane material in high winds, handling of equipment, and walking on geomembrane surfaces.
 - a. Shoes of personnel walking on geomembrane shall be smooth bonded sole or be covered with smooth type of overboot.
 - b. Prohibit smoking, eating, or drinking in vicinity of geomembrane, placing heated equipment directly on geomembrane, or other activities that may damage geomembrane.
 - 3. Do not operate equipment without spark arrestors in vicinity of geomembrane material nor place generators or containers of flammable liquid on geomembranes.
 - 4. Protect from vehicle traffic and other hazards.
 - 5. Keep free of debris during placement.
 - 6. Prevent uplift, displacement, and damage by wind.
 - 7. Only small rubber-tired equipment, with maximum tire inflation pressure of 5 pounds per square inch, shall be allowed directly on geomembrane, unless otherwise approved by STR.
 - a. Demonstrate that equipment can be operated without damaging geomembrane.
- C. Placement:
 - 1. Miscellaneous products required for completion of geomembrane installation shall be in accordance with this specification and geomembrane manufacturer's recommendations.
 - 2. Deleted
 - 3. Prevent wrinkles, folds, or other distress that can result in damage or prevent satisfactory alignment or seaming.
 - a. Provide for factors such as expansion, contraction, overlap at seams, anchorage requirements, seaming progress, and drainage.
 - 4. Temporarily weight sheets to anchor or hold them in position during installation.
 - a. Use continuous holddowns along edges to prevent wind flow under sheet.

5. Anchor perimeter of geomembrane as shown or in accordance with manufacturer's instructions.
 - a. Anchor and seal geomembrane to structures and other types of penetrations as shown.
6. Place overlying mud mat following completion of geomembrane installation and field testing as acceptable to STR.

D. Field Seams:

1. Wipe sheet contact surfaces clean to remove dirt, dust, moisture, oil, and other foreign materials and prepare contact surfaces in accordance with seaming method in the manufacturer's instructions.
2. Lap sheet edges to form seams.
 - a. Adjust edges to be seamed and temporarily anchor to prevent wrinkling and shrinkage.
3. Avoid seam intersections involving more than three thicknesses of geomembrane material.
 - a. Offset seam intersections at least 2 feet.
 - b. Extend seams through HDPE embedments to sheet edges.
4. Seal seam "T" intersections by removing excess material and extrusion welding lap joint.
5. Seam sheets together, using fusion-extrusion or hot-wedge welding system, equipment, and techniques.

E. Geomembrane Attachment to Flat Concrete Surfaces:

1. HDPE Embedments:
 - a. Coordinate with Section 03300 and supplier.
 - b. Allow ¼ inch to 3/8 inch spacing between butt joints to allow for thermal expansion before welding joints.
 - c. Allow 6 inch spacing from walls or edges of concrete.
 - d. Chamfer ends of butt joints or intersection joints to allow for extrusion welding seal of strip.
 - e. On sloped or horizontal surfaces, embedments with air release holes may be pushed into poured concrete.
 - f. Seal air holes with extrudate prior to installing geomembrane.
 - g. Make full perimeter weld of geomembrane to embedment to ensure maximum watertightness.

3.4 PLACING PRODUCTS OVER GEOMEMBRANE

- A. Prior to placing material over geomembrane, notify STR.
 1. Do not cover installed geomembrane until after STR provides authorization to proceed.
- B. Use mud mat placement to push HDPE wrinkles to the perimeter.
- C. Do not place mud mat in manner that will cause wrinkles to fold over or become confined to form a vertical ridge.

- D. If tears, punctures, or other geomembrane damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geomembrane, and repair damage as specified in Article Repairing Geomembrane.
- E. Geomembrane installer shall remain available during placement of overlying products to repair geomembrane if damaged.

3.5 REPAIRING GEOMEMBRANE

- A. On penetration by foreign objects, replace or cover and seal with an additional layer of geomembrane material of proper size.
- B. Repair damaged or rejected seams with pieces of flat and unwrinkled geomembrane material free from defects and seams.
 - 1. Patches shall be tightly bonded on completion of repair work.
- C. Patch shall be neat in appearance and of size 6 inches larger in all directions than area to be repaired.
 - 1. Round corners of patch to minimum 1 inch radius.
- D. Prepare contact surfaces and seam patch in accordance with paragraph Field Seams.
 - 1. Pull and hold flat receiving surface in area to be patched.
 - 2. Seal each patch by extrusion welding continuous bead along edge, with no free edge remaining.
 - a. Vacuum box test each patch on completion.

3.6 AS-BUILT RECORD DOCUMENTATION

- A. Record Documents, include the following:
 - 1. Panel and sheet numbers.
 - 2. Seaming equipment and operator identification.
 - 3. Temperature and speed setting of equipment.
 - 4. Date seamed.
 - 5. Identity and location of each repair, cap strip, and sample taken from installed geomembrane for testing.

3.7 MANUFACTURER'S SERVICES

- A. In accordance with Section 01640, HDPE geomembrane manufacturer's representative or installer trained by HDPE geomembrane manufacturer shall be present at Site for technical supervision and assistance as follows:
 - 1. Preparation and inspection of surfaces on which HDPE geomembrane is to be placed and initial 2 days of installation.
 - 2. A minimum of one additional Site inspection visit, for a minimum of 4 hours, in order to provide Manufacturer's Certificate of Proper Installation, in accordance with Section 01640.
 - 3. Deleted
- B. Submit HDPE Geomembrane Manufacturer's Certificate of Proper Installation.

3.8 CLEANUP

- A. Cleanup work area as the Work proceeds.
- B. Take particular care to ensure that no trash, tools, and other unwanted materials are trapped beneath geomembrane and that scraps of geomembrane material are removed from the work area prior to completion of installation.

3.9 INSPECTION, EXAMINATION, TESTING, AND OBSERVATION

- A. Geomembrane Installer shall perform Field Testing in accordance with Section 01400.
 - 1. Notify STR in the event that non-compliant subsurface materials are encountered at the GCL or top of concrete mud mat elevation.
 - 2. Inspect HDPE geomembrane rolls delivered to the site for conformance with the requirements of the Specifications.
 - 3. Inspect for damage such as cuts, tears, holes, blisters, undispersed raw materials, and deleterious conditions.
 - a. Replace damaged or non-conforming materials.
 - 4. Prior to starting geomembrane installation and daily thereafter for installation on GCL, geomembrane installer shall certify in duplicate that surface upon which geomembrane shall be installed is acceptable, on form located at end of section.
 - a. Submit Geomembrane Installer's Certification of Subsurface Acceptability.
 - 5. Identify each test by date of sample, date of test, sample location, name of individual who performed test, standard test method used, list of departures from standard test methods, at minimum.
 - 6. Installation Observation and Testing:
 - a. Visually inspect geomembrane sheets, seams, anchors, seals, and repairs for defects as installation progresses and again on completion.
 - b. Depending on seam welding equipment used, test each seam and repair using vacuum testing device, spark testing device, or air channel pressure test for double wedge welded seams.
 - c. Perform testing in presence of Independent Quality Control Inspector and Special Inspector.
 - 7. Field Testing Equipment:
 - a. Tensiometer:
 - i. Motor driven portable tensile tester with jaws capable of traveling at measured rate of 2 inches per minute for HDPE.
 - ii. Equip with gauge which measures force in unit pounds exerted between jaws.
 - iii. Minimum capacity of 500 pounds.
 - b. Vacuum Box: Conform to ASTM D 5641.
 - c. High Voltage Spark Detector: Tinker and Rasor Holiday Detector, Model AP-W, set at 20,000 volts.
 - 8. Startup Seam Sampling:
 - a. Verify that seaming equipment and operators are performing adequately.
 - b. Produce test seam samples at beginning of each shift for each seaming crew.

- c. If seaming has been suspended for more than ½ hour, or if breakdown of seaming equipment occurs, produce test seam samples prior to resuming seaming.
 - d. Sample Size: 12 inches wide plus seam width, and 60 inches long.
- 9. Random Nondestructive Seam Sampling:
 - a. All seams shall be nondestructive tested over full length, with the following exception.
 - i. HDPE geomembrane welds to HDPE embedment strips do not require nondestructive seam testing. Visual inspection will be performed by the Independent Quality Control Inspector and Special Inspector.
 - b. For seams that cannot be otherwise tested, insert copper wire for spark test at edge of overlapping sheet in extrudate of weld prior to fillet welding.
 - i. Position to within 1/8 inch of sheet edge.
 - c. Frequency: Minimum one Sample per 500 feet of field seam or portion thereof, and minimum one Sample per seaming crew per 4 hour work period.
 - d. Produce Samples using same materials, equipment, personnel, and procedures as field seams made at time of work in progress and under same conditions.
- 10. Sample Identification:
 - a. Number, date, and identify each sample as to personnel making seam and location of sample or location of field seam work in progress at time Sample is made.
 - b. Mark location of Sample, or location of field seam in progress at time sample is made, on panel/sheet layout drawing.
- 11. Testing Requirements: Conform to the following testing requirements for nondestructive seam tests used to define quality of field seams:
 - a. Perform shear and peel testing on portion of sample as specified hereinafter using approved field tensiometer.
 - i. Independent Quality Control Inspector and Special Inspector will observe testing.
 - b. Provide a portion of sample to Independent Testing Agency for verification of field test results.
 - c. Conform to ASTM D 6392 and this section.
 - i. Vacuum box testing, high voltage spark tests, air channel pressure tests, and probing.
- 12. Field Seam Strength Sample Testing for Startup and Random Nondestructive Seams:
 - a. Test each sample for seam peel and tensile strength.
 - b. Save test samples, including specimens tested, until notified Special Inspector and Registered Design Professional Geotechnical Representative.
 - c. Each sample that fails under test shall be shipped immediately by express delivery to Independent Testing Agency with notification to STR and Registered Design Professional Geotechnical Representative for determination of corrective measures required.

- d. Field Seam Acceptance Criteria: Seam strength equal to 90 percent of that of parent material.
 - i. Parent material shall be tested in accordance with ASTM D 638.
 - e. Bonded Shear Strength of HDPE:
 - i. In Shear: Minimum 2 pounds per inch width per mil thickness as determined in accordance with ASTM D 6392.
 - ii. In Peel: Minimum 1.2 pounds per inch width per mil thickness as determined in accordance with ASTM D 6392.
 - f. Test Failure: If sample fails, entire field seam from which it was taken shall be considered a failure and shall be rejected as a result of nonconformance with specification requirements. Comply with following corrective measures:
 - i. Nondestructive Sample Failure: Rerun field weld test using same sample.

If that test passes, Independent Testing Agency and Registered Design Professional Geotechnical Representative may assume error was made in first test and accept field seam.

If second test fails, cap each field seam represented by failed sample and submit new test Sample made during capping.
13. Nondestructive Seam Integrity Testing: Independent Quality Control Inspector and Special Inspector shall observe Subcontractor testing.
- a. All seams shall be nondestructive integrity tested over full length, with the following exception.
 - i. HDPE geomembrane welds to HDPE embedment strips do not require nondestructive seam testing.
 - ii. Visual inspection will be performed by the Independent Quality Control Inspector and Special Inspector.
 - b. Vacuum Box Testing of Geomembrane Welds:
 - i. Vacuum box test each of these types of welds: Fillet, extrusion lap, and single hot-wedge fusion lap.
 - ii. Testing Procedures: Conforming to ASTM D 5641.
 - c. High-Voltage Spark Testing of Fillet Welds:
 - i. Provide each seam to be tested with copper wires properly embedded in seam as shown and with provisions for electrical grounding to test equipment.
 - ii. Pass spark tester along length of seam containing copper wire.
 - iii. Presence of a visible spark along tested seam shall be evidence of a faulty seam.
 - iv. Mark faulty areas for repair and retesting.
 - d. Air Channel Pressure Testing of Double Hot-Wedge Seam:
 - i. Insert a needle with gauge in air space between welds.

Pump air into space to 30 psi and hold for 5 minutes.
 - ii. At end of 5 minutes, depressurize seam by placing needle hole in air space between welds at opposite end of seam and observe gauge.
 - iii. Seam is acceptable if seam maintains at least 27 psi during 5 minute hold and pressure drops within 30 second of depressurization.

- iv. Seam is acceptable if seam maintains a minimum of 27 psi.
If pressure drops below 27 psi during test period, or does not drop during 30 second depressurization period, repair needle holes and retest seam by same procedure or vacuum box test along entire length of seam.
- v. Vacuum box test entire length of seam if second air pressure test fails.
If no bubbles appear in vacuum box, lower weld will be considered defective and upper seam is acceptable.
If bubbles appear in vacuum box, repair each defective area by extrusion welding and test again by vacuum box.
- vi. As alternative to vacuum box testing, apply soap solution to exposed seam edge while maintaining required air channel test pressure.
If bubbles appear, mark, trim unbonded edge, and extrusion weld defective areas.
If no bubbles appear and test pressure cannot be maintained, leak is judged to be in bottom or second seam.
- vii. If leak is judged to be in bottom seam, cap strip length of seam tested.
- viii. Mark and repair needle holes.

14. Prepare and Submit HDPE Geomembrane As-Built Drawing(s)
Geomembrane Layout

- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.
- D. Independent Quality Control Inspector shall perform the following inspections.
 - 1. Visually inspect geomembrane sheets, seams, anchors, seals and repairs for defects as installation progresses and again on completion.
 - 2. Observe random nondestructive seam sampling and field testing.
 - 3. Coordinate random nondestructive seam testing conducted by Independent Testing Agency.
 - 4. Observe nondestructive seam integrity testing conducted by geomembrane installer.

3.10 ATTACHMENT

- A. Geomembrane Installer's Certification of Subsurface Acceptability.

END OF SECTION

**GEOMEMBRANE INSTALLER'S CERTIFICATION
OF SUBSURFACE ACCEPTABILITY**

Attachment No. 02661-A
Revision No. 3
Spec/Req'n No. C-SPP-Z-00008
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Geomembrane installer, _____
for Savannah River Remediation SDU 6 Project, hereby certify that supporting surfaces are
acceptable for installation of geomembrane, undersigned having personally inspected
condition of prepared surfaces. This certification is for areas shown on Subcontractor's
Attachment figure or defined by Subcontractor as follows:

Condition of supporting surfaces in defined area meets or exceeds minimum requirements
for installation of geomembrane.

Signed: _____
(Representative of Geomembrane Installer)

(Position)

Date: _____

Witness: _____

GEOSYNTHETIC CLAY LINER
SECTION 02667

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Geosynthetic Clay Liner (GCL)

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 02661

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standard

1. American Society for Testing and Materials (ASTM)

- a. D 4643
- b. D 5261
- c. D 5887
- d. D 5890
- e. D 5891
- f. D 5993
- g. D 6496
- h. D 6768
- i. D 4873

2. International Code Council (ICC)

- a. IBC

3. National Institute for Certification in Engineering Technologies (NICET)

- a. 1030-12-95

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. Geosynthetic Clay Liner (GCL): Flexible panel made of a layer of domestic, natural, high swelling sodium bentonite clay (montmorillonite) encapsulated between two geotextiles.
- B. Geotextile: Woven or nonwoven permeable manmade textile used with geotechnical engineering related materials.
- C. Maximum Average Roll Value (MaxARV): Maximum of a series of average roll values representative of product furnished.

- D. Minimum Average Roll Value (MinARV): Minimum of a series of average roll values representative of product furnished.
- E. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.
- F. Registered Design Professional: Geotechnical registered design professional responsible for project design or designee for Geotechnical Observation during Construction as required by the Statement of Special Inspection Plan provided on Drawings.
- G. See Section 01100 for additional definitions.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. Geosynthetic Clay Liner Manufacturer Qualifications, 1.7 A. 2.
 - 2. Geosynthetic Clay Liner Installer Qualifications, 1.7 B. 2.
 - 3. Geosynthetic Clay Liner Field Supervisor or Superintendent Resume and References, 1.7 C. 2.
 - 4. Geosynthetic Clay Liner Field Crew Resumes and References, 1.7 D. 2.
 - 5. Independent Quality Control Inspector Resume and References, 1.7.E.3.
 - 6. GCL Letter of Compliance for the Materials Delivered at Project Site, 2.1 A.
 - 7. Geosynthetic Clay Liner Manufacturer's Specifications, Literature, 2.3 J.
 - 8. Geosynthetic Clay Liner Installation Plan, 2.6 B.
 - 9. Geosynthetic Clay Liner Quality Control And Inspection Plan, 2.7 B.
 - 10. GCL Manufacturer's Certificate of Proper Installation, 3.7 B.
 - 11. Geosynthetic Clay Liner As-Built Drawing(s) Geomembrane Layout, 3.9 A. 7.

- B. Deleted

1.7 QUALIFICATIONS

- A. Manufacturer
 - 1. Successfully manufactured a minimum of 10 million square feet of each type of Geosynthetic Clay Liner (GCL) material specified.
 - 2. Submit Geosynthetic Clay Liner Manufacturer Qualifications.
- B. Installer
 - 1. Successfully installed in the last 5 years a minimum of two projects on no less than a combined total of 1 million square feet of GCL specified in applications similar to the Project.
 - 2. Submit Geosynthetic Clay Liner Installer Qualifications.
- C. Field Supervisor or Superintendent
 - 1. Successfully installed in the last 5 years a minimum of two projects on no less than a combined total of 1 million square feet of GCL specified in applications similar to the Project.
 - 2. Submit Geosynthetic Clay Liner Field Supervisor or Superintendent Resume and References.

D. Field Crew

1. Knowledgeable and skilled in GCL installation methods and shall have installed, collectively, at least 2 million square feet of GCL specified in applications similar to the Project.
2. Submit Geosynthetic Clay Liner Field Crew Resumes and References.

E. Independent Quality Control Inspector

1. 5 years of experience in field of geomembrane testing and inspection.
2. Certified by the National Institute for Certification in Engineering Technologies (NICET) Level III, NICET 1030-12-95, for geosynthetic materials installation inspection or the Geosynthetic Certification Institute-Inspector Certification Program (GCI-ICP) for geosynthetics inspection.
3. Submit Independent Quality Control Inspector Resume and References.

1.8 COORDINATION MEETINGS

A. Meet at least once prior to commencing each of the following activities:

1. Submission of Submittals.
2. Manufacture of GCL panels.
3. Installation of GCL.

B. Attendees:

1. Subcontractor's designated quality control representative.
2. STR.
3. Special Inspector.
4. Registered Design Professional Geotechnical Representative.
5. Representatives of GCL subcontractor.
6. Others requested by STR.

C. Topics:

1. GCL Installation Plan.
2. GCL Quality Control and Inspection Plan.
3. Submittal requirements and procedures.
4. Schedule for beginning and completing GCL installation.
5. Training for installation personnel.
6. Installation crew size.
7. Establishing GCL marking system, to include sheet identification, defects, and satisfactory repairs, to be used throughout work.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Store and handle geotextile material in accordance with ASTM D 4873.
- B. Wrap GCL in plastic to protect it from moisture and degradation during shipment and storage.
- C. Store GCL in a dry, protected facility or in protected area on pallets off the ground.
 1. Cover materials stored outside with heavy, waterproof covering that allows free flow of air between covering and materials.
- D. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 MANUFACTURING QUALITY CONTROL (MQC)

- A. Submit GCL Letter of Compliance for the Materials Delivered at Project Site, in accordance with Section 01640.
 - 1. Reference to the batch, lot, and roll numbers and Manufacturing Quality Control (MQC) test data.

2.2 MANUFACTURERS

- A. Needle-Punched GCL Products: GSE Lining Technology, Houston, TX; BentoLiner EC.
- B. Adhesive-Stabilized GCL Products: Colloid Environmental Technologies Co. (CETCO), Arlington Heights, IL; Bentomat 200R.
- C. Or approved equal.

2.3 GEOSYNTHETIC CLAY LINING

- A. Panels of bentonite and encapsulating geotextiles manufactured shall perform as continuous lining.
 - 1. Panels shall contain a Min ARV of 0.75 pound per square foot of high-swelling granular sodium bentonite clay at 0 percent moisture content, or equivalent weight at other moisture content using ASTM D 5993.
- B. Bentonite Properties:
 - 1. High quality natural sodium bentonite without chemical resistance enhancers or polymers.
 - 2. 90 percent typical montmorillonite content by weight.
 - 3. Minimum Bentonite Swell Index of 24 mL/2g when tested pursuant to ASTM D 5890.
 - 4. Maximum moisture content of 12 percent when tested pursuant to ASTM D 4643.
 - 5. Maximum fluid loss of 18 mL when based on ASTM D 5891 test standard.
- C. GCL shall be manufactured so the bentonite component is continuously contained throughout GCL and to support geotextile so that no displacement of the bentonite occurs when material is unrolled, moved, cut, torn, or punctured.
 - 1. To contain granular bentonite, GCL materials shall be stabilized by process of needle punching through top and bottom layers of geotextile and bentonite. Or the adhesive used to stabilize GCL shall be inert, nontoxic, and water soluble.
- D. Encapsulating geotextile materials shall protect the bentonite component and be sufficiently porous to allow bentonite flow-through to create a positive bentonite-to-bentonite seal at seams.
- E. Woven Carrier Geotextile Mass: 3.1 oz/sq yd, MinARV in accordance with ASTM D 5261.
- F. Nonwoven Cover Geotextile Mass: 3.0 oz/sq yd, MinARV in accordance with ASTM D 5261.
- G. Sheet Width: Minimum 15 feet.
- H. Roll Length: Minimum 150 feet.
- I. Manufactured GCL products shall meet the following material properties:
 - 1. Mass (Weight), lb/sq ft, MinARV: 0.81
 - a. Test Method: ASTM D 5993

2. Grab Strength, lbs/in, Tested Dry, MinARV: 30
 - a. Test Method: ASTM D 6768
3. Peel Strength, lbs/-in, Tested Dry, MinARV: 1.0
 - a. Test Method: ASTM D 6496
4. Index Flux, $\text{m}^3/\text{m}^2/\text{sec}$, max. at 34.5 kPa: 1×10^{-8}
 - a. Test Method: ASTM D 5887
- J. Submit Geosynthetic Clay Liner Manufacturer's Specifications, Literature that identifies the following:
 1. Montmorillonite content by weight, typical moisture content, and swell index values.
 2. Recommended sealing compound.
 3. Repair adhesive.

2.4 BENTONITE SEALING COMPOUND

- A. Bentonite sealing compound in powder or granular form shall be same product used in manufacture of GCL materials.
- B. Sealing compound shall be applied to seal around penetrations and structures shown on Drawings.
 1. Use manufacturer's recommended minimum amount of sealing compound to use in each instance in order to affect adequate seal.

2.5 REPAIR ADHESIVE

- A. Repair adhesive for securing GCL patches shall be nontoxic adhesive as recommended by GCL manufacturer.

2.6 GCL INSTALLATION PLAN

- A. Prepare geomembrane installation plan addressing the following topics:
 1. Prepare installation drawings for overlap locations, penetration seals, panel layouts, anchorage, and other necessary details to install GCL.
 - a. Drawings shall be verified, reviewed, signed and sealed by Subcontractor's or Specialty Subcontractor's registered design professional engineer licensed in the State of South Carolina who is qualified to perform work based on previous design work of the same nature.
 2. Production dates for GCL.
 3. Storage and handling instructions.
 4. Provide GCL sheet layout with proposed size, panel identification coding system, position, and sequence of sheet placement, and location of overlap.
 5. Deployment of GCL, including equipment used, and coordination with HDPE Geomembrane and concrete mud mat placement.
 - a. Use equipment that will not damage supporting mud mat surface.
 - b. Provide precautions from sudden wind damage.
 - c. Provide precautions for protecting GCL during placement of HDPE Geomembrane.
 6. Repair procedures.
- B. Submit Geosynthetic Clay Liner Installation Plan

2.7 GCL QUALITY CONTROL AND INSPECTION PLAN

- A. Prepare quality control and inspection plan addressing the following topics:
 - 1. Written description of GCL manufacturer's formal quality control programs for manufacturing and fabricating GCL.
 - 2. Written description of GCL installer's formal quality control programs for handling, installing, seaming, testing, and repairing GCL.
 - 3. Inspection requirements, acceptance criteria, and procedure.
 - 4. Field quality control testing and inspection procedures.
 - 5. Sample checklist for field inspection, including the following;
 - a. Inspection of GCL rolls delivered to the site for conformance with requirements of Specification.
 - b. Inspection of GCL for damage, such as cuts, tears, holes, blisters, undispersed raw material, and other deleterious conditions.
- B. Submit Geosynthetic Clay Liner Quality Control And Inspection Plan

PART 3 EXECUTION

3.1 PREPARATION

- A. Do not place GCL until condition of concrete mud mat is acceptable.
 - 1. Maintain surface on which GCL is to be placed in firm, clean, dry, and smooth condition during GCL installation.
- B. Remove only quantity of material from storage that is to be installed during current work day.

3.2 PLACEMENT OF GEOSYNTHETIC CLAY LINING

- A. Only those GCL panels that can be anchored and covered in the same day shall be unwrapped and placed in position.
- B. Place GCL surface on underlying concrete mud mat with surface of GCL in contact with mud mat as recommended by manufacturer.
- C. GCL panels shall not be dragged over surface, except for slight adjustments as may be necessary for obtaining correct overlap of panels. Rolled-up panels shall not be allowed to unroll unrestrained down slope.
- D. Anchor GCL per manufacturer's recommendations.
- E. Panels shall be placed to provide overlap of 6 inches to 9 inches on longitudinal seams and 24 inches on transverse seams.
 - 1. No lap seams parallel to slope shall be allowed on slopes steeper than 7H:1V, unless otherwise approved by STR.
 - 2. Such approval will be dependent upon demonstration by Subcontractor that sufficient additional overlap will be provided to anchor GCL and prevent it from moving downslope during and after placement of overlying materials.
- F. Protection:
 - 1. GCL panels shall not be installed in standing water, while it is raining, or when rain may begin before panels can be covered with geomembrane and protected.
 - a. GCL shall be "dry" when installed and "dry" when geomembrane is installed over it.
 - 2. Protect GCL against wind in accordance with manufacturer's recommendations.

3. Instruct workers about requirements for protection of GCL, such as, handling GCL material in high winds, handling of equipment, and walking on GCL surfaces.
 - a. Shoes of personnel walking on GCL shall be smooth bonded sole or be covered with smooth type of overboot.
- G. GCL shall be laid smooth without creases or wrinkles and without stretching material to fit area.
 1. GCL shall be free of tension or stress upon completion of installation.
- H. Cover GCL with required geomembrane cover as soon as practicable after it is installed.
 1. Exposed GCL is to be completely covered and protected by soil, geomembrane, or other approved cover material at end of each shift or workday.
 2. Subcontractor shall limit amount of exposed GCL to the amount which can be immediately covered in event of rain.
- I. Leading edge and panels of GCL left uncovered shall be protected with heavy, waterproof membrane or tarp that is adequately secured and protected with sandbags or other ballast.

3.3 SEAMING GCL PANELS

- A. Mark overlaps 6 inches and 9 inches from panel edge longitudinally on GCL to assist in obtaining proper overlap.
- B. Prior to lapping, remove dirt, gravel, or other debris from overlap area.
- C. Apply ¼ pound of sealing compound per lineal foot of seam, or as otherwise recommended by manufacturer, whichever represents greatest amount of bentonite.
- D. Where soil and sand encroaches lap areas after initial application of bentonite sealant, additional bentonite sealant in amount of ¼ pound per lineal foot shall be spread evenly across longitudinal seam area.
- E. Alternative seaming methods may be used upon successful demonstration to STR that alternative method will result in a seam equivalent to seam specified above.
 1. Subcontractor shall strictly adhere to manufacturer's recommendations and conditions of approval for these alternative seams.
- F. Seam overlap on slopes shall be shingled so direction of flow is from top panel onto bottom panel.
 1. Overlaps shall be as hereinbefore specified.
- G. Hot Weather Installation:
 1. Provide compensation for shrinkage when ambient temperatures are greater than 85 degrees F.
 - a. At minimum, longitudinal overlap should be increased to 12 inches and transverse overlap should be increased to 36 inches.

3.4 PATCHING AND REPAIRS

- A. Irregular shapes, cuts, or tears in GCL shall be overlapped minimum of 12 inches in all directions from defect with additional layer of GCL material.
- B. Patch seams parallel to slope and secure with repair adhesive recommended by manufacturer.

- C. Patches and repairs shall not be allowed on slopes greater than 7H:1V.
- D. Complete panels shall be removed and replaced with undamaged panels when damage is extensive as determined by STR.

3.5 PLACEMENT OF OVERLYING MATERIALS

- A. Equipment shall not operate directly on GCL, except to minimum extent necessary to deploy HDPE geomembrane materials on GCL.
- B. Deploy HDPE geomembrane with equipment and by methods approved by STR.

3.6 AS-BUILT RECORD DOCUMENTATION

- A. Record Documents, include the following:
 - 1. Panel numbers.
 - 2. Identity and location of each repair, cap strip, and sample taken from installed GCL for testing.

3.7 MANUFACTURER'S SERVICES

- A. In accordance with Section 01640, GCL manufacturer's representative or installer trained by GCL manufacturer shall be present at Site for technical supervision and assistance as follows:
 - 1. Inspection of surfaces on which GCL is to be placed and on first day of GCL installation.
 - 2. A minimum of one additional Site inspection visit, for a minimum of 2 hours, in order to provide Manufacturer's Certificate of Proper Installation.
 - 3. Deleted
- B. Submit GCL Manufacturer's Certificate of Proper Installation.

3.8 CLEANUP

- A. Clean up work area as the work proceeds.
- B. Take particular care to ensure that no trash, tools, and other unwanted materials are trapped beneath GCL and that scraps of GCL material are removed from the work area prior to completion of installation.

3.9 INSPECTION, EXAMINATION, TESTING, AND OBSERVATION

- A. GCL Installer shall perform Field Testing in accordance with Section 01400.
 - 1. Notify STR in the event that non-compliant subsurface materials are encountered at the top of concrete mud mat elevation.
 - 2. Inspect GCL rolls delivered to the site for conformance with the requirements of the Specifications.
 - 3. Inspect for damage such as cuts, tears, holes, blisters, undispersed raw materials, and deleterious conditions.
 - a. Replace damaged or non-conforming materials.
 - 4. Prior to starting GCL installation and daily thereafter for installation on concrete mud mat, GCL installer shall certify in duplicate that surface upon which GCL shall be installed is acceptable, on form located at end of section.
 - a. Prior to GCL installation, include the Geomembrane Installer's Certification of Subsurface Acceptability (Attachment 02667-A) with the weekly Quality Control Report.
 - 5. Deleted

6. Installation Observation and Testing:
 - a. Visually inspect GCL panels, overlap, damaged areas, and repairs for defects as installation progresses and again on completion.
 - b. No installation tests are required.
 7. Prepare and Submit Geosynthetic Clay Liner As-Built Drawing(s) Geomembrane Layout
 - B. Provide for SRR Special Inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 1. Subcontractor responsibilities and related information are included in Section 01810.
 - C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.
 - D. Independent Quality Control Inspector shall perform the following inspections:
 1. Visually inspect GCL panels.
 2. Verify overlap area is clean.
 3. Verify the amount of sealing compound applied at GCL overlaps is as specified or as recommended by manufacturer.
 4. Observe repair of damaged areas.
- 3.10 ATTACHMENT
- A. GCL Installer's Certification of Subsurface Acceptability.

END OF SECTION

GCL INSTALLER'S CERTIFICATION OF SUBSURFACE ACCEPTABILITY

Attachment No. 02667-A
Revision No. 3
Spec/Req'n No. C-SPP-Z-00008
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GCL installer, _____
for Savannah River Remediation SDU 6 Project, hereby certify that supporting surfaces are
acceptable for installation of GCL, undersigned having personally inspected condition of
prepared surfaces. This certification is for areas shown on Subcontractor's Attachment figure or
defined by Subcontractor as follows:

Condition of supporting surfaces in defined area meets or exceeds minimum requirements for
installation of GCL.

Signed: _____
(Representative of GCL Subcontractor)

(Position)

Date: _____

Witness: _____

CONCRETE FORMING AND ACCESSORIES**SECTION 03100****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Formwork

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 03300

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standards

- 1. American Concrete Institute (ACI)
 - a. 117
 - b. 318
 - c. 347
- 2. International Code Council (ICC)
 - a. IBC

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. See Section 01100.

1.5 QUALITY ASSURANCE**A. Qualifications:**

- 1. Formwork Designer: Formwork, falsework, and shoring design shall be by an engineer licensed in the State of South Carolina.

- B. See Section 01400 for general requirements..

1.6 DESIGN REQUIREMENTS

- A. Design formwork in accordance with ACI 347 and ACI 318 to provide concrete finishes specified in Section 03300.
- B. When high range water reducer (superplasticizer) is used in concrete mix, forms shall be designed for full hydrostatic pressure per ACI 347.
- C. Make joints in forms watertight.
- D. Limit panel deflection to 1/360th of each component span to achieve tolerances specified.

1.7 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. Form Tie Sample, 2.1 F. 6.
 - 2. Shop Drawings, 2.2 A.
 - 3. Certification of Structural Calculations, 2.2 A. 4.
 - 4. Certificate of Proper Installation, 3.3 C.
- B. Deleted

1.8 DELIVERY, STORAGE AND HANDLING

- A. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 FORM MATERIALS

- A. Wall Forms and Underside of Slabs:
 - 1. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particle board, or steel in "new and undamaged" condition, of sufficient strength and surface smoothness to produce specified finish.
 - 2. Circular Structures:
 - a. Wall forms shall conform to the circular shape of the structure.
 - b. Straight panels may be substituted for circular forms provided panels do not exceed 3 feet in horizontal width and angular deflection is no greater than 3 ½ degrees per joint.
- B. Circular Columns: Fabricated steel or fiber reinforced plastic with bolted together sections or spirally wound laminated fiber form internally treated with release agent for height of column.
- C. All Other Forms: Materials as specified for wall forms.
- D. Form Release Agent:
 - 1. Material: Release agent shall not bond with, stain, or adversely affect concrete surfaces, and shall not impair subsequent treatments of concrete surfaces when applied to forms.
 - a. A ready-to-use water based material formulated to reduce or eliminate surface imperfections, containing no mineral oil or organic solvents.
 - b. Environmentally safe, meeting local, state, and federal regulations.
 - 2. Manufacturers and Products:
 - a. BASF, Shakopee, MN; MBT, Rheofinish 211.
 - b. Cresset Chemical Company; Crete-Lease 20-VOC.
 - c. Unitex Chemicals; Farm Fresh.
 - d. Atlas Construction Supply, Inc.; Bio-Guard.
 - e. Or approved equal.
- E. Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

F. Form Ties:

1. Material: Steel.
2. Spreader Inserts:
 - a. Conical or spherical type.
 - b. Design to maintain positive contact with forming material.
 - c. Furnish units that will leave no metal closer than 1.5 inches to concrete surface when forms, inserts, and tie ends are removed.
3. Wire ties and snap ties not permitted.
4. Through-Bolts: Tapered minimum 1 inch diameter at smallest end.
5. Elastic Vinyl Plug:
 - a. Design and size of plug to allow insertion with tool to enable plug to elongate and return to original length, and diameter upon removal forming watertight seal.
 - b. Manufacturer and Product: Dayton/Richmond Co., Miamisburg, OH; A58 Sure Plug, or approved equal.
6. Submit Form Tie Sample

2.2 SHOP DRAWINGS**A. Prepare and Submit Shop Drawings that include:**

1. Layout of panel joints and tie hole pattern.
2. Form Ties-Tapered Through-Bolts: Proposed method of sealing form tie hole; coordinate with details shown.
3. Manufacturer's data for form release agent.
4. Submit Certification of Structural Calculations:
 - a. Letter of certification for structural design of formwork systems, shall be signed and sealed by Registered Professional Engineer licensed in the State of South Carolina.
 - b. Copies of detailed structural design calculations shall not be submitted for review.

PART 3 EXECUTION**3.1 FORM SURFACE PREPARATION**

- A. Thoroughly clean form surfaces that will be in contact with concrete or that have been in contact with previously cast concrete, dirt, and other surface contaminants prior to coating surface.
- B. Exposed Wood Forms in Contact with Concrete: Apply form release agent as recommended by the manufacturer.
- C. Steel Forms: Apply form release agent to steel forms as soon as they are cleaned to prevent discoloration of concrete from rust.

3.2 ERECTION

- A. General: Unless specified otherwise, follow applicable recommendations of ACI 347.
- B. Beveled Edges (Chamfer):
 1. Form $\frac{3}{4}$ inch bevels at concrete edges, unless noted otherwise.
 2. Where beveled edges on existing adjacent structures are other than $\frac{3}{4}$ inch, obtain STR's approval of size prior to placement of beveled edge.

C. Wall Forms:

1. Do not reuse forms with damaged surfaces.
2. Locate form ties and joints in an uninterrupted uniform pattern.
3. Inspect form surfaces prior to installation to assure conformance with specified tolerances.

D. Prestressed Tank:

1. Concrete Wall Forms:

- a. Strategically locate windows in wall forms for concrete placement and observation as follows:
 - i. Minimum 22 inches wide and 24 inches high, spaced horizontally and vertically no farther than 6 feet on center.
 - ii. Place bottom of lower horizontal row of windows for tank wall within 3 feet from top of wall footing.

2. Prestressed Tank Wall Footing Forms:

- a. Design to locate and securely hold plastic water stop and lateral cables to continuous circular location within vertical and horizontal tolerance of plus or minus $\frac{1}{4}$ inch.
- b. Locate water stop by radial measurement from reservoir center.
- c. Establish reservoir center point and construct rigid unmovable survey monument to allow consistent radial measurements for wall base and wall construction within accuracy and tolerance specified.
- d. Design forms to hold water stop circular and at correct location during concrete placement.

3. Core Wall Panels: Install plumb and keep braced in vertical position before and after casting concrete until roof slab is completed or horizontal prestressing is well underway and walls are supported to prevent each panel from tipping out-of-plumb and to keep control joint width constant prior to stressing.

E. Form Tolerances: Provide forms in accordance with ACI 117, ACI 347, and ACI 318 and the following tolerances for finishes specified:

1. Wall Tolerances:

- a. Straight Vertical or Horizontal Wall Surface: Flat planes within tolerance specified.
- b. Wall Type W-A (See Schedule Of Concrete Finishes, Section 03300):
 - i. Plumb within $\frac{1}{4}$ inch in 10 feet or within 1 inch from top to bottom for walls over 40 feet high.
 - ii. Depressions in Wall Surface: Maximum $\frac{5}{16}$ inch when 10 foot straightedge is placed on high points in all directions.
- c. Wall Type W-B (See Schedule Of Concrete Finishes, Section 03300):
 - i. Plumb within $\frac{1}{8}$ inch in 10 feet or within $\frac{1}{2}$ inch from top to bottom for walls over 40 feet high.
 - ii. Depressions in Wall Surface: Maximum $\frac{1}{8}$ inch when 10 foot straightedge is placed on high points in all directions.
- d. Thickness: Maximum $\frac{1}{4}$ inch minus or $\frac{1}{2}$ inch plus from dimension shown.
- e. Form Offset: Between adjacent pieces of formwork, facing material shall not exceed $\frac{1}{4}$ inch.

2. Column Tolerances:
 - a. Exposed Straight Vertical Surfaces: Flat planes within tolerances specified.
 - b. Lateral Alignment:
 - i. Centerlines must be within plus or minus $\frac{1}{2}$ inch from dimensions shown.
 - ii. At intersections, centerlines shall intersect within plus or minus $\frac{1}{2}$ inch of dimensions shown.
 - c. Column:
 - i. Physical Dimensions: Maximum $\frac{1}{4}$ inch minus or $\frac{1}{2}$ inch plus from dimension shown.
 - ii. Plumb within $\frac{1}{4}$ inch in 10 feet in all directions with maximum $\frac{1}{2}$ inch out-of-plumb at top with respect to bottom.

3.3 FORM REMOVAL

- A. Nonsupporting forms (sides of walls, columns, and similar parts of Work) may be removed after cumulatively curing at not less than 50 degrees F for 24 hours (unless approved by SRR) from time of concrete placement if:
 1. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
 2. Curing and protection operations are maintained.
- B. Elevated Structural Slabs: In accordance with ACI 318, Chapter 6, and at such time as concrete has reached compressive strength equal to 80 percent of specified 6000 psi compressive strength as determined by field cured test cylinders.
- C. Submit Certificate of Proper Installation.

3.4 INSPECTION, EXAMINATION, TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance over site inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

REINFORCING STEEL**SECTION 03210****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Reinforcing Steel
- B. Stirrups
- C. Ties
- D. Spirals
- E. Dowels

1.2 RELATED SECTIONS

- A. Division 1 – All Sections

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standards

- 1. American Concrete Institute (ACI)
 - a. 318
 - b. SP-66
- 2. American Society for Testing and Materials (ASTM)
 - a. A 615/A 615M
- 3. Concrete Reinforcing Steel Institute (CRSI)
 - a. MANUAL
 - b. PRB
- 4. International Code Council (ICC)
 - a. IBC

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. C-C2-Z-00005

1.4 DEFINITIONS

- A. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. Reinforcing Steel Shop Drawings, 2.2 E.
 - 2. Reinforcing Steel Material Test Reports, 2.2 F.
 - 3. Reinforcing Steel Manufacturer's Fabrication and Installation Instructions, 2.2 G.
 - 4. Verification of Device Threads Reports, 2.3 A.
 - 5. ICC Evaluation Service Report, 3.2 E. 2.a.
- B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

- A. Reinforcing steel shall be shipped in bundles.
- B. All bundles shall be tagged at the mill with an indelible weatherproof tag in accordance with the CRSI Manual of Standard Practice showing the mill name, heat #, grade, size, and identifying mark number and placement drawing, and SRR Purchase Order number.
- C. Unload, store, and handle bars in accordance with CRSI PRB.
- D. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Reinforcing Bars:
 - 1. Includes stirrups, ties, and spirals.
 - 2. ASTM A 615/A 615M, Grade 60.
 - 3. Mechanical Threaded Connections:
 - a. Furnish metal coupling sleeve with internal threads engaging threaded ends of bars developing in tension or compression 125 percent of yield strength of bar.
 - b. Manufacturers and Products:
 - i. Erico Products, Inc., Cleveland, OH; Lenton Reinforcing Steel Couplers.
 - ii. Richmond Screw Anchor Co., Inc., Fort Worth, TX; Richmond DB-SAE Dowel Bar Splicers.
 - iii. Or approved equal.
- B. Tie Wire:
 - 1. Either of the following:
 - a. Black, soft annealed 16-gauge wire.
 - b. Nylon, epoxy, or plastic coated wire.
- C. Bar Supports and Spacers:
 - 1. Use precast concrete bar supports and side form spacers, unless noted otherwise.
 - a. Do not use other types of supports or spacers, except stainless steel or hard plastic shims under ends of core wall vertical reinforcing bars where shown on Drawings.

2. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation.
 - a. Space bar supports so minimum concrete cover is maintained for reinforcing between supports.
3. Precast concrete supports shall have same minimum strength and shall be made from same materials as that of the concrete in which they are to be embedded.
 - a. Precast concrete supports shall be cast and properly cured for at least 7 days before use and shall have a wire or other device cast into each block for the purpose of attaching them securely to reinforcing steel.
4. Coat wire projecting from precast concrete bar supports with dielectric material, epoxy, or plastic.
5. Design and fabricate special bar supports for top reinforcing bars in slabs where standard bar supports do not possess necessary geometry, strength, or stiffness.
6. Precast Concrete Supports: Total bond precast high performance concrete bar supports as supplied by Con Sys Inc., Pinawa, MB, Canada, or approved equal.

2.2 FABRICATION

- A. In accordance with CRSI MANUAL.
- B. Bend bars cold.
- C. Product Data Submittals Required
- D. Prepare Reinforcing Steel Shop Drawings in accordance with CRSI MANUAL and ACI SP-66 that include the following:
 1. Bending lists.
 2. Placing drawings.
 3. Mechanical threaded connections.
- E. Submit Reinforcing Steel Shop Drawings.
- F. Submit Reinforcing Steel Material Test Reports showing stress-strain curves and ultimate strengths.
- G. Submit Reinforcing Steel Manufacturer's Fabrication and Installation Instructions.

2.3 INSPECTION / EXAMINATION / TESTING

- A. Submit Verification of Device Threads Reports identifying they have been tested and meet requirements for thread quality in accordance with manufacturer's published methods.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean reinforcing bars of loose mill scale, oil, earth, and other contaminants.
- B. Provide for Special inspection by SRR in accordance with Section 01810 and as indicated on Drawings.
 1. Notify STR when reinforcing steel is ready for special inspection in accordance with Section 01810 and allow sufficient time for inspection prior to placing concrete.

3.2 INSTALLATION

- A. Bundle or space bars, instead of field bending, where construction access through reinforcing is necessary.

- B. Spacing and Positioning: Conform to ACI 318.
- C. Location Tolerances: In accordance with CRSI PRB.
- D. Splicing:
 - 1. In accordance with ACI 318.
 - 2. Use lap splices, unless otherwise shown or permitted in writing by STR.
 - a. For minimum lap splice lengths see General Structural Notes – Drawing C-C2-Z-00005.
 - 3. Stagger splices in adjacent bars where indicated.
- E. Mechanical Splices and Connections:
 - 1. Use only in areas specifically approved in writing by STR.
 - 2. Obtain an ICC Evaluation Service Report or equivalent code agency report appropriate for the work defined in this Section that lists findings and includes acceptance, special inspection requirements, and restrictions.
 - a. Submit ICC Evaluation Service Report
 - 3. Install threaded rods as recommended by manufacturer with threads totally engaged into coupling sleeve and in accordance with ICC Evaluation Service Report or SRR accepted equivalent code agency report.
 - 4. Maintain minimum edge distance and concrete cover as required by Drawing C-C2-Z-00005.
- F. Tying Reinforcing Bars:
 - 1. Tie every other intersection on mats made up of Nos. 3, 4, 5, and 6 bars to hold them firmly at required spacing.
 - 2. Bend tie wire away from concrete surface to provide a minimum clearance of 1 inch from surface of concrete to tie wire.
- G. Reinforcement Around Openings: On each side and above and below pipe or opening, place an equivalent area of steel bars to replace steel bars cut for opening.
 - 1. Extend steel reinforcing a standard lap length beyond opening at each end.
- H. Welding Reinforcement: Welding of reinforcing steel bars is not permitted.
- I. Straightening and Rebending: Field bending of reinforcing steel bars is limited to cold bending once at 15 degrees maximum with prior approval of the STR.
- J. Deleted

3.3 INSPECTION / EXAMINATION / TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
 - 1. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 2. Subcontractor responsibilities and related information are included in Section 01810.
- B. SRR quality assurance over site inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

CONCRETE DOWELING**SECTION 03215****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Concrete Doweling

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 03210

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standards

- 1. American Society for Testing and Materials (ASTM)
 - a. C 881/C 881M
- 2. International Code Council (ICC)
 - a. IBC

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE**A. Qualifications:**

- 1. Installer: Trained and certified by manufacturer.
 - a. Manufacturer shall prepare a letter of certification identifying completion of installer's installation training.
 - b. Submit Concrete Doweling Installer's Qualifications.

- B. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. Concrete Doweling Installer's Qualifications, 1.5 A. 1.b.
 - 2. Concrete Doweling Adhesive Manufacturer's Catalog Product Data, 2.1 A. 9.
 - 3. Concrete Doweling Reinforcing Dowel Manufacturer's Catalog Product Data, 2.1 B. 2.
 - 4. Concrete Doweling ICC Evaluation Service Report(s), 2.1 C.
 - 5. Concrete Doweling Manufacturer's Instructions, 2.1 D.

B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

A. Container Markings to include:

1. Manufacturer's name,
2. Product name,
3. Batch number,
4. Product expiration date,
5. ANSI hazard classification,
6. Appropriate ANSI handling precautions.

B. Store adhesive components in accordance with manufacturer's written instructions.

1. Discard when stored other than per manufacturer's instructions or shelf life has expired.

C. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 DESCRIPTION

A. Adhesive:

1. Approved by an ICC Evaluation Service Report (ESR) for conformance to ICC IBC requirements for doweling of steel reinforcing bars in cracked concrete.
2. Suitable for long-term loads as well as for wind and seismic loads.
3. Meet requirements of ASTM C 881/C 881M.
4. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
5. Disposable, Self-Contained Cartridge System:
 - a. Capable of dispensing both components in proper mixing ratio.
 - b. Fit into manually or pneumatically operated caulking gun.
6. Mixed Adhesive: Nonsag, light paste consistency with ability to remain in a 1 inch diameter overhead drilled hole without runout.
7. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
8. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; HIT-RE 500-SD or HIT-HY 150 MAX-SD Adhesive Anchors.
 - b. Powers Fasteners, Brewster, NY; Power PE1000+ Epoxy Adhesive Anchor System (1/2-inch to 7/8-inch diameter anchors).
 - c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-XP Epoxy Adhesive Anchors.
 - d. Or approved equal.
9. Submit Concrete Doweling Adhesive Manufacturer's Catalog Product Data.

B. Reinforcing Used for Dowels:

1. As specified in Section 03210.
2. Submit Concrete Doweling Reinforcing Dowel Manufacturer's Catalog Product Data.

- C. Submit Concrete Doweling ICC Evaluation Service Report(s).
 - 1. Specific to doweling system manufacturer.
- D. Submit Concrete Doweling Manufacturer's Instructions that include:
 - 1. Preparation,
 - 2. Placement,
 - 3. Drilling of holes,
 - 4. Installation of anchors and adhesive,
 - 5. Handling of cartridges, nozzles, and equipment.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Drilling Equipment:
 - 1. Drilling Hammers for Dowel Holes:
 - a. Electric or pneumatic rotary type with medium or light impact and an electric circuit drill stop.
 - b. Hollow drills with flushing air systems are preferred.
 - 2. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.
- B. Hole Diameter: Use drill bit diameter meeting ICC Evaluation Service Report requirements and as recommended by manufacturer.
- C. Obstructions in Drill Path: When existing reinforcing steel is encountered during drilling, obtain STR approval for proposed fix.
- D. Doweling:
 - 1. Install per details shown on Drawings and in accordance with adhesive manufacturer's instructions.
 - a. Dispense components using manufacturer's standard cartridge.
 - 2. When using epoxy anchors, prebending dowels a maximum of 15 degrees, prior to installation, for alignment with other bars is acceptable.
 - a. Do not heat dowels to bend.
 - 3. Bent Bar Dowels: Where edge distances are critical, and intersection with reinforcing steel is likely, drill hole at 10 degree angle or less and use prebent reinforcing bars.

3.2 INSPECTION, EXAMINATION, TESTING, AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR Special Inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

LATERAL CABLING**SECTION 03230****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Lateral Cables

1.2 RELATED SECTIONS

- A. Division 1 – All Sections

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

- A. Required Codes and Standards

- 1. American Society for Testing and Materials (ASTM)
 - a. A 416/A 416M
- 2. International Code Council (ICC)
 - a. IBC

- B. Regulations

- 1. None Specified in this Section

- C. Documents

- 1. None Specified in this Section

- D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. Hold Point, Work shall not proceed without prior approval of STR.

- B. See Section 01100 for additional definitions.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.

- 1. Lateral Cable Certified Material Test Report, 2.1 C.
- 2. Lateral Cable Manufacturer's Certificate of Compliance, 2.1 D.
- 3. Galvanized Cable Inspection Report, 2.1 E. 4.c.
- 4. Certified Tension Test Report, 2.1 E. 5.c.
- 5. Lateral Cabling Details of Sponge Rubber Sleeve, 2.2 D.
- 6. Lateral Cabling Manufacture's Catalog Product Data, 2.3 A.
- 7. Lateral Cabling Fabrication and Installation Instructions, 2.4 B.

- B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

- A. See Section 01600 for general requirements.

PART 2 PRODUCTS**2.1 CABLE DESCRIPTION**

- A. Fabricate from seven-wire stress-relieved galvanized prestressing strands:
- B. Pre-galvanized Cable
 - 1. Strands: Conform to ASTM A 416/A 416M, Grade 270, prior to being hot-dipped galvanized.
- C. Submit Lateral Cable Certified Material Test Report (Mill Test Data) of ungalvanized cable.
- D. Submit Lateral Cable Manufacturer's Certificate of Compliance in accordance with Section 01640 and include the following:
 - 1. Data for minimum of three Samples of final galvanized cables taken from actual material to be used on the Job.
 - 2. Chemical composition for cable prior to galvanizing.
 - 3. Physical properties and dimensions of cable prior to galvanizing, including yield and breaking strengths, elongation, and strand diameter.
 - 4. Zinc coating weight.
- E. Cable Galvanizing
 - 1. Zinc Coating: 0.85 ounce per square foot minimum weight.
 - 2. Elongation: Minimum 4.5 percent in a 24 inch gauge length.
 - 3. After galvanizing, strands shall meet or exceed the following Minimum Properties:
 - a. Diameter; 0.60-inch
 - b. Net area (square inches); 0.217
 - c. Breaking strength (pounds); 54,200
 - d. Yield strength at 1 percent offset (pounds); 40,700
 - 4. Galvanized Cable Inspection
 - a. Inspect a minimum of three samples of final galvanized cable taken from actual material to be used on the Job.
 - b. Measure, record, and compare to the respective acceptance criterion; the Diameter and Net Area of each sample.
 - c. Submit Galvanized Cable Inspection Report
 - 5. Tension Test
 - a. Perform a Tension Test on one of the samples.
 - b. Utilize a Testing Laboratory, in accordance with Section 01450, to conduct the test.
 - c. Submit a Certified Tension Test Report that includes the stress-strain curve with the ultimate tensile strength and yield stress at 1 percent offset marked.

2.2 SPONGE RUBBER SLEEVES

- A. Closed cellular neoprene.
- B. Manufacturers and Products:
 - 1. Monmouth Rubber & Plastics Corp., Long Branch, NJ; Durafoam DK2121MD.
 - 2. Armacell, LLC, Mebane, NC; Monarch Neoprene Blend F-05013.

3. Rubatex, International, LLC, Bedford, VA; R-431-N or R-423-N Soft Grade.
4. Or approved equal.
- C. Adhesive for Sponge Rubber Sleeves: Furnish manufacturer's standard neoprene contact adhesive.
- D. Submit Lateral Cabling Details of Sponge Rubber Sleeve.
 1. Include the sequence of installation.

2.3 PRODUCT DATA

- A. Submit Lateral Cabling Manufacture's Catalog Product Data that includes:
 1. Lateral Cables,
 2. Sponge Rubber Sleeve,
 3. Sponge Rubber Sleeve Contact Adhesive.

2.4 SOURCE QUALITY CONTROL

- A. Fabrication:
 1. SRR approved method and as shown on Drawings.
 2. Cut sponge sleeves and cable recesses as required.
 3. Cut undersized cable recesses and insert cables so voids do not remain inside sleeve.
 4. Glue sleeves back together to provide a sleeve that will not come apart during handling or construction.
 5. Shop fabricate and shape lateral cable sleeve sections to dimensions required prior to placement in forms.
 - a. Spacing between cables shall be as required by sleeve supplier based on cable size and number.
 - b. Dimensions may be varied from those shown on Drawings to provide geometry standard to supplier if approved by SRR through the SDDR process defined in Section 01250.
- B. Prepare and Submit Lateral Cabling Fabrication and Installation Instructions.
 1. Include placement details for lateral cables showing clearances to vertical post-tensioning units and tank wall and slab joints, spacing, and cover.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Place cables in base joint.
- B. Install cables to penetrate joints between wall and footing at angle shown on Drawings. (HOLD POINT)

NOTE: This is a "HOLD POINT" to allow for SRR inspection and observation prior to placing foundation.

 1. A Special Inspection, in accordance with Section 01810 and the Drawings, of the installed cable shall be performed prior to placing concrete.
- C. Secure cables to horizontal wall reinforcing bars as shown on Drawings.

3.2 INSPECTION / EXAMINATION / TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR Special Inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

CONCRETE JOINTS AND ACCESSORIES**SECTION 03251****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Waterstops
- B. Bond Breaker
- C. Accessories

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 03210
- C. Section 03255
- D. Section 03300

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standards

- 1. American Society for Testing and Materials (ASTM)
 - a. D 638
 - b. D 792
 - c. D 2240
- 2. US Army Corps of Engineers (COE)
 - a. CRD-C 572
- 3. International Code Council (ICC)
 - a. IBC

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE**A. Demonstration Mockup for Waterstop Joints:**

- 1. For plastic waterstop, each installer shall prepare one demonstration mockup of a field splice representative of splices to be made on Project.
 - a. Demonstrate field splicing procedures.

- b. After splices have cooled, the splices shall be bent by hand at a sharp angle and shall evidence no visible separation at the splice.
 - c. Splicing methods shall produce joints free of charred material, porosity, and misalignment.
 - 2. Document the results of the Mockup Demonstration for each installer and maintain as retained records.
- B. Installer: Trained and certified by manufacturer.
 - 1. Manufacturer shall prepare a letter of certification identifying completion of installer's installation training.
 - 2. Submit Installer's Qualifications.
- C. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. Installer's Qualifications, 1.5 B. 2.
 - 2. Shop Drawings, 2.1 A.
 - 3. Concrete Joint and Accessories Samples, 2.2 A.
 - 4. Waterstop Manufacturer's Instructions, 2.3 D.
- B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

- A. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 SHOP DRAWINGS

- A. Prepare and Submit Shop Drawings that include at a minimum:
 - 1. Waterstop:
 - a. Details of Waterstop splices,
 - b. Method of securing and supporting waterstop in forms to maintain proper orientation and location during concrete placement.
 - 2. Layout and location for each construction and control joint.

2.2 SAMPLES

- A. Submit Concrete Joint and Accessories Samples:
 - 1. PVC waterstop splice,
 - 2. PVC waterstop joint,
 - 3. Fabricated cross of each size, shape, and fitting of waterstop.

2.3 WATERSTOPS

- A. Plastic Waterstop
 - 1. Extruded from elastomeric plastic compound of which basic resin shall be prime virgin polyvinylchloride (PVC).
 - a. Compound shall not contain scrapped material, reclaimed material, or pigment.

2. Specific Gravity, ASTM D 792 : 1.38 maximum.
 3. Shore Durometer Type A Hardness, ASTM D 2240 : 79 \pm 3.
 4. Ultimate Elongation, ASTM D 638: 350 percent minimum.
 5. Performance Requirements: COE CRD-C 572.
 6. Type: Center bulb with parallel ribs or protrusions on each side of strip center.
 7. Corrugated or tapered type waterstops are not acceptable.
 8. Thickness: Constant from bulb edge to outside stop edge.
 9. Minimum Weight per Foot of Waterstop:
 - a. 1.60 pounds for 3/8 inch by 6 inches.
 - b. 3.40 pounds for 3/8 inch by 12 inches.
 10. Factory Fabrications: Use only factory fabrications for intersections, transitions, and changes of direction.
 11. Manufacturers and Products:
 - a. Vinylex Corp., Knoxville, TN; Catalog No. 03250/VIN: No. RB6-38H (6 inches by 3/8 inch).
 - b. Greenstreak Plastic Products, St. Louis, MO; Catalog No. 03150/GRD: Style 732 (6 inches by 3/8 inch) and Style 726 (12 inches by 3/8 inch).
 - c. Four Seasons Industries Durajoint, Garrettsville, OH; Catalog No. CSP-162: Type 9 (6 inches by 3/8 inch).
 - d. Or approved equal.
- B. Wire Looped Plastic Waterstop
1. Furnish as alternative to plastic waterstops for wall vertical control joints.
 2. Same material and geometry as plastic waterstops.
 3. Furnish with continuous galvanized wire looping at edge, for convenience in positioning and securing stop in place in forms.
 4. Manufacturer and Product: Paul Murphy Plastics, Roseville, MI; Wire Stop Waterstop; geometry number CR-6380.
 5. Or approved equal.
- C. Injection-Type Waterstop
1. Reinjectable waterstop hose system for use where shown on Drawings.
 2. Injectable Water Stop Hose:
 - a. Fabricated of polyvinylchloride (PVC) compound.
 - b. Contain discharge openings to allow for disbursement of an injection material into expansion joint.
 - i. Discharge openings designed to be sealed tight during concreting operation to prevent entry of mixing water and cement slurry.
 - c. Allows free and uniform discharge of injection material over entire length of hose during injection process.
 - d. Able to be internally cleaned by using water and vacuum pressure.
 3. Injection Material: Ultra-fine cement grout consisting of a one component, injection grout mix of ultra-fine slag and Portland cement, mixed with water and dispersant to form grout for low-pressure injection as recommended by reinjectable waterstop hose manufacturer.

4. Manufacturers and Products:
 - a. Greenstreak/BBZ, Bristol, CT; Fuko Type 1 Injection Hose System with Tricodur Micro-cement.
 - b. Deneef Construction Chemicals, Inc., Waller, TX; TRIOject Injection Hose System with MC 300 Microfine Cement.
 - c. Or approved equal.
 - D. Submit Waterstop Manufacturer's Instructions:
 1. Product shipment,
 2. Storage,
 3. Handling,
 4. Installation/application,
 5. Repair.
- 2.4 BOND BREAKER
- A. Tape for Joints: Adhesive-backed glazed butyl or polyethylene tape, same width as joint that will adhere to concrete surface.
 - B. Use either bond breaker tape or bond prevention material as specified in Section 03300 except where tape is specifically called for.
- 2.5 ACCESSORIES
- A. Reinforcing Steel: As specified in Section 03210.
 - B. Ties for PVC Waterstop: "Hog Rings" or grommets for each edge at 12 inch maximum spacing.

PART 3 EXECUTION

- 3.1 GENERAL
- A. Commence concrete placement after joint preparation is complete.
 - B. Time Between Concrete Pours: As specified in Section 03300.
 - C. Prestressed Tank Walls:
 1. Horizontal construction joints are not permitted.
 2. Vertical joints in addition to those shown may be proposed for use through the SDDR process, refer to Section 01250.
- 3.2 SURFACE PREPARATION
- A. Construction Joints: Prior to placement of abutting concrete, clean contact surface:
 1. Remove laitance and spillage from reinforcing steel and dowels.
 2. Roughen surface to minimum of ¼ inch amplitude. Methods which are acceptable include the following:
 - a. Sandblast after concrete has fully cured.
 - b. Water blast after concrete has partially cured.
 - c. Green cut fresh concrete with high pressure water and hand tools.
 3. Perform cleaning so as not to damage waterstop, if one is present.
 - B. Control Joint:
 1. Coat concrete surfaces to each side of plastic waterstop with bond breaker.
 2. Do not damage or coat waterstop.

3.3 INSTALLATION OF WATERSTOPS

A. General:

1. Continuous waterstop (as specified) shall be installed in all construction joints in walls and slabs, unless noted or shown otherwise on Drawings.
2. Join waterstop at intersections to provide continuous seal.
3. Center waterstop on joint unless noted otherwise on Drawings.
4. Secure waterstop in correct position.
 - a. Tie waterstop to reinforcing steel using grommets, "Hog Rings," tie wire, or approved equivalent positive measure at maximum spacing of 12 inches unless otherwise shown on Drawings.
 - b. Do not displace waterstop during concrete placement.
5. Repair or replace damaged waterstop.
6. Place concrete and vibrate to obtain impervious concrete in vicinity of joints.
7. Joints in Footings and Slabs:
 - a. Ensure that space beneath plastic waterstop is completely filled with concrete.
 - b. During concrete placement, make visual inspection of waterstop area.
 - c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, then place remaining concrete to full height of slab.

B. Plastic Waterstop:

1. Install in accordance with manufacturer's written instructions.
 - a. Misalignment of center bulb and ribs shall not exceed 1/16 inch.
2. Splice in accordance with waterstop manufacturer's written instructions using Teflon-coated thermostatically controlled heating iron at approximately 380 degrees F.
 - a. Allow at least 10 minutes before new splice is pulled or strained in any way.
 - b. Finished splices shall provide cross section that is dense and free of porosity.
 - i. Splices shall be free of charred or burnt material.
 - c. Use only factory made waterstop fabrications for all intersections, changes of directions and transitions.
 - d. Field splice permitted only for straight butt welds.
3. Wire looped plastic waterstop may be substituted for plastic waterstop for wall vertical control joints.

C. Injection-Type Waterstop:

1. Install reinjectable waterstop hose, in accordance with manufacturer's instructions.
2. After concrete has been placed and cured for a minimum of 28 days, inject specified injection material into reinjectable waterstop hose in accordance with manufacturer's instructions.
3. Upon completion of injection process, clean out remaining injection material in hose in accordance with manufacturer's instructions.

D. See Section 03255 for additional information concerning installation at the top of the footer at concrete wall base.

3.4 CONTROL JOINT INSTALLATION

- A. Install PVC waterstop.
- B. Concrete surfaces shall be dense and smooth.
- C. Install bond breaker to concrete surfaces to each side of waterstop.

3.5 INSPECTION / EXAMINATION / TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
 - 1. Perform visual inspection for proper placement of waterstops, including alignment and intersections, and joint quality.
 - a. Field inspect all joints for specified requirements.
- B. Provide for SRR Special Inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

CONCRETE WALL BASE AND TOP JOINTS**SECTION 03255****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Rubber Pad
- B. Sponge Rubber
- C. Sealant

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 03230
- C. Section 03251

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

- A. Required Codes and Standards
 - 1. American Society for Testing and Materials (ASTM)
 - a. D 1056
 - b. D 2000
 - 2. International Code Council (ICC)
 - a. IBC
- B. Regulations
 - 1. None Specified in this Section
- C. Documents
 - 1. None Specified in this Section
- D. Drawings
 - 1. None Specified in this Section

1.4 DEFINITIONS

- A. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01300 and 01400.
 - 1. Product Data, 2.2 A.
 - 2. Manufacturer's Splicing Instructions, 3.1 A. 4.a.
 - 3. Proposed Method for Holding Waterstop, 3.1 A. 5.h.i.
- B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

- A. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Plastic Waterstop: As specified in Section 03251.
- B. Rubber Pad: Neoprene meeting ASTM D 2000, Type M2BC 414 A14C12F17.
 - 1. Manufacturers:
 - a. Dacon Industries Co., Portland, OR.
 - b. West American Rubber Company, Inc., Orange, CA.
 - c. Monmouth Rubber & Plastics Corp., Long Branch, NJ.
 - d. Or approved equal.
- C. Sponge Rubber: Closed-cell, expanded neoprene meeting ASTM D 1056, Type 2A5 with a compression deflection, 25 percent deflection (limits) 120 to 170 kPA, (17 to 25 psi) minimum.
 - 1. Manufacturers:
 - a. Monmouth Rubber & Plastics Corp., Long Branch, NJ.
 - b. Armacell, LLC, Mebane, NC.
 - c. Or approved equal.
- D. Sealant: Gun grade or pourable immersible sealant.
 - 1. Manufacturer and Product: Sika Chemical Co.; Sikaflex-1A or 2C, or approved equal.
- E. Rubber Adhesive: Immersible neoprene contact adhesive for bonding rubber to concrete surfaces.
 - 1. Manufacturer and Product: 3M Industrial Adhesives and Tapes Division, St. Paul, MN; Scotch-Weld Neoprene Contact Adhesive 10, or approved equal.

2.2 PRODUCT DATA

- A. Submit Product Data
 - 1. Rubber Pad
 - 2. Sponge Rubber
 - 3. Sealant

PART 3 EXECUTION

3.1 INSTALLATION

- A. Plastic Waterstop:
 - 1. Continuous and as specified in Section 03251.
 - 2. Field bond waterstop in wall base joint to waterstops in the wall vertical joint and slab or footing joints to form a continuous barrier capable of withstanding water pressure involved.
 - 3. Make connections and splices required with field equipment capable of applying sufficient heat to bond the joint.
 - 4. Method of Splicing: Butt splices with prefabricated intersections in accordance with Section 03251.
 - a. Submit Manufacturer's Splicing Instructions.

5. Installation in Footings:
 - a. Form footing so base of wall joint waterstop shall be continuously supported as concrete is placed.
 - b. Position hollow-bulb section of waterstop in base of wall joint as shown on Drawings to vertical and horizontal tolerance of plus or minus ¼ inch.
 - c. Field measure location of waterstop at base of wall using radial measurements from reservoir center to guarantee waterstop is located and placed in a true circle over its entire length.
 - d. Install a continuous circular form to secure the waterstop to final shape and position.
 - e. Carefully screed and trowel concrete surface within area to be occupied by the wall to provide a uniform bearing surface for rubber pads.
 - f. Grind or repair surface irregularities that may interfere with the required action of joint.
 - g. Prepared Surface Tolerance: Not to exceed 1/8 inch in 10 feet.
 - h. Provide approved means to ensure support of the projecting half of the waterstop as wall concrete is placed, to prevent out of tolerance movement and location due to concrete pressure or other construction loads that might be placed on waterstop.
 - i. Submit Proposed Method for Holding Waterstop.
- B. Lateral Cables: Locate and install as shown on Drawings and as specified in Section 03230.
- C. Rubber Pad:
 1. Place between wall and base slab and between wall and roof slab as shown on Drawings.
 2. Prior to cementing rubber pad or sponge rubber in place, dry concrete surface and brush thoroughly to remove dirt and foreign material.
 3. Use waterproof rubber adhesive that will not damage pad to bond rubber to concrete surface.
 4. Caulk between waterstop and rubber pad with sealant that will remain in place to ensure fresh concrete or mortar does not penetrate below top of rubber pad.
 - a. Seal gaps that would allow concrete from wall pour to penetrate pad area and cause local spalling.
- D. Sponge Rubber:
 1. Place to preclude concrete-to-concrete bearing between wall and base slab and between wall and roof slab.
 2. Caulk crevices in the trimmed sponge rubber with sealant that will remain in place to ensure fresh concrete or mortar does not penetrate below top of neoprene pad or sponge rubber pads.
 3. Support edges of sponge rubber pieces and strips:
 - a. To restrain surfaces from movement during concrete placement.
 - b. To reduce load deflection of sponge rubber under weight of fresh concrete to a minimum.
 4. Protect during initial concrete placement to prevent movement of sponge rubber from vibration, falling concrete, and other forces.

5. Prior to horizontal prestressing or filling of tank, clean face of joints of concrete and mortar so sponge rubber is seen at full depth and joint is free from concrete or other material that would restrict or prevent wall movement and cause local spalling.

3.2 INSPECTION / EXAMINATION / TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR Special Inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

CAST IN PLACE CONCRETE

SECTION 03300

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cast In Place Concrete

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 03100
- C. Section 03251
- D. Section 03370
- E. Section 03600
- F. Section 03720
- G. Section 03722
- H. Section 03740
- I. Section 09900

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standards

1. American Concrete Institute (ACI)
 - a. 117
 - b. 211.1
 - c. 301
 - d. 305.1
 - e. 306.1
 - f. 350.1
2. American Society for Testing and Materials (ASTM)
 - a. C 31/C 31M
 - b. C 33/C 33M
 - c. C 39/C 39M
 - d. C 40/C 40M
 - e. C 94/C 94M
 - f. C 117
 - g. C 136
 - h. C 142/C 142M
 - i. C 143/C 143M
 - j. C 150/C 150M
 - k. C 157/C 157M
 - l. C 260/C 260 M
 - m. C 494/C 494M

- n. C 566
- o. C 618
- p. C 881/C 881M
- q. C 989/C 989M
- r. C 1077
- s. C 1240
- t. C 1602/C 1602M
- u. E 329
- v. C 227
- w. C 1260
- x. C 1293
- y. C 1567
- z. C 173/C 173 M
- aa. C 1064/C 1064M
- 3. International Code Council (ICC)
 - a. IBC
- 4. National Ready-Mixed Concrete Association (NRMCA)
 - a. QC-3
- B. Regulations
 - 1. None Specified in this Section
- C. Documents
 - 1. None Specified in this Section
- D. Drawings
 - 1. None Specified in this Section

1.4 DEFINITIONS

- A. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.
- B. Subcontractor's Licensed Design Engineer: Individual representing Subcontractor who is licensed to practice engineering as defined by statutory requirements of professional licensing laws in state or jurisdiction in which Project is to be constructed.
- C. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/8 inch deep, surface voids greater than 1 inch in diameter, cracks in containment structures and that are 0.005 inch wide and wider, cracks that leak, and cracks in other structures that are 0.010 inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections.
 - 1. Crack widths in prestressed concrete elements shall be measured following application of prestressing forces.
- D. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.
- E. Hot Weather: As defined in ACI 305.1.

- F. Containment Structure: Closed structure designed to contain Saltstone grout.
- G. New Concrete: Less than 60 days old.
- H. Slurry Mixture: Mixture of sand, 3/8 inch maximum nominal aggregate size, cement, and water for wall construction joints with waterstop meeting requirements of Type V wall concrete mix in all respects except for omission of aggregates greater than 3/8 inch.
- I. See Section 01100 for additional definitions.

1.5 QUALITY ASSURANCE

- A. Concrete construction shall conform to requirements of ACI 117 and ACI 301, except as modified herein.
- B. Qualifications:
 - 1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
 - a. Meet the NRMCA QC-3 Check List Certification requirements for storage and handling, batching, mixing and transporting equipment.
 - i. Maintain NRMCA Certification or SRR Equivalence Document through completion of the contract.
 - ii. Submit a Statement of Qualification for Batch Plant NRMCA Certification or Equivalence Document.
 - 2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work.
 - a. Requirement may be waived if individual is Subcontractor's Licensed Design Engineer.
 - b. Submit a Statement of Qualification for Mix Designer.
 - 3. Testing Agency: Unless otherwise permitted, an independent agency qualified according to ASTM C 1077 and ASTM E 329 for acceptance testing for Type II Mix Design.
 - a. Personnel performing laboratory tests shall be ACI certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician – Grade I.
 - i. Testing Agency laboratory supervisor shall be an ACI certified Concrete Laboratory Testing Technician – Grade II.
 - b. Submit a Statement of Qualification for Testing Agency.
- C. Preinstallation Conference:
 - 1. Required Meeting Attendees:
 - a. Subcontractor, including pumping, placing and finishing, and curing subcontractors.
 - b. Ready-mix producer.
 - c. Admixture representative.
 - d. Testing and sampling personnel.
 - e. STR representatives.
 - 2. Schedule and conduct prior to incorporation of respective products into Project.
 - a. Notify the STR of location and time.

3. Agenda shall include:
 - a. Admixture types, dosage, performance, and redosing at Site.
 - b. Mix designs, test of mixes, and Submittals.
 - c. Placement methods, techniques, equipment, consolidation, and form pressures.
 - d. Slump and placement time to maintain slump.
 - e. Locations of air, slump and strength sampling.
 - f. Finish, curing, and water retention.
 - g. Protection procedures for weather conditions.
 - h. Other specified requirements requiring coordination.
4. Submit Preinstallation Conference Minutes.
- D. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 1. Statement of Qualification for Batch Plant NRMCA Certification, 1.5 B. 1.a.ii.
 2. Statement of Qualification for Mix Designer, 1.5 B. 2.b.
 3. Statement of Qualification for Testing Agency, 1.5 B. 3.b.
 4. Preinstallation Conference Minutes, 1.5 C. 4.
 5. Batch Tickets for Concrete Placed, 1.7 A. 9.
 6. Certificate of Compliance for Portland Cement, 2.1 A. 1.b.
 7. Cement Chemical Analysis, 2.1 A. 1.c.
 8. Certificate of Compliance for Fly Ash, 2.1 A. 2.a.i.
 9. Fly Ash Test Report, 2.1 A. 2.a.ii.
 10. Certificate of Compliance for Slag Cement, 2.1 A. 2.b.i.
 11. Slag Cement Test Report, 2.1 A. 2.b.ii.
 12. Certificate of Compliance for Silica Fume, 2.1 A. 2.c.i.
 13. Silica Fume Test Report, 2.1 A. 2.c.ii.
 14. Supplementary Cementitious Materials Chemical Analysis, 2.1 A. 2.d.
 15. Certificate of Compliance for Aggregates, 2.1 A. 3.c.
 16. Certificate of Compliance for Admixtures, 2.1 A. 4.d.
 17. Certificate of Compliance for Bonding Agent, 2.2 A. 5.
 18. Manufacturer's Application Instructions for Bonding Agent, 2.2 A. 6.
 19. Certificate of Compliance for Bond Breaker, 2.2 B. 3.
 20. Manufacturer's Application Instructions for Bond Breaker, 2.2 B. 4.
 21. Proportions Of Materials And Admixtures To Be Used For Type II Mix Design, 2.3 A. 2.f.
 22. Documentation Of Average Strength For Proposed Type II Mix Design, 2.3 A. 2.g.
 23. Test Reports for Type II Mix Design, 2.3 A. 2.h.
 24. Aggregate Data for Type II Mix Design, 2.3 A. 2.i.

25. Admixtures Manufacturer's Catalog Cut Sheets And Product Data Sheets, 2.3 A. 2.j.
26. Detailed Plan For Hot Weather Placements, 3.1 J. 3.
27. Detailed Plan For Curing And Protection Of Concrete Placed And Cured In Cold Weather, 3.1 K. 5.
28. Aggregate Test Results, 3.12 B. 9.
29. Production Aggregate Testing Report, 3.12 B. 10.
30. Detailed Plan for Liquid Tightness Test Procedures, 3.12 C. 10.
31. Liquid Tightness Test Results, 3.12 C. 11.
32. Deleted

B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

A. Batch Ticket – For Each Batch Delivered to SRS

1. Utilize batch tickets in accordance with ASTM C 94/C 94M, including requirements 14.2.1 through 14.2.10.
2. Designate the start time for mixing when all the solid materials are in the drum for a stationary mixer.
 - a. Designate the revolutions on the truck drum revolution counter at the end of discharge from the stationary mixer into the truck.
3. If truck mixing is utilized, designate the start time for mixing as the time of the first addition of water to the dry material components.
 - a. Designate the revolutions on the truck drum revolution counter at the first addition of water to the dry material components.
4. Designate the amount of water in gallons, not exceeding the water-to-cementitious material ratio, available for addition at the point of delivery.
 - a. Initial the batch ticket.
5. Verify and record on the batch ticket that the Supplier's representative has reviewed the batch ticket for the amount of water added and the Supplier's representative has initialed the batch ticket.
6. Complete discharge of the concrete within ninety (90) minutes or before the drum has revolved three hundred (300) revolutions, whichever comes first.
 - a. These limits may be exceeded, with Special Inspector approval and signature on Batch Ticket, in accordance with ASTM C 94/C 94M Section 12.1 provided the concrete is of such slump and/or flow that it can be placed without the additional introduction of high range water reducing admixture to the batch.
7. Record the discharge completion time and number of drum revolutions from the drum revolution counter at the completion time of discharge on the batch ticket.
 - a. Record the total time (start of mixing time to the discharge completion time) plus the total number of drum revolutions and record this information on the batch ticket(s).
8. Ensure that the concrete is in accordance with the requirements outlined in this document.
9. Submit Batch Tickets for Concrete Placed by including with weekly QC Report.

B. See Section 01600 for general requirements.

PART 2 PRODUCTS**2.1 MATERIALS****A. Cementitious Materials:****1. Cement:**

- a. Portland Cement: Unless otherwise specified, conform to requirements of ASTM C 150/C 150M.
- b. Submit Certificate of Compliance for Portland Cement.
- c. Submit Cement Chemical Analysis.

2. Supplementary Cementitious Materials (SCM):

- a. Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C 618.
 - i. Submit Certificate of Compliance for Fly Ash.
 - ii. Submit Fly Ash Test Report.
- b. Slag Cement: In accordance with ASTM C 989/C 989M, Grade 100.
 - i. Submit Certificate of Compliance for Slag Cement.
 - ii. Submit Slag Cement Test Report.
- c. Silica Fume: In accordance with ASTM C 1240.
 - i. Submit Certificate of Compliance for Fly Ash.
 - ii. Submit Silica Fume Test Report.

d. Submit Supplementary Cementitious Materials Chemical Analysis.**3. Normal-Weight Aggregates: In accordance with ASTM C 33/C 33M.**

- a. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).
- b. Aggregates shall have been tested to determine potential alkali-aggregate reactivity in concrete in accordance with ASTM C 1260 and ASTM C 1567.
 - i. Aggregates that indicate expansion greater than 0.10 percent at 16 days after casting shall not be used unless they have been shown to be nondeleteriously reactive in accordance with ASTM C 227 or ASTM C 1293, with less than 0.04 percent expansion at 1 year for cement-aggregate combinations or 2 years for combinations with pozzolan or slag or as approved by SRR.
 - ii. Alkali content of cement used in proposed concrete mixture shall not be greater than alkali content used in test for potential alkali-aggregate reactivity.

c. Submit Certificate of Compliance for Aggregates.**4. Admixtures: Unless otherwise permitted, furnish from one manufacturer.**

- a. Compatible with other constituents in mix, contain at most only trace amount of chlorides in solution, and as recommended by manufacturer for anticipated temperature range.
- b. Water-Reducing Admixture: ASTM C 494/C 494M, Type A or Type D.
- c. Air-Entraining Admixture for Type V Mix Design: ASTM C 260/C 260 M.
- d. Submit Certificate of Compliance for Admixtures.

- B. Liquid Nitrogen, water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.
 - 1. Water from alternative sources shall comply with requirements of ASTM C 1602/C 1602M, and concentration of chemicals in combined mixing water shall be less than:
 - a. Chloride Content: 500 ppm.
 - b. Sulfate Content as SO_4 : 3,000 ppm.
 - c. Alkalis as $(\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O})$: 600 ppm.
 - d. Total Solids by Mass: Less than 50,000 ppm.

2.2 ANCILLARY MATERIALS

- A. Bonding Agent: Unless otherwise specified, in accordance with the following:
 - 1. ASTM C 881/C 881M, Type V.
 - 2. Two-component, moisture insensitive, 100 percent solids epoxy.
 - 3. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.
 - 4. Manufacturers and Products:
 - a. BASF Building Systems Inc., Shakopee, MN; Concrese Standard LVI.
 - b. Euclid Chemical Co., Cleveland, OH; Euco # 352 Epoxy System LV.
 - c. Prime Resins, Conyers, GA; Prime Bond 3000 to 3900 Series.
 - d. Sika Chemical Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod LPL.
 - e. Or approved equal.
 - 5. Submit Certificate of Compliance for Bonding Agent.
 - 6. Submit Manufacturer's Application Instructions for Bonding Agent.
- B. Bond Breaker:
 - 1. Nonstaining type, providing positive bond prevention.
 - 2. Manufacturers and Products:
 - a. Dayton Superior Corporation, Kansas City, KS; EDOCO Clean Lift Bond Breaker.
 - b. Nox-Crete Products Group, Omaha, NE; Silcoseal Select.
 - c. Or approved equal.
 - 3. Submit Certificate of Compliance for Bond Breaker.
 - 4. Submit Manufacturer's Application Instructions for Bond Breaker.
- C. Repair Material:
 - 1. In accordance with requirements of Section 03720.
 - 2. In accordance with requirements of Section 03722.
 - 3. Form Tie Through Hole Type V Dry Pack Repair Mortar:
 - a. Type V Lehigh cement and fine aggregate with maximum cement to aggregate ratio by weight of 1:2.5.
 - i. No coarse aggregate shall be used.
 - b. Add water just sufficient to produce a mortar that will stick together.
 - 4. Deleted

5. Fine Aggregate for Through Hole Repair Mortars:
 - a. Cement and fine aggregate shall be obtained from the Argos USA Batch Plant Facility and conform to the requirements in Attachment 03300-A, Identifier D5000-8-S-2-AB, with the following exception:
 - i. Screen fine aggregate through #16 sieve prior to use to remove larger aggregates.

D. Crack Repair: In accordance with requirements of Section 03740.

2.3 CONCRETE MIX DESIGN

A. There are two basic mix designs required for the Work.

1. Type V Design - SRR accepted Class III sulfate resistant Type V mix design.
 - a. Use for core walls, bottom slab, and top slab of the Saltstone Disposal Unit 6 tank, as well as stair tower foundation and equipment pads.
 - i. See Attachment 03300-A for mix design requirements.
 - ii. This mix, developed by SRR, may be obtained from the following supplier:
Argos USA Batch Plant Facility, 50 Main Street, Jackson, SC 29831
 - b. The products and constituents used in the approved mix design shall not be changed without prior SRR acceptance.
 - i. No admixtures shall be used in addition to those listed in the approved mix design.
 - ii. Mixing silica fume bags in the mix is prohibited.
2. Type II Design – A mix design using Type II cement.
 - a. Use for mud slabs and other miscellaneous concrete work.
 - i. This mix design shall not be used for structural elements containing tank contents.
 - b. This mix design shall be developed by the Subcontractor and shall meet the following minimum requirements:
 - i. Concrete compressive strength at 7 days: 1,400 psi minimum.
 - ii. Concrete compressive strength (f'c) at 28 days: 2,000 psi.
 - c. Select and proportion ingredients using trial batches; sample, cure, and test concrete mix through approved independent testing laboratory in accordance with ACI 211.1.
 - i. Selection of constituent materials and products in mix design are optional, unless specified otherwise.
 - d. Unless otherwise specified, desired fresh properties of concrete shall be determined by Subcontractor, and coordinated with concrete producer.
 - i. Fresh properties of concrete shall remain stable to satisfaction of Subcontractor for duration of placement and consolidation and shall remain in conformance with requirements of Subcontract Documents.
 - e. Prepare separate mix designs when admixtures are required for hot and cold weather concrete work.
 - f. Submit Proportions Of Materials And Admixtures To Be Used For Type II Mix Design, signed by mix designer.
 - g. Submit Documentation Of Average Strength For Proposed Type II Mix Design in accordance with ACI 301.

- h. Submit Test Reports for Type II Mix Design:
 - i. Cement: Chemical analysis report.
 - ii. Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.
- i. Submit Aggregate Data for Type II Mix Design:
 - i. Coarse Aggregate Gradation: List gradings and percent passing through each sieve.
 - ii. Fine Aggregate Gradation: List gradings and percent passing through each sieve.
 - iii. Deleterious substances in fine aggregate per ASTM C 33/C 33M, Table 2.
 - iv. Deleterious substances in coarse aggregate per ASTM C 33/C 33M, Table 4.
- j. Submit Admixtures Manufacturer's Catalog Cut Sheets And Product Data Sheets for each admixture used in proposed Type II mix design.

2.4 CONCRETE MIXING

- A. General: In accordance with ACI 301, except as modified herein.
- B. Truck Mixers:
 - 1. For every truck, test slump of samples taken per ASTM C 94/C 94M, paragraph 12.5.1.
 - 2. Where specified slump is more than 4 inches, and if slump tests differ by more than 3 inches, discontinue use and placement unless causing condition is corrected and satisfactory performance is verified by additional slump tests.

2.5 SOURCE QUALITY CONTROL

- A. Source Quality Control Inspection: STR shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and Subcontractors, providing products included in this Section.

PART 3 EXECUTION

3.1 PLACING CONCRETE

- A. Preparation: Meet requirements ACI 301, except as modified herein.
- B. Inspection: Notify STR and Special Inspector at least 3 full working days in advance before starting to place concrete.
- C. Placement into Formwork:
 - 1. Reinforcement: Secure in position before placing concrete.
 - 2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs which shall be placed full depth.
 - a. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
 - 3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
 - 4. Use placement devices, for example chutes, pouring spouts, and pumps as required to prevent segregation.

5. Vertical Free Fall Drop to Final Placement:
 - a. Forms 8 Inches or Less Wide: 5 feet.
 - b. Forms Wider than 8 Inches: 8 feet, except as specified.
 6. For placements where drops are greater than specified, use placement device such that free fall below placement device conforms to required value.
 - a. Limit free fall to prevent segregation caused by aggregates hitting steel reinforcement.
 7. Do not use aluminum conveying devices.
 8. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
 9. Joints in Footings and Slabs:
 - a. Ensure space beneath plastic waterstop completely fills with concrete.
 - b. During concrete placement, make visual inspection of entire waterstop area.
 - c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, and place remaining concrete to full height of slab.
 - d. Apply procedure to full length of waterstop.
 10. Trowel and round off top exposed edges of walls with ¼ inch radius steel edging tool.
 11. Cure concrete as specified in Section 03370.
- D. Conveyor Belts and Chutes:
1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
 2. Do not use chutes longer than 50 feet.
 3. Minimum Slopes of Chutes: Angled to allow concrete to readily flow without segregation.
 4. Conveyor Belts:
 - a. Approved by STR.
 - b. Wipe clean with device that does not allow mortar to adhere to belt.
 - c. Cover conveyor belts and chutes.
- E. Retempering: Not permitted for concrete where cement has partially hydrated.
- F. Pumping of Concrete:
1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
 2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
 3. Replace pumping equipment and hoses (conduits) that are not functioning properly.
- G. Maximum Size of Concrete Placements:
1. Locate control and contraction joints where shown on Drawings.

2. Construction Joints: Unless otherwise shown or permitted, locate construction joints as follows:
 - a. Locate construction joints as shown on Drawings.
 - i. Additional construction joint locations shall be submitted for SRR review and approval, in accordance with Section 01250, where required for Subcontractor's operations.
 - ii. No horizontal construction joints shall be placed in concrete walls as required by Section 03251.
 3. Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.
 4. Should placement sequence result in cold joint located below finished water surface, install waterstop in joint.
- H. Minimum Time between Adjacent Placements:
1. Construction or Control Joints: 7 days unless otherwise specified or shown on Drawings.
 2. Construction joint between top of footing or slab, and column or wall: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
 3. Expansion or Contraction Joints: 1 day.
- I. Consolidation and Visual Observation:
1. Consolidation Equipment and Methods: ACI 301. Form vibrators shall not be used.
 2. Provide adequate standby vibrators in operable condition at Site prior to placing concrete.
 3. Provide sufficient windows in forms or limit form height to allow for concrete placement through windows and for visual observation of concrete.
 4. Vibrate concrete with special attention to vicinity of joints to obtain impervious concrete.
- J. Hot Weather:
1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:
 - a. Maintain concrete temperature below 90 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration.
 - i. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
 - b. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.
 2. Concrete Curing: As specified in Section 03370.
 3. Submit Detailed Plan For Hot Weather Placements including curing and protection for concrete placed in ambient temperatures over 90 degrees F in accordance with ACI 305.1. Plan shall include, but not be limited to, the following:
 - a. Procedures for measuring, and recording temperatures of forms reinforcement and other embedded items prior to concrete placement.

- b. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.
- c. Types of shading and wind protection to be provided.
- d. Curing methods, including use of evaporation retardant.
- e. Procedures for measuring and recording concrete temperatures.
- f. Procedures for preventing drying during dry, windy conditions.

K. Cold Weather Placement:

1. Unless otherwise permitted, shall be in accordance with requirements of ACI 306.1 and as follows:
 - a. Cold weather requirements shall apply when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling.
 - b. Do not place concrete over frozen earth or against surfaces with frost or ice present.
 - i. Frozen earth shall be thawed to acceptance of STR.
 - c. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35 degrees F.
 - i. Requirement is applicable to all surfaces including reinforcement and other embedded items.
 - d. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1 and with STR approval.
 - e. Maintain minimum surface temperature of concrete as specified in ACI 306.1 for no less than 3 days during cold weather conditions.
 - f. Cure concrete as specified in Section 03370.
 - i. Protect concrete from freezing until end of curing period and until concrete has attained a compressive strength of 3,500 psi or design compressive strength if less than 3,500 psi.
2. Provide maximum and minimum temperature sensors placed on concrete surfaces spaced throughout work to allow monitoring of concrete surface temperatures representative of work.
 - a. Unless otherwise permitted, record surface temperature of concrete at least once every 6 hours during specified curing period.
3. External Heating Units: Do not exhaust heater flue gases directly into enclosed area as it causes concrete carbonation as a result of concentrated carbon dioxide.
4. Maintain curing conditions as specified in Section 03370.
5. Submit Detailed Plan For Curing And Protection Of Concrete Placed And Cured In Cold Weather in accordance with ACI 306.1. Details shall include, but not be limited to, the following:
 - a. Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.
 - b. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
 - c. Methods for temperature protection during placement.
 - d. Types of covering, insulation, housing, or heating to be provided.

- e. Curing methods to be used during and following protection period.
- f. Methods for verification of in-place strength.
- g. Procedures for measuring and recording concrete temperatures.
- h. Procedures for preventing drying during dry, windy conditions.

3.2 CONCRETE BONDING

A. Construction Joints in New Concrete Members:

- 1. Prepare surface of construction joint as specified in Section 03251.
- 2. Horizontal Construction Joints Containing Waterstop in New Concrete Walls:
 - a. Unless otherwise permitted, place slurry mixture 4 inch maximum thickness, 2 inch minimum thickness in horizontal construction joints containing waterstops.
 - b. Use positive measuring device such as bucket or other device that will contain only enough slurry mixture for depositing in visually measurable area of wall to ensure that portion of form receives appropriate amount of slurry mixture to satisfy placement thickness requirements.
 - c. Do not deposit slurry mixture from pump hoses or large concrete buckets, unless specified placement thickness can be maintained and verified through inspection windows close to joint, or by other means.
 - d. Limit concrete placed immediately on top of slurry mixture to 12 inches thick. Thoroughly vibrate to mix concrete and slurry mixture together.

B. Construction Joints at Existing Concrete:

- 1. Thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of $\frac{1}{4}$ inch.
- 2. Saturate surface with water for 24 hours prior to placing new concrete.

3.3 REPAIRING CONCRETE

NOTE: Cracks on mud mats need not be repaired.

A. General:

- 1. Penetrations (i.e. nails, screws, etc.) to the Type V concrete shall be minimized to the maximum extent practical.
 - a. Any penetrations to the Type V concrete after setting shall be approved by the STR.
- 2. Inject cracks that leak with crack repair epoxy as specified in Section 03740.
- 3. Repair defective areas of concrete.
- 4. Repair horizontal concrete surfaces in accordance with Section 03722.
- 5. Repair vertical and overhead concrete surfaces in accordance with Section 03720.
- 6. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to STR.

B. Form Ties, Through-Bolts:

- 1. Mechanically roughen entire interior surface of through hole.
- 2. Apply bonding agent to roughened surface and drive elastic vinyl plug to a minimum depth of 8 inches as measured from inside face of tank wall and as close to center of wall as allowed.

3. Dry pack hole from inside face of wall to plug with Type V Dry Pack Repair Mortar.
 4. Dry pack hole from outside face of wall to plug with nonshrink grout, as specified in Section 03600.
 5. Use only enough water to dry pack Type V Repair Mortar and nonshrink grout.
 6. Dry pack while bonding agent is still tacky.
 7. If bonding agent has dried, remove bonding agent by mechanical means and reapply new coat of bonding agent.
 8. Compact grout using steel hammer and steel tool to drive grout to high density.
 9. Cure cementitious grout materials with water.
- C. Exposed Metal Objects:
1. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1 inch and then cutting or removing metal object.
 2. Repair area of chipped-out concrete as specified for defective areas.
- D. Blockouts at Pipes or Other Penetrations: Where shown install in accordance with requirements of Drawings.

3.4 CONCRETE WALL FINISHES

- A. Type W-1 (Ordinary Wall Finish):
1. Patch tie holes.
 2. Knock off projections.
 3. Repair defective areas.
 4. Inject cracks in accordance with requirements of Section 03740.
- B. Type W-2 (Smooth Wall Finish):
1. Patch tie holes.
 2. Grind off fins and other projections.
 3. Repair defective areas to provide smooth uniform appearance.
 4. Inject cracks in accordance with requirements of Section 03740.
- C. Type W-5 (Finish for Painting):
1. Patch tie holes.
 2. Grind off projections, fins, and rough spots.
 3. Patch and repair defective areas as specified for Type W-2.
 4. Leave surface ready for painting as specified in Section 09900.
- D. Type W-6 (Finish for Prestressed Tanks):
1. Remove form ridges, pieces of wood, and excess concrete from formed surfaces same day forms are removed.
 2. If forms are removed within 7 days of placement, minimize interruption of curing.
 3. In accordance with requirements for Type W-2 except as follows:
 - a. Sandblast core wall exterior surface.
 - b. Exposed edge of roof shall have Type W-5 finish.

3.5 CONCRETE SLAB FINISHES

A. General:

1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
2. Do not use "jitterbugs" or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
3. Finish slab in accordance with specified slab finish.
4. Do not dust surfaces with dry materials nor add water to surfaces.
5. Cure concrete as specified in Section 03370.

B. Type S-1 (Steel Troweled Finish):

1. Finish by screeding and floating with straightedges to bring surfaces to required finish elevation.
2. Wood float to true, even plane with no coarse aggregate visible.
3. Use sufficient pressure on wood floats to bring moisture to surface.
4. After surface moisture has disappeared, hand steel trowel concrete to produce a smooth dense surface, free from trowel marks.
5. Provide light steel-troweled finish (two trowelings) at air-entrained slabs.
 - a. Provide hard steel-troweled finish (ringing sound from the trowel) for nonair-entrained slabs.
6. Do not use dry cement or additional water during troweling, nor will excessive troweling be permitted.
7. Power Finishing:
 - a. Approved power machine may be used in lieu of or in addition to hand finishing in accordance with directions of machine manufacturer.
 - b. Do not use power machine when concrete has not attained necessary set to allow finishing without introducing high and low spots in slab.
 - c. Do first steel troweling for slab S-1 finish by hand.

C. Type S-3 (Underside Elevated Slab Finish): When forming is removed, patch defective areas.

D. Type S-5 (Broomed Finish):

1. Finish as specified for Type S-1 floor finish, except use only a light-steel troweled finish, and then finish surface by drawing fine-hair broom lightly across surface.
2. Broom in same direction and parallel to expansion joints, or, in case of inclined slabs, perpendicular to slope, except for round roof slab, broom surface in radial direction.

E. Type S-6 (Sidewalk Finish):

1. Slope walks down $\frac{1}{4}$ inch per foot away from structures, unless otherwise shown.
2. Strike off surface by means of strike board and float with wood or cork float to true plane, then flat steel trowel before brooming.
3. Broom surface at right angles to direction of traffic or as shown.
4. Lay out sidewalk surfaces in blocks, as shown or as directed by STR, with grooving tool.

3.6 CONCRETE SLAB TOLERANCES

A. Slab Tolerances:

1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10 foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10 foot straightedge.
3. Slab Type S-A: Steel gauge block 5/16 inch thick.
4. Slab Type S-B: Steel gauge block 1/8 inch thick.
5. Slab Type S-A and S-B: Finish Slab Elevation: Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.
6. Thickness: Maximum $\frac{1}{4}$ inch minus or $\frac{1}{2}$ inch plus from thickness shown.
 - a. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed $\frac{1}{2}$ inch plus.

B. Slab Elevation and Thickness:

1. Finish Slab Elevation: Slope slabs to floor drains and gutter.
 - a. Slabs shall adequately drain regardless of tolerances.
2. Thickness: Maximum $\frac{1}{4}$ inch minus or $\frac{1}{2}$ inch plus from thickness shown.
 - a. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed $\frac{1}{2}$ inch plus.

3.7 COLUMN FINISHES

- A. Type C-2: Match wall Type W-2.

3.8 BACKFILL AGAINST STRUCTURES

- A. Do not backfill against walls until concrete has obtained specified 6000 psi compressive strength.
- B. Refer to General Structural Notes on the Drawings for additional requirements.
- C. Unless otherwise permitted, place backfill simultaneously on all sides of structure, where such fill is required, to prevent differential pressures.

3.9 MANUFACTURER'S SERVICES

- A. Provide manufacturer's representative at Site in accordance with Section 01640 for installation assistance, inspection, and certification of proper installation for concrete ingredients, mix design, mixing, and placement.
1. Concrete Producer Representative:
 - a. Assist with concrete mix design, performance, placement, weather problems, and problems as may occur with concrete mix throughout Project, including instructions for redosing.
 - b. Establish control limits on concrete mix designs.
 - c. Provide equipment for control of concrete redosing for air entrainment or high-range, water-reducing admixture, superplasticizers, at Site to maintain proper slump and air content if needed.

- B. Provide support by manufacturer's representative for installation assistance and incorporation of concrete ingredients and ancillary materials. Attendance at the site is not required.
 - 1. Admixture Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.
 - 2. Bonding Agent Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.

3.10 PROTECTION OF INSTALLED WORK

- A. After curing as specified in Section 03370 and after applying final floor finish, locally cover slabs subject to traffic with plywood or particle board or plastic sheeting or other material to keep floor clean and protect it from material and damage as a result of other construction work.
- B. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.11 SCHEDULE OF CONCRETE FINISHES

A. Form Tolerances: As specified in Section 03100.

B. Provide concrete finishes as scheduled:

Area	Type of Finish	Required Form Tolerances
Exterior Wall Surfaces		
Prestressed tank wall	W-6	W-B
Other exterior wall surfaces	W-2	W-B
Interior Wall Surfaces		
Prestressed tank wall	W-1	W-A
Other interior wall surfaces	W-1	W-A
Exterior Slabs		
Roof slab/exposed	S-5 or as required by the roof coating manufacturer	S-B
Mudmats	S-1	S-A
Other slabs	S-5	S-A
Interior Slabs		
Tank floor	S-5	S-A
Underside of elevated slabs	S-3	S-A
Columns		
Columns/not coated	C-2	See Section 03100

3.12 INSPECTION, EXAMINATION, TESTING, AND OBSERVATION

A. Perform Field Testing in accordance with Section 01400.

B. Production Aggregate Testing:

1. Perform the following tests prior to initial use in the production of the concrete mixes and at the testing frequency indicated below.
2. Aggregate Moisture Content, ASTM C 566 :
 - a. For batches less than 100 CY per day, one test at the beginning of each day, minimum.
 - b. For batches greater than 100 CY per day, one test at the beginning of each day and a second test during the day, minimum.
 - c. Upon observed moisture change during the day.

3. Fine Aggregate Gradation, ASTM C 136 : Weekly.
4. Materials Finer than 75µm (No. 200) Sieve for Fine Aggregate, ASTM C 117 : Monthly.
5. Organic Impurities in Fine Aggregates, ASTM C 40/C 40M : Monthly.
6. Clay Lumps and Friable Particles in Fine Aggregates, ASTM C142/C142M : Monthly.
7. Coarse Aggregate Gradation, ASTM C 136 : Weekly.
8. Materials Finer than 75µm (No. 200) Sieve for Coarse Aggregate, ASTM C 117: Monthly.
9. Submit Aggregate Test Results.
10. Submit Production Aggregate Testing Report monthly from each production facility.

C. Liquid Tightness Tests:

1. Purpose: To determine integrity and liquid-tightness of finished exterior and interior concrete surfaces of containment structures.
2. Test the following structures for liquid-tightness:
 - a. Saltstone Disposal Unit 6.
 - b. Perform and document a Black Light Test (For Base conditions)prior to introducing water.
3. Water for liquid tightness tests will be provided by SRR from on site wells. Provide means to transport water to structure to be tested.
4. After testing has been completed, dispose of test water in a manner approved by STR.
5. Liquid-Tightness Test Requirement:
 - a. Perform HST-NML liquid tightness tests in accordance with ACI 350.1 as modified herein.
 - b. Do not place backfill, install coatings, or perform other work that will cover concrete surfaces until tightness testing has been completed and approved.
 - c. Conduct baseline black light (or visual for blue dye) inspection of exposed surfaces of the tank exterior including wall shotcrete and foundation prior to filling tank for tightness testing.
 - d. Fill tank with water to the maximum operating level of 41 feet.
 - i. Initial fill rate of tank shall not exceed 8 feet per 24 hours.
 - e. While filling the tank, introduce a dye/tracer into the tank that can be observed by using a black light or by visual inspection.
 - i. Dyes that have already been evaluated and are acceptable for use include:
Rhodamine WT (Water Test) [CAS 37299-86-8] (acid red 388).
Fluorescein Green Concentrate (Lime Green Dye) [CAS 2321-07-5] (uranine).
Erioglaucine (Standard Blue Dye) [CAS 3844-45-9] (acid blue 9, brilliant blue fcf). This dye does not fluoresce.
 - ii. Dyes/tracers identified above shall be used in the order listed should multiple tests be required. This order minimizes any interference from one dye to the next.

- f. Measure evaporation, precipitation, and temperature as specified.
- 6. Measure water surface at two points 180 degrees apart when possible where attachments, such as ladders exist, at 24 hour intervals.
- 7. Acceptance Criteria:
 - a. No measurable loss.
 - b. Observation of traces of dye, either as observation of dye color by the naked eye or evidence of dye fluorescence not documented in the baseline, at any location exterior to the tank, up to the wetted level of the tank, will constitute failure of the test and indicate that leakage exists.
 - c. Final liquid tightness test acceptance will be the responsibility of SRR based upon field inspections and clear and objective evidence provided by the Subcontractor and accepted by SRR.
 - i. Final acceptance includes SRR participation as a witness to the tank liquid tightness test.
- 8. Repairs When Test Fails:
 - a. Dewater structure (unless otherwise approved by the STR); fill leaking cracks with crack repair epoxy as specified in Section 03740.
 - b. Patch areas of damp spots previously recorded, and repeat water leakage test in its entirety until structure successfully passes test.
- 9. Test Interruption: STR can interrupt and restart the test if inclement weather makes leak detection indeterminate.
 - a. If the test is stopped, STR will determine the amount of remaining test time required for the test conclusion.
- 10. Submit Detailed Plan for Liquid Tightness Test Procedures. Plan shall include, but not be limited to, the following:
 - a. Baseline black light (or visual for blue dye) inspection of tank exterior.
 - b. Dosing volume of dye required.
 - c. Dye product(s) to be used.
 - d. Mixing requirements.
 - e. Sampling requirements to assure adequate mixing and dosage.
 - f. Dye introduction methods.
 - g. Examination requirements.
- 11. Submit Liquid Tightness Test Results
- D. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. General:
 - a. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
 - b. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.

- c. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
 - i. Provided results of air content tests for first load of the day are within specified limits, testing need only be performed at point of delivery for subsequent loads of that concrete mixture for that day except that testing should be performed at point of placement when placement method is changed.
- d. Evaluation will be in accordance with ACI 301 and Specifications.
- e. Test specimens shall be made, cured, and tested in accordance with ASTM C 31/C 31M and ASTM C 39/C 39M.
- f. Frequency of testing may be changed at discretion of STR.
- g. Pumped Concrete: Take concrete samples for slump, ASTM C 143/C 143M, and test specimens, ASTM C 31/C 31M and ASTM C 39/C 39M at placement (discharge) end of line.
 - i. Provided results of slump tests for first load of the day are within specified limits, testing need only be performed at point of delivery for subsequent loads of that concrete mixture for that day unless directed otherwise by STR if consistency of concrete appears to vary.
- h. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit.
 - i. If check test fails, concrete has failed to meet requirements of Subcontract Documents.
 - ii. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C 94/C 94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Subcontract Documents.
 - iii. Concrete that has failed to meet requirements of Subcontract Documents shall be rejected.

2. Concrete Field Tests:

- a. Refer to the Attachments to this Section for required sampling for concrete compressive strength tests. Provide additional samples for Performance Assessment Testing by SRR as required in the attachment.
 - i. Test cylinders shall be 4 inches in diameter by 8 inches long, in accordance with ASTM C 31/C 31M.
 - ii. Provide one set of three 6 inch diameter by 12 inch long cylinders for each mix design, taken at the start of construction from the same load as the standard set for comparison.

NOTE: SRR will conduct a test of 6"X12" cylinders versus a 4"X8" and determine the Ks value for each Design Mix. All 4"X8" cylinder test results will be adjusted for this Ks value

- b. Tests for slump, air content in accordance with ASTM C 173, bulk density or unit weight, temperature in accordance with ASTM C 1064, and compressive strength to be performed by the Special Inspector.
 - i. Refer to the Statement of Special Inspections (Plan) on Drawings and Attachments to this Section for frequency of testing.

3. Shrinkage Tests for Type V Concrete:
 - a. When required to conform to shrinkage limits, collect actual concrete materials being batched and before liquids have been added to mix.
 - b. Shrinkage testing will be performed by Special Inspector on sampled material mixed in a laboratory at proportions matching batched concrete.
 - c. Test shrinkage characteristics every 5,000 cubic yards of concrete used on job or every 3 months, whichever comes first, during construction shipping same component materials to laboratory as used for same day production.
 - i. Make the shrinkage prisms the same day as placements take place.
 - d. Concrete Shrinkage Limits: Test in accordance with ASTM C 157/C 157M, with the following modifications:
 - i. Prisms shall be moist cured for 7 days prior to 28 day drying period.
 - ii. Comparator reading at end of 7 day moist cure shall be used as initial length in length change calculation.
 - iii. Reported results shall be average of three prisms.
 - iv. If drying shrinkage of a specimen departs from average of that test age by more than 0.004 percent, disregard results obtained from that specimen.
 - v. Results at end of 28 day drying period shall not exceed 0.048 percent if 3-inch prisms are used, or exceed 0.046 percent if 4 inch prisms are used.
 - vi. If 7 day or 14 day shrinkage tests results exceed shrinkage limits established by design mix testing, furnish additional 14 days of moist curing beyond original curing period, for concrete surfaces of hydraulic structures represented by prisms.

Increased curing times shall be maintained until shrinkage testing is within specified limits for constituent materials being used in the work.
 - e. Deleted
4. High-Range, Water-Reducer (Superplasticizer) Admixture Segregation Test: Perform one segregation test per each compressive strength test performed prior to use on Project.
 - a. Perform additional tests as required by STR whenever consistency of concrete appears to vary.
 - b. Segregation Test Objective: Concrete with 4 inch to 8 inch slump shall stay together when slumped.
 - i. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump test.
 - c. Test Procedure: Make slump test and check for excessive slump and observe to see if mortar or moisture flows from slumped concrete.
 - d. Reject concrete if mortar or moisture separates and flows out of mix.
5. Cold Weather Placement Tests:
 - a. During cold weather concreting, cast cylinders for field curing as follows. Use method that will produce greater number of specimens:
 - i. Six extra test cylinders from last 100 cubic yards of concrete.
 - ii. Minimum three specimens for each 2 hours of placing time or for each 100 cubic yards.
 - b. These specimens shall be in addition to those cast for lab testing.

- c. Protect test cylinders from weather until they can be placed under same protection provided for concrete of structure that they represent.
 - d. Keep field test cylinders in same protective environment as parts of structure they represent to determine if specified strength has been obtained.
 - e. Test cylinders in accordance with applicable sections of ASTM C 31/C 31M and ASTM C 39/C 39M.
 - f. Use test results to determine specified strength gain prior to falsework removal or for prestressing.
6. Tolerances:
- a. Walls: Measure and inspect walls for compliance with tolerances specified in Section 03100.
 - b. Slab Finish Tolerances and Slope Tolerances:
 - i. Make floor flatness measurements day after floor is finished and before shoring is removed to eliminate effects of shrinkage, curing, and deflection.
 - ii. Support 10 foot long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
 - iii. Compliance with designated limits in four of five consecutive measurements is satisfactory, unless defective conditions are observed.
7. Subcontractor responsibilities and related information are included in Section 01810.
- E. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

3.13 ATTACHMENTS

- A. Concrete Mix Design, Identifier D5000-8-S-2-AB.
- B. Type V Concrete Compressive Strength Testing Requirements.
- C. Type II Concrete Compressive Strength Testing Requirements.
- D. Representative Compressive Strength Curves for Type V Concrete.

END OF SECTION

Concrete Mix Design, Identifier D5000-8-S-2-AB

Attachment No. 03300-A
Revision No. 3
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Type V Materials Used in Mix (for $f'_c = 6000$ psi):

Cement: Lehigh – Leeds, Alabama, Type V

Slag: Holcim, Grade 100

Fly Ash: Southeastern Fly Ash Co., Class F

Silica Fume: Force 10,000, W.R. Grace & Co.

Sand: Foster Dixiana #33, Clearwater Sand Plant

Stone: Rinker Aggregates #67, Dogwood Quarry

AEA: Darex II, W.R. Grace & Co.

WRA: WRDA 35, W.R. Grace & Co.

HRWR: ADVA 380, W.R. Grace & Co.

Water: City / County

Mix Characteristics:

Slump – Before HRWR: 0.25" to 3"

Slump – After HRWR: 3" to 8"

Workability: Sticky

Concrete Mix Design, Identifier D5000-8-S-2-AB

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Segregation: None

Bleeding: None

Air: 3% to 6%

Unit Weight: 139.6 pcf

W/C Ratio: 0.38 Maximum

Concrete Temperature: 50°F to 90°F

Fine/Coarse Ratio: 35:65

<u>Mix Quantities:</u>	<u>Cubic Yard</u>	<u>Batch</u>	<u>Specific Gravity</u>	<u>Cubic Feet</u>
Cement:	213	lbs.	3.15	1.084
Slag:	284	lbs.	2.90	1.569
Fly Ash:	163	lbs.	2.20	1.187
Silica Fume:	50	lbs.	2.20	0.364
Sand:	991	lbs.	2.63	6.039
Stone #67:	1850	lbs.	2.64	11.230
Design Air:	4.5%			1.215
AEA: (*)	3.91	ozs.		
WRA: (*)	42.6	ozs.		
HRWRA: (*)	34.1	ozs.		
Water:	269	lbs.		4.311
Total				27.00

(*) - May be adjusted according to manufacturer's recommendations.

TYPE V CONCRETE COMPRESSIVE STRENGTH TESTING REQUIREMENTS

Attachment No. 03300-B
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Testing for Placements > 100 CY (e.g., Tank Floors, Wall Sections, and Roof)						
Frequency	No. Test Cyl.	7 Day	28 Day	56 Day	Hold	To SRR
First Truck	7	1	1	3	1	1
At 100 CY	7	1	1	3	1	1
At 200 CY	7	1	1	3	1	1
At 300 CY	7	1	1	3	1	1
At 400 CY	7	1	1	3	1	1
Each Additional 100 CY	7	1	1	3	1	1
Performance Assessment *	36	0	0	0	0	36

* Provide samples only for Type V mix Performance Assessment. Samples shall include 3 cylinders each per quadrant for tank floor, roof slab, and core wall.

Testing for Placements < 100 CY (e.g., Columns and Stair Foundation)						
Frequency	No. Test Cyl.	7 Day	28 Day	56 Day	Hold	To SRR
First Truck	7	1	1	3	1	1

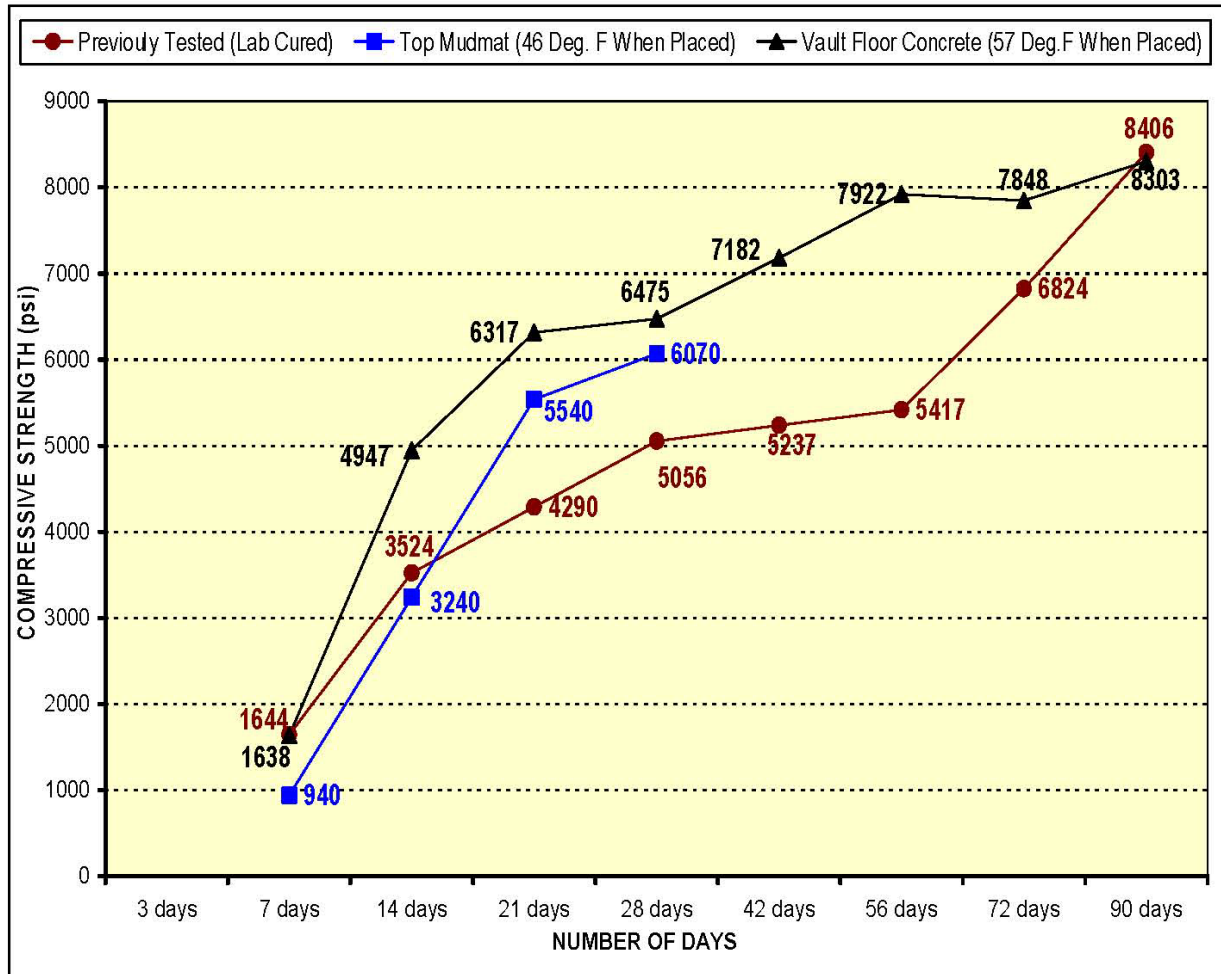
TYPE II CONCRETE COMPRESSIVE STRENGTH TESTING REQUIREMENTS

Attachment No. 03300-C
Revision No. 3
Spec/Req'n No. C-SPP-Z-00008
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Testing for Placements > 150 CY (e.g., Mud Mats)						
Frequency	No. Test Cyl.	7 Day	28 Day		Hold	
First Truck	4	1	2		1	
At 150 CY	4	1	2		1	
At 300 CY	4	1	2		1	
At 450 CY	4	1	2		1	
At 500 CY	4	1	2		1	
Each Additional 150 CY	4	1	2		1	

Representative Compressive Strength Curves for Type V Concrete

Attachment No. 03300-D
Revision No. 3
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PRESTRESSED TANK VERTICAL POST-TENSIONING**SECTION 03314****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Circumferential Prestressing Steel
- B. Vertical Tendons
- C. Epoxy Grout
- D. Shotcrete
- E. Insulation System

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 03300

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standards

- 1. American Association of State Highway and Transportation Officials (AASHTO)
 - a. T 260
- 2. American Concrete Institute (ACI)
 - a. 301
 - b. 506.2, Specification for Shotcrete
- 3. American Society for Testing and Materials (ASTM)
 - a. A 90/A 90M
 - b. A 123/A 123M
 - c. A 416/A 416M
 - d. A 722/A 722M
 - e. B 6
 - f. C 31/C 31M
 - g. C 33/C 33M
 - h. C 39/C 39M
 - i. C 42/C 42M
 - j. C 94/C 94M
 - k. C 150/C 150M
 - l. C 173/C 173 M
 - m. C 231/C 231 M
 - n. C 233/C 233 M
 - o. C 260/C 260 M
 - p. C 457/C 457M
 - q. C 494/C 494M
 - r. C 1116/C 1116M

- s. D 1621
 - t. D 2842
 - u. E 96/E 96M
 - v. E 84
 - 4. International Code Council (ICC)
 - a. IBC
 - 5. International Concrete Repair Institute (ICRI)
 - a. 310.2
 - 6. United States Navy (NAVY)
 - a. MIL-P-21035B
 - 7. Precast/Prestressed Concrete Institute (PCI)
 - a. MNL-120
 - B. Regulations
 - 1. None Specified in this Section
 - C. Documents
 - 1. None Specified in this Section
 - D. Drawings
 - 1. None Specified in this Section
- 1.4 DEFINITIONS
- A. Shotcrete: Mortar projected by jet directly upon intended surface.
 - B. See Section 01100 for additional definitions.
- 1.5 QUALITY ASSURANCE
- A. Qualifications:
 - 1. Shotcrete, Equipment, and Operator:
 - a. Shotcrete shall be applied only by the Prestressing Subcontractor under a fully automated wet shotcrete mix process, using equipment mounted in the prestress machine.
 - b. The operator shall be a full-time employee of the Prestressing Subcontractor with a minimum of 5 years' experience in using this automated equipment. Two years of this 5 years' experience shall be contiguous to this bidding period.
 - 2. Shotcrete Operator and/or Nozzleman and Gunman:
 - a. Automated Equipment Operator and/or Nozzleman:
 - i. Minimum 2 years' experience on shotcreting work similar to Project.
 - ii. Experience on shotcrete pool and ditch construction will not be considered as experience for qualifying nozzleman.
 - iii. Capable of applying thin coats of even and uniform thickness.
 - b. Gunman: Minimum 6 months' experience with handling gun for work similar to Project.
 - 3. Submit a Statement of Qualifications for each Shotcrete Nozzleman and Gunman.
 - B. See Section 01400 for general requirements.

1.6 PRESTRESSING SUBCONTRACTOR SUPERINTENDENT ONSITE EARLY ASSISTANCE

A. Site Visits:

1. In addition to onsite work for prestressing operations, the Subcontractor shall ensure that the superintendent for the Prestressing Subcontractor is present to provide onsite assistance to the Subcontractor during:
 - a. Formwork and casting of the wall footing,
 - b. Selection and erection of wall formwork,
 - c. Bracing of wall formwork,
 - d. Installation of vertical post-tensioned bars,
 - e. During placement of concrete into the wall forms.
2. Prestressing Subcontractor's superintendent shall provide guidance and expertise for:
 - a. Placement of lateral cables,
 - b. Embeds for shotcreting,
 - c. Rubber pads,
 - d. Waterstops,
 - e. Vertical wall joints,
 - f. Wall to roof connections, and
 - g. All other items in core wall and footing,
 - h. Inspect these items prior to casting concrete in core wall.

1.7 SUBMITTALS

A. Submit the following Engineering documents in accordance with Section 01330 and 01400.

1. Statement of Qualifications for each Shotcrete Nozzleman and Gunman, 1.5 A. 3.
2. Certificate of Successful Pre-shipment Inspection of Prestress Units, 1.8 B. 4.
3. Epoxy Grout Manufacturer's Product Data, 2.3 C.
4. Manufacturer's Information Certifying the Insulation, 2.7 E. 1.
5. Insulation Shop Drawings, 2.7 E. 2.
6. Certified Insulation Calculations, 2.7 E. 3.
7. Design Data for Prestressing and Post-Tensioning, 3.1 A. 1.
8. Design Calculations for Prestressing and Post-Tensioning, 3.1 A. 2.
9. Prestressed Tank Vertical Post-Tensioning Instructions, 3.1 A. 3.
10. Manufacturer's Certificate of Compliance – Strand or Bar, 3.1 A. 5.
11. Shotcrete Batch Tickets, 3.1 A. 6.
12. Proposed Grouting Equipment Information for Grouting Tendon Ducting, 3.3 A. 1.

B. Deleted

1.8 DELIVERY, STORAGE AND HANDLING

A. Post-tensioned Bars:

1. Load bars manually or use nylon slings to avoid damage to galvanizing.
2. Support bars during handling and loading on trucks to avoid permanent bending and deformation.
3. Place bars on wooden supports and protect bars from rubbing by using tight metal band supports.
 - a. Provide adequate burlap, plastic, or wood covering between metal bands and bars to avoid damage from bands and banding operations.
4. Place spacers between bars to reduce chipping of zinc during delivery.
5. Do not mix bars from one bundle to another. Keep bars in their respective bundles.
6. Identify packages or rolls of strand or bars with mill and heat number.

B. Prestressing Materials:

1. Prevent accumulation of moisture on materials or in wrapping.
2. Prevent rusting of circumferential strand.
3. Handle and store vertical post-tensioning materials to prevent bending.
4. Submit a Certificate of Successful Pre-shipment Inspection of Prestress Units verifying that units contain no apparent defects.

C. Insulation Materials:

1. On packaging clearly identify manufacturer, contents, brand name, applicable standard, and R-value.
2. Store materials off ground and keep them dry.
 - a. Protect against weather, condensation, and damage.
 - b. Do not store where exposed to direct sunlight.

D. See Section 01600

1.9 ENVIRONMENTAL REQUIREMENTS

A. Obtain approval for method used to protect shotcrete from excessive heat and drying that may occur when temperatures exceed 90 degrees F.

1. Approved control measures shall be utilized for shotcreting operations.

B. Delay work under the following conditions:

1. During high winds causing sand to separate at the nozzle.
2. When weather approaches freezing defined as below 40 degrees F when temperature is falling, or until temperature is 35 degrees F when temperature is rising.
3. During rains of high intensity to wash cement out of fresh material.

C. Cold Weather: Take precautions to avoid low temperatures detrimental to epoxy grout or the ability to pump.

1. If grouting procedure cannot be postponed, keep wall temperatures within the required temperature range.

PART 2 PRODUCTS

2.1 CIRCUMFERENTIAL PRESTRESSING STEEL

A. Seven-Wire Continuous Strand:

1. Meeting requirements of ASTM A 416/A 416M /A416M, Grade 270, prior to galvanizing.
2. Hot-dipped galvanized.
3. Nominal Strand Diameter: 3/8 inch.
4. Nominal Strand Area: 0.089 square inches (after galvanizing).
5. Nominal Weight per 1,000 Linear Feet: 303 pounds.
6. Pitch: 12-16 (strand diameter).
7. Minimum Breaking Strength after Galvanizing: 21,400 pounds.
8. Yield Strength at 1-percent Extension after Galvanizing: 16,000 pounds.
9. Elongation in 24 inches at Fracture: 4.5 percent.
10. Zinc Coating Weight: 0.85 ounce per square foot.

B. Anchorage for Strand: Prestressing Subcontractor's standard, capable of safely developing 90 percent of full strength of strand and not susceptible to galvanic action with strand.

2.2 VERTICAL TENDONS

A. Threaded Bars—Galvanized:

1. Deformations of Threaded Bars:

- a. Form screw thread suitable for mechanically coupling lengths of threaded bar and for positive attachment of anchor assemblies.
- b. In accordance with ASTM A 722/A 722M, uniform such that all lengths of bar may be cut at any point and internal threads of a coupling designated for that size of bar freely screws on the bar.

2. Tensile and Physical Properties:

- a. Nominal Diameter: 1.375 inches.
- b. Minimum Tensile Stress: 150,000 psi.
- c. Minimum Yield Stress at 0.2 Percent Offset: 120,400 psi.
- d. Minimum elongation in 10 bar diameter 7 percent.
- e. Nominal Cross-section Area: 1.577 square inches for 1.375 inch diameter.
- f. Nominal Bar Weight: 5.56 pounds per foot for 1.375 inch diameter.
- g. Zinc Coating Weight: 0.85 ounce per square foot.
- h. Maximum Carbon Content: 0.55 percent.

3. Do not furnish thread bars with quenched or tempered steels.

4. Bars and their deformations shall be hot-rolled.

B. Tendon Ducts:

1. 1 ½ inch diameter, Class 200 PVC pipe, for 1.375 inch diameter bars.
2. Sufficient strength to maintain shape under potential forces created during handling, placing, and vibrating of concrete.

C. Anchorage:

1. Furnish anchor plates of steel to dimensions which will show no permanent physical distortion when tested with a unit of size required, together with standard anchorage devices, to 100 percent of the ultimate tensile strength of unit.
2. Size plate so concrete stresses shall meet allowable concrete bearing stresses in accordance with PCI MNL-120.
3. Anchor Nuts: Capable of holding 90 percent of ultimate strength of bars.
4. Conical hole in top and bottom bearing plates, 35 degree cone angle with vertical.
5. Fully threaded anchor connections at both bar ends, incorporating a nut with spherical shaped bearing surface to match conical surface in the bearing plate.
6. Contact point of spherical-shaped bearing surface to conical hole approximately $\frac{1}{4}$ inch to $\frac{1}{2}$ inch below bearing plate surface.
7. Steel, grout-tight structural tube blockout, blockout size large enough to allow stressing and anchoring of bar.

D. Bar Galvanizing:

1. Grit Blasting:
 - a. Remove mill scale from bars by abrasive blast cleaning immediately prior to flash pickling.
 - b. Appearance after blast cleaning shall be whitish gray.
2. Flash Pickling: Flash pickle bars to a maximum of 2 minutes with a solution of sulfuric acid, not to exceed 6 percent by weight of acid, at a temperature maintained at 150 degrees F to 160 degrees F.
 - a. A 4 minute maximum cold pickling in a 20 percent Baume HCL plus 50 percent water at ambient temperature is also permitted.
 - b. Hydrogen Inhibitor Agent: Add to sulfuric acid or cold pickling solution as directed by manufacturer.
 - i. Manufacturer: Pacific Chemical of San Francisco.
3. Rinse and Preflux:
 - a. Immediately after flash pickling, water rinse bars thoroughly to remove acid and dip in and out, 15 seconds to 30 seconds, in an ambient preflux tank.
 - b. Maintain liquid zinc ammonia preflux at 19 - 20 Baume and 1.126 specific gravity.
 - c. Manufacturer and Product: Dupont; Zaclon Type F, or approved equal.
4. Galvanizing:
 - a. From liquid preflux solution, immerse bars in a galvanizing kettle through a top flux.
 - b. Do not double dip bars.
 - c. Limit length of bars to approximately 35 feet or less as required to permit galvanizing operation, accomplish in a single operation.
 - d. Zinc in accordance with ASTM B 6.
 - e. Maintain temperature of zinc between 820 degrees F minimum and 830 degrees F maximum with the use of thermocouples attached to controls.

- f. Immerse bars for 2 minutes and air cool gradually to avoid sudden temperature changes.
 - g. Manufacturers and Products:
 - i. Preflux: Dupont; Zaclon 2 N, or approved equal.
 - 5. Removal of Excess Zinc:
 - a. Use air rings and wire brushing to remove excessive zinc buildups after galvanizing.
 - b. Chemical treatments not permitted.
 - c. Air ring of a circular tube bent in a half circle with holes along inside radius of tube.
 - d. Place air ring around galvanized bar immediately after dipping to remove excessive zinc buildups.
 - e. Carefully clean each bar to ensure threadability of bars.
 - f. Do not clean galvanized bar ends by abrasive blasting or heating.
 - g. Remove excessive buildups by steel brushing provided it leaves specified amount of zinc on bars.
 - 6. Touch up small areas where galvanizing has been accidentally removed with a zinc-rich paint in accordance with NAVY MIL-P-21035B.
 - 7. Color of Galvanized Bars: Uniform, silvery to dark gray.
 - 8. Protect bars with polyethylene sheeting after galvanizing against rain, moisture, and contamination from dust and dirt.
 - 9. Galvanize bars in accordance with ASTM A 123/A 123M.
 - 10. Weight of Coating: ASTM A 90/A 90M, modified to determine coating of each surface separately.
 - 11. Zinc Coating:
 - a. Minimum of 0.85 ounce per square foot on all surfaces.
 - b. Adhere tenaciously to surface of base metal.
 - c. Coating free from blisters, excess zinc; even, smooth, and uniform throughout.
 - 12. Test Coupons:
 - a. Sized for determining quantity and quality of galvanizing, to represent amount of coating deposited on finished product.
 - b. Wired to materials to be galvanized before immersion.
- E. Test bars in accordance with ASTM A 722/A 722M, minimum of four samples from materials from each heat test. Test two Samples in tension, and two Samples from bend test.

2.3 EPOXY GROUT

- A. Two-component water-insensitive epoxy.
- B. Manufacturers:
 - 1. Sika Chemical Co.
 - 2. Adhesive Engineering Co.
 - 3. Rhino Linings Corp., Epoxy Division
 - 4. Or approved equal.
- C. Submit Epoxy Grout Manufacturer's Product Data.

2.4 FIBROUS SHOTCRETE REINFORCEMENT

A. Manufacturers and Products:

1. Fibermesh Co., Chattanooga, TN; Fibermesh 150.
2. W.R. Grace & Co., Cambridge, MA; Grace MicroFiber.
3. Or approved equal.

B. Shotcrete, unless specified otherwise herein shall be fibrous reinforced.

1. Reinforcement shall consist of 100 percent virgin polypropylene multi-filament fibers used as secondary reinforcement for shotcrete.

C. Required volume of fibers per cubic yard of shotcrete shall be 1.5 pounds.

D. Fibers shall be in accordance with ASTM C 1116/C 1116M, Type III.

E. Physical Characteristics:

1. Specific Gravity: 0.91.
2. Tensile Strength: 40 ksi to 60 ksi.
3. Fiber Length: Graded per manufacturer.

F. Fibers shall be added to shotcrete in accordance with manufacturer's instructions.

2.5 SHOTCRETE

A. Fine Aggregates (Sand):

1. In accordance with ASTM C 33/C 33M. Furnish from one source.
2. Saturated, surface-dry, hard, dense, uncoated rock fragments free from injurious amounts of foreign or deleterious substances in accordance with ASTM C 33/C 33M, Table 2. Limit material finer than 75- μ m (No. 200) sieve to 5 percent mass of total sample.
3. Fineness Modulus for Sand: Range from 2.70 to 3.00 with maximum particle size of $\frac{1}{4}$ inch.
4. Maintain sand at 3 percent to 6 percent moisture content; dampen or dry with sand dryers if necessary.
5. Gradation:

Sieve Size	Percent Passing by Weight
No. 4	95 - 100
No. 8	80 - 90
No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	2 - 10

B. Screen sand for finish coat, to produce dense surface uniform in texture and appearance.

C. Portland Cement: Conform to requirements of ASTM C 150/C 150M, Type II.

D. Admixtures:

1. Characteristics:

- a. Compatible with other constituents in mix.
- b. Contain at most, only trace amount chlorides in solution.
- c. Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.

2. Air-Entraining Admixture: ASTM C 260/C 260 M.
3. Water-Reducing Admixture: ASTM C 494/C 494M, Type A or Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. Retarding Admixture: ASTM C 494/C 494M, Type B.
6. Accelerating Admixture: ASTM C 494/C 494M, Type C.
7. Hydration Stabilizer: ASTM C 494/C 494M, Type D.
- E. Air Content: 5 to 7 percent when tested in accordance with ASTM C 231/C 231 M prior to shooting.
- F. Water: As specified in Section 03300.
- G. Shotcrete Strength (f'c):
 1. Minimum 5,500 psi at 28 days based upon cylinders taken from wet mix prior to entering hose for shotcreting.
 2. Minimum 6,000 psi at 28 days based upon samples taken from wet mix after being gunned onto a test panel or in final work.
 3. Higher shotcrete strengths shall not permit a reduction in cement contents.
 4. See Section 3.12 for requirements for sampling and testing of shotcrete strength.

2.6 SHOTCRETE MIXING AND PROPORTIONING

- A. General: In accordance with ACI 506.2. Where moderate wind is expected during shotcreting operation, make shotcrete mix richer to compensate for strength loss due to addition of moisture in mix and rapid loss during curing.
- B. Wet Mix Process:
 1. Each cubic yard of mortar shall consist of:
 - a. Minimum 894 pounds portland cement and maximum 3:1 ratio of moist sand to cement by weight.
 - b. Water Reducing and Retarding Admixtures: Up to 50 ounces may be added during warm weather conditions for applications other than overhead positions.
 2. Cold Temperature Conditions:
 - a. Whenever night temperatures are expected to drop below 35 degrees F, use "high-early" portland cement in lieu of regular portland cement.
 - b. If "high-early" portland cement is not available, mix design shall consist of minimum 1,034 pounds regular portland cement to 2,674 pounds moist sand without additives.
 - c. Moist sand-cement mix ratio by weight, maximum 2.59 for site batching.
 - d. Weight measuring equipment and tolerances in accordance with ASTM C 94/C 94M.
 - e. Total volumetric air content 7 percent plus or minus 1 percent before placement as determined by ASTM C 173/C 173 M or ASTM C 231/C 231 M. Air-entraining agents in accordance with ASTM C 260/C 260 M, ASTM C 233/C 233 M, and ASTM C 457/C 457M.
 3. Mix shotcrete in either stationary plant, portable batch type, or truck mixers.

2.7 INSULATION SYSTEM

A. Insulation Materials, Provide One of the Following:

1. Spray Foam:

- a. The in-place density of the insulation shall be a minimum of two pounds and a maximum of three pounds per cubic foot.
- b. The compressive strength shall be a minimum of 25 psi at 7 percent deflection per ASTM D 1621, and the closed cell content shall be a minimum of 90 percent.
- c. Thermal conductivity (K factor) shall be a maximum of 0.16 Btu per hour per square foot per degree Fahrenheit per inch at 75 degrees F mean temperature.

2. Rigid Insulation:

- a. Insulation materials shall meet Class A requirements (Flame spread < 25, smoke development < 450) per ASTM E 84.
- b. Extruded polystyrene.
 - i. Water absorption shall be less than 0.6 perm-inches as specified by tests in ASTM D 2842 and ASTM E 96/E 96M.
 - ii. The insulation shall have zero capillarity.
 - iii. Thermal conductivity shall be 0.20 Btu per hour per square foot per degrees Fahrenheit per inch at 75 degrees F mean temperature average and 0.18 at 40 degrees F.
 - iv. Compressive strength shall be a minimum of 25 psi.
- c. Finish in preformed panels to fit the curvature of the tank or provide written certification by the manufacturer that the rigid insulation can be bent to fit the curvature without rupturing.

3. Prefabricated Insulated Panel:

- a. The insulated panels shall be precurved to fit the tank.
 - i. The panels shall be composed of an isocyanate foam core molded between moisture-impervious aluminum foil sheets.
 - ii. The exposed face of the panel shall be aluminum sheathing a minimum of 0.032-inch thick.
 - iii. Color of exterior sheathing shall be neutral from manufacturer's standard color palette.
 - iv. The tank side of the panel shall have a vinyl coating finish.
- b. The prefabricated panels shall be as manufactured by Thermocon Industries, Inc., or an approved equal.

B. R-value for insulation system shall be as shown on Drawings.

1. Insulation shall be applied to the tank walls only.

C. Metal Jacketing:

1. The tank walls shall have metal jacketing applied over the exterior insulation as a protective covering if either the sprayed polyurethane foam or rigid insulation alternative is selected.
2. The metal jacketing shall be 20 gauge minimum.
 - a. Aluminum jacketing may be used if the jacketing is designed specifically for insulation protection, is a standard product of a national manufacturer, and is provided with a factory coating system that is equivalent to or better than the steel paint system.

3. Banding and clamping materials shall be designed to withstand wind loads as shown on the Drawings, and shall allow for thermal expansion and contraction of the banding.
4. Color to be selected by SRR.
- D. Anchorage to the Prestressed Concrete Tank Wall:
 1. Make attachments to the tank wall using concrete inserts at the time of concrete core wall pour or install stainless steel expansion anchors after first prestress wrap and prior to shotcrete placement.
 - a. Install greased stainless steel bolts prior to shotcreting and maintain the hole through the shotcrete to allow bolt removal and insulation installation later.
 - b. Final anchors shall be installed in epoxy.
- E. Insulation System Submittals
 1. Insulation Manufacturer's Information Certifying the Insulation:
 - a. Is in conformance to one of the three types specified,
 - b. Is compatible between spray-on insulation and the coating system.
 2. Insulation Shop Drawings
 - a. Detail the complete insulation system.
 - b. Include a 6-inch by 6-inch sample of the metal jacketing or insulated panel.
 - c. Manufacturer's literature.
 3. Certified Insulation Calculations showing conformance with the wind design criteria stamped and signed by a professional engineer registered in the State of South Carolina.

PART 3 EXECUTION

3.1 GENERAL

- A. Submittals
 1. Design Data for Prestressing and Post-Tensioning that includes:
 - a. Fabrication Details, Erection Drawings of Prestressing and Proposed Post-tensioning Systems, and source of materials.
 - b. Load strain curves showing physical properties of steel.
 - c. Proposed anchorage for circumferential prestressing strand.
 - d. Method of spacing strand for circumferential prestressing.
 - e. Proposed anchorage for vertical post-tensioning.
 2. Design Calculations for Prestressing and Post-Tensioning that include:
 - a. Calculations showing initial and final prestressing force.
 - b. Stress losses due to plastic flow, shrinkage in concrete, creep in steel, anchorage losses, and stated machinery tolerances for circumferential prestressing.
 - i. Specific anchorage losses shall be provided for circumferential prestressing and vertical post-tensioning.
 3. Prestressed Tank Vertical Post-Tensioning Instructions:
 - a. Proposed cold weather grouting procedures and techniques to keep wall grouting above freezing temperature until cured.

4. Shotcrete Design Data:
 - a. Mix design.
 - b. Aggregate gradations.
 - c. Fibrous shotcrete reinforcement.
 - d. Proposed admixtures.
 - e. Proposed mixing equipment and procedures.
 - f. Method of adding polypropylene fibers into shotcrete mix.
 - g. Proposed method for obtaining, handling, and testing cores for strength testing.
 - h. Proposed hot weather shotcreting procedures for temperatures above 90 degrees F.
5. Manufacturer's Certificate of Compliance – Strand or Bar:
 - a. For strand or bar used for prestressing and include:
 - i. Chemical composition, physical properties, and dimensions of unit prior to galvanizing.
 - ii. Test data for a minimum of three samples of final galvanized unit taken from actual material to be used in work.
 - b. Certificate of calibration of equipment used to measure and record tensioning values for circumferential prestressing and vertical post-tensioning bars indicating machine tolerance.
6. Shotcrete Batch Tickets:
 - a. Certificate of each delivery of shotcrete showing manufacturer's name and product of the polypropylene fibers and amount of fiber added per cubic yard.
7. Written Test Reports:
 - a. Threaded bars.
- B. Do not apply vertical post-tensioning and circumferential prestressing to tank until core wall has obtained the 6000 psi compressive field strength, as determined by field cured test cylinders.
- C. Stress all vertical post-tension units prior to circumferential prestressing and prior to roof concrete placement.
- D. Installation includes, but not limited to:
 1. Placement of vertical and circumferential prestressing units.
 2. Placement of shotcrete.
 3. Placement of anchorages by methods of prestressing.
 4. Grouting vertical post-tensioning units.
- E. Perform necessary welding in vicinity of post-tension bars with extreme caution to avoid touching post-tension bar with electrode and avoid electrical circuits that may cause resistance heating to pass through post-tension bars.
- F. Do not use bent post-tension bars, bars with surface damage, and bars with rust.
- G. Joints at base and top of wall are intended to act with minimum of restraint to wall as prestressing of wall is performed.
- H. Expansion and vertical control joints have been designed to permit placing slabs and walls in sections and to minimize shrinkage cracks.
- I. Do not provide horizontal construction joints in walls.

3.2 VERTICAL POST-TENSIONING

- A. Do not weld vertical post-tensioning bars.
- B. Bundles: work only on one bundle of bars at one time. Do not open a new bundle until previous bundle has been banded and marked.
- C. Marking:
 - 1. Remove original plastic-coated paper or metal tag(s) from bundle.
 - 2. Reinstate marking on rebundled bars before removing tags and before opening another bundle.
- D. Placing Post-Tensioning Units:
 - 1. Place post-tensioning units level and plumb in tank wall.
 - 2. Encase vertical post-tensioning units in grout-tight tendon duct or pipe so mortar cannot enter and hinder free movement of bar.
 - 3. Adequately vent tendon duct to facilitate grouting.
 - 4. Thread end of vent tube at bottom of tendon duct and project from concrete; remove after grouting.
 - 5. Tie units securely in position, supporting tendon ducts from top of form and keeping vent pipes perpendicular to wall.
 - 6. Provide tight connections between anchorages, vent pipe, and forms to prevent movement or leakage of concrete into units during pouring operations.
 - 7. Tension units from top ends.
 - 8. After pouring first 8 feet of concrete wall and each subsequent lift of concrete, flush tendon ducts with water through top allowing water to drain from bottom vent pipe extending through wall form.
 - 9. Provide threaded hose connections to threaded vent pipe and connections shall be tight to keep water from entering forms below.
 - 10. Inform STR if units do not drain freely.
 - 11. Allowable Stresses:
 - a. Determine initial prestressing force for vertical bar units by using a 25,000 psi stress loss allowance for concrete shrinkage, plastic flow, and steel relaxation.
 - b. Temporary jacking stresses up to 75 percent of ultimate strength for unit are acceptable to overcome losses due to tendon friction, anchorage seating, and elastic shortening.
 - c. Initial stress in bar unit after anchorage losses have occurred shall not exceed 73.5 percent of ultimate strength of unit.
 - d. Do not stress units before the 6000 psi concrete field strength has been obtained.
- E. Anchorage Plate at Top of Unit: Provide grout-tight structural tube blockout, welded to top bearing plate and extending to top of wall, except extend tubes above wall where shown on Drawings.
- F. Measurement of Tensioning and Elongation:
 - 1. Field verify by measuring and recording both elongation and gauge reading on prestressing machine.
 - 2. Calibrate gauge for this Project prior to starting work and obtain comparable results between gauge readings and elongation readings.

3. Provide continuously, electronically, monitored permanent force/elongation record from zero to full force at final lockoff for vertical prestressing work.
4. Show elongation in inches on ordinate axis of permanent recording and force in pounds or kips on abscissa axis.
5. Use manually recorded force and elongation readings to cross-check electronic recorder.

3.3 GROUTING OF VERTICAL TENDONS

- A. Equipment: Provide grouting equipment with pressure gauge having a full-scale reading to 500 psi and capable of developing a minimum of 150 psi pressure.
 1. Submit Proposed Grouting Equipment Information for Grouting Tendon Ducting.
- B. Filling Tendon Ducts:
 1. Ensure ducts are clean and free of water and deleterious materials that would impair bonding of grout or interfere with grouting procedures.
 2. Fit grout injection pipes with positive mechanical shutoff valves.
 3. Introduce epoxy grout through bottom grout pipe until it flows from and into steel blackout at top of unit.
 4. Valve off bottom grout pipe.
 5. Wait for a minimum of 12 hours following grouting operation before removing bottom tube.
 6. Fill top steel blackout with upward moving grout $\frac{1}{4}$ inch over top of anchor nut.
 - a. Fill remaining space with two-component epoxy and pea gravel.

3.4 ANCHOR BOLTS

- A. Install in top of roof slab sections near center of tank for anchoring and guying, circumferential prestressing machine and equipment.
- B. After prestressing operations are completed, remove anchors to minimum 1 inch below concrete surface and patch as specified.

3.5 CORE WALL PREPARATION

- A. Concrete as specified in Section 03300.
- B. Abrasive Blasting of Core Wall:
 1. Inspect core wall and patched surfaces.
 2. Patch surfaces requiring repair with shotcrete by building out in uniform circular area level with the existing core wall prior to abrasive blasting surface.
 3. Test surfaces per Corrosion Protection Article.
 4. Remove corrosive chemicals (if test prove positive for chlorides) from surfaces prior to abrasive blasting.
 5. Abrasive blasting shall be performed by a mechanical etching or shotblast system combined with a vacuum recovery system, or a self-contained waterblasting system.
 6. The surface shall be abrasive blasted sufficiently to remove all laitance, form oil, or other types of coatings.
 7. The surface shall be cut to a minimum CSP 5 profile, as established by the ICRI 310.2, over a minimum of 90 percent of the surface being prepared as measured over any one foot square area.

8. The Prestressing Subcontractor performing the abrasive blasting shall make available to the inspector ICRI sample coupons to assist in evaluating the abrasive cut.
 9. Do not abrasive blast until walls are cured and have obtained the 6000 psi strength specified and tie holes have been dry packed and have cured for at least 7 days.
 10. Complete abrasive blast prior to installation of the initial 3/8 inch shotcrete layer.
- C. Shotcrete a uniform 3/8 inch layer over abrasively blasted surface prior to applying the initial circumferential prestressing, as indicated in Article Shotcreting of Circumferential Prestressing.

3.6 CIRCUMFERENTIAL PRESTRESSING

- A. Apply uniformly stressed continuous steel strand to concrete core wall using a wrapping machine to provide final prestressing force per linear foot of wall height.
1. Use electronic servo controlled wrapping systems with automatic electronic recording.
- B. Initial Prestress Force in Strand:
1. Maximum 75 percent of ultimate strength of strand after anchoring.
 2. Determine by using a stress loss of 25,000 psi for concrete shrinkage, plastic flow, and creep in steel plus the proven machine tolerance for electronic servo controlled wrapping machine with automatic electronic recording equipment.
- C. Stress Measurement and Recording:
1. Continuously measure stress of strand accurately as it is laid on the wall.
 2. Electronic stress measuring and continuously recording apparatus shall be calibrated by a recognized gauge manufacturer or testing laboratory on strand samples taken from prestressing strand delivered to Site to be used in the work.
 3. Perform calibration work within 15 days prior to prestressing.
 4. Do not use stress measuring device on other work until prestressing work is finished.
 5. Recalibrate stress measuring apparatus during progress of the work.
 6. Provide automatic, electronic continuous recording at all points on strand around wall.
 7. If stresses measured exceed values specified, discontinue operation and make satisfactory adjustments prior to proceeding with wrapping.
 8. Apply additional strand to compensate for understressed strand.
 9. Measure strand stress by a continuous sensing of applied force on strand between tensioning drum and wall when strand is being wrapped and laid on wall.
 - a. Measurement by deflecting strand and/or die-drawing is not acceptable.
 - b. Handheld stress measuring devices are not acceptable.
 10. Force Tolerance: The applied force in the strand shall not vary more than plus or minus 1.5 percent of the ultimate strength of the prestressing strand and the prestressing equipment shall be capable of continuously adjusting the stress, as the strand is being applied to the wall, to maintain this tolerance.

D. Splicing of Strand:

1. Do not weld splice strands.
2. Join ends of strands with steel sleeves or splicing devices which will develop minimum 90 percent of full strength of strand without slippage or loss of stress.
3. Anchor stressed strand only at designed wall sockets, or tie off at frequent intervals as stressing proceeds to minimize loss of stress in event of strand break.
4. Remove from the work coils of strand which have broken three or more times.
5. Stress strand only once.
6. Anchor wrapped strand to wall at least once for every coil or reel.
7. Do not permanently anchor one strand to previously wrapped strand.

E. Spacing:

1. Maximum Spacing: Two strands of 0.375 inch diameter, per foot of wall height.
2. Minimum Spacing: 12 strands of 0.375 inch diameter, per foot of wall height.
3. Minimum clear spacing between units not less than 1.5 unit diameters or 3/8 inch, whichever is larger.

3.7 SHOTCRETING OF CIRCUMFERENTIAL PRESTRESSING**A. Shotcrete Layers:**

1. After abrasive blasting, build up a minimum 3/8 inch cover over core wall prior to installing circumferential prestressing.
2. Build up intermediate shotcrete coatings in layers of approximately 3/8 inch thickness.
3. On tank walls and dome-rings start shotcrete at bottom of wall until wrapped strand is covered.
4. Subsequent shotcrete layers may be applied from top down or from bottom up.
5. While nozzle for automated equipment travels around wall, raise or lower nozzle at uniform rate for adequate overlapping of coatings and as uniform finish develops.

B. Multiple Layers of Circumferential Prestressing Units:

1. Apply shotcrete at minimum thickness.
2. A minimum of 3/8 inch cover for underlayer and intermediate layers, where more than one layer of circumferential prestressing units are required.
3. Minimum shotcrete cover over outer layer of prestressing strand, 2 inches in thickness applied in several coats.

C. Application:

1. Apply coat of shotcrete to abrasively blasted core wall as well as between each layer of circumferential prestressing.
2. Operator shall spiral up or down and around the wall.
3. Ensure complete embedment of strands without voids.
4. Ensure flow of material at nozzle is uniform at all times when nozzle is pointed toward the work.
5. Cut out slugs, sand spots, or wet sloughs resulting from nonuniform material flow and repair as work progresses.
6. Clear rebound away from work before initial set occurs.

D. Slump and Moisture:

1. To achieve penetration around strand and conveyance of material through hose, a 6 inch to 8 inch slump of mortar for wet mix process at pump is recommended for mix design.
2. Do not pre-wet wall prior to shotcrete application without written approval from STR, even in arid areas.
 - a. Moisture absorption by earlier applied layers is relied upon to improve bond and strength of material and to reduce drying shrinkage of applied shotcrete.
3. Application of shotcrete in number and thickness of layers specified is mandatory to achieve penetration of shotcrete behind strand and reduced shrinkage due to more uniform in-depth drying of shotcrete.

3.8 SHOTCRETE

A. General: In accordance with ACI 506.2. Apply shotcrete utilizing wet mix process.

B. Wet Mix Process Equipment:

1. Delivery Equipment:
 - a. Ready-mix truck from a batching plant or mixer providing automatic weighing as specified in Section 03300.
 - b. Capable of discharging mixed material into hose under close control, and able to deliver continuous smooth stream of uniformly mixed material at a velocity to automated discharge nozzle and free from slugs.
2. Automated Nozzle:
 - a. Of design and size to ensure smooth and uninterrupted flow of materials.
 - b. Mount on power driven machinery enabling nozzle to travel parallel to surface to be sprayed at uniform linear or bi-directional speed.
 - c. Keep nozzle at uniform constant distance from surface, always ensuring a right-angle spray of material to surface.
 - d. Hand-operated nozzles and shotcreting operations dependent on performance of nozzleman are not acceptable except where additional shotcrete is needed to correct flat areas.
3. Thoroughly clean equipment at end of each shift.
4. Regularly inspect equipment parts and replace as necessary.
5. Air capacity of compressor large enough to supply minimum 400 cfm of air at nozzle, irrespective of whether or not air from same air supply is used for other purposes.

3.9 FINISHING OF SHOTCRETE**A. Underlayers or Exposed Surfaces:**

1. On completing surface, bring shotcrete to an even plane and to well-formed corners by working up to ground wires or other thickness or alignment guides, using lower placing velocity than normal.
2. Screed exposed surfaces or underlayers by working upward against gravity with thin-edged screed using a slicing motion to trim off high spots and expose low spots.
3. Avoid pulling and breaking surface with subsequent checking.

B. Finish Layer:

1. Apply finish layer in several coats of 3/8 inch to 1/2 inch thickness to remove rough areas.
2. Carefully screen sand for finish coat to remove oversize particles which rebound and mar surfaces.
3. Surface of finish coat shall be of natural texture and coloration; free from spotting, cement or dust streaking, lap lines, uneven surfaces, and rebounded material.
4. Do not hand-patch.
5. Check coatings for bond by tapping lightly to test for hollow sounding spots.
6. Cut out areas where bond is not fully developed and repair.

C. Corrosion Protection:

1. Inspect patched surfaces.
2. Test surfaces for chlorides that cause corrosion of prestressing.
 - a. Field tests for chloride shall be in accordance with AASHTO T 260.
 - b. As an alternate to testing hardened concrete, field test wet concrete per AASHTO T260 and provide additional field tests of finished surfaces and wash water using CHLOR*EXTRACT solution by GENEQ, Inc., Rochester Hills, MI, or approved equal.
 - c. Concrete shall not contain water-soluble chloride ions in excess of 0.06 percent by weight of cement.
3. Remove corrosive chemicals from surfaces prior to sandblasting.
4. Patch surfaces by building out in uniform circular area level with surface.
5. Sandblast patches in accordance with Abrasive Blasting of Core Wall Article.

3.10 WATER CURING OF SHOTCRETE

- A. Initial and intermediate shotcrete layers shall be kept damp by hand watering or by use of a fine mist spray no sooner than 12 hours after the shotcrete has been applied.
- B. Watercuring for initial and intermediate shotcrete layers is not required should additional shotcrete layers be applied to the entire wall surface within the following 12 hours.
- C. Continuously water cure completed shotcrete surfaces for 7 days after application. The final 7 day water cure after the final shotcrete layer is applied shall be accomplished by one of two methods:
 1. Keep the shotcrete continuously wet by water spraying.
 2. Soak the shotcrete using the automated shotcrete machine and then encapsulate the shotcrete inside of plastic sheeting that is applied with the machinery.
 3. The plastic sheeting shall be tight, sufficiently lapped, and clear enough to inspect and see that water is present on the shotcrete continuously during the entire curing period.
 4. If water is not present and cannot be detected through the clear plastic, use machine or hand watering methods to soak the entire shotcrete surface.
- D. Do not use curing compounds.

3.11 INSULATION APPLICATION

A. Sprayed Foam:

1. Maximum thickness at any point shall not exceed the required minimum thickness by more than 1/2 inch.
 - a. Thin areas shall receive additional spray insulation, and overly-thick areas shall be planed or shaved until insulation thickness conforms to the required minimum and maximum thickness limitations.
2. Before insulation application, the ladders and other equipment not to be insulated shall be wrapped with suitable coverings and secured.
 - a. This covering shall be removed after the polyurethane foam and protective coating applications are complete.
3. Spraying shall not be allowed to proceed in the presence of water, rain, fog, condensation, or wind velocities above 15 miles per hour, unless the work area is protected with a windproof, weatherproof enclosure.
 - a. The foam shall be applied in strict accordance with the manufacturer's recommendations.
4. Standard commercial spray equipment specifically designed for two-component polyurethane foam spray systems shall be used.
 - a. A preheater shall be used and adjusted to achieve the hose temperature recommended by the polyurethane foam manufacturer.
5. Unless the work area is protected in a weathertight enclosure, the substrate area to be insulated each day shall be limited by the applicator's ability to apply the first coat of the protective coating to the foam and protect it from precipitation.
6. Utilize ground wires or other thickness or alignment guides as necessary to maintain specified tolerances on sprayed foam application thickness.
7. The finished foam surface shall be as smooth as possible, with an orange peel type surface desired.
 - a. A popcorn type surface with irregularities greater than 1/4 inch will not be permitted, and shaving of these areas to acceptable smoothness shall be required.

B. Rigid Insulation:

1. Install the rigid insulation in two separate layers.
 - a. Adjacent sheets within the same layer shall butt snugly against each other.
 - b. Joints on the outer layer shall not be placed directly over joints on the inner layer.
2. Cut and install the rigid insulation to fit snugly around the ladder support brackets.
 - a. Fill any spaces with a polyurethane foam sealant similar to the polyurethane insulation specified in this Section.

C. Prefabricated Insulated Panels:

1. The complete system, including the fastening system, shall be weathertight and installed in accordance with the manufacturer's recommendations.
2. The panels shall be cut and installed to fit snugly around ladder supports and other projections.
3. Fill any spaces with polyurethane foam sealant.

D. Metal Jacketing:

1. The jacketing shall be applied directly against the urethane covering in the case of the sprayed polyurethane insulation alternative or against the extruded polystyrene rigid insulation if that alternative is selected.
 - a. If the sprayed foam alternative is installed, the urethane coating shall be fully cured before the metal jacketing is installed.
 - b. Jacketing or flutes, if any, shall run vertically.
 - i. A 2-inch minimum overlap shall be provided at all joints with the top sheet overlapping the bottom sheet.
2. The jacketing shall be cut and installed to fit snugly around ladder supports and other projections.

E. Fastening System:

1. The tension bands shall be vertically supported a minimum of every 20 feet around the circumference of the tank to prevent the bands from sliding downward.
2. The support devices shall be approved by the STR and shall allow the bands to slide horizontally through each device but not be permanently attached to the devices or jacketing.
3. Maximum band spacing shall be 4 feet with the top band located 4 inches on center from the top of the tank wall and the bottom band located 3 inches on center from the top of the tank wall.
4. The band tension clamps shall be aligned in a single vertical line down the side of the tank as located by the STR.

3.12 INSPECTION, EXAMINATION, TESTING AND OBSERVATION**A. Perform Field Testing in accordance with Section 01400.**

1. Utilize a Testing Laboratory in accordance with Section 01450.

B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.**1. Automated Wet Mix Process:**

- a. Where automated wet mix equipment is used, take shotcrete cylinders from mixer or ready-mix and test in accordance with ASTM C 31/C 31M and ASTM C 39/C 39M..
- b. Cubes for Shotcrete testing shall be 6 by 12 inch.
- c. Evaluation will be in accordance with ACI 301 and Specification.
 - i. Every arithmetic average of three consecutive strength tests shall equal or exceed f_c , and no individual strength test shall fall below f_c by more than 600 psi.

2. Hand-Operated Shotcreting Operations:

- a. Where shotcrete is applied by hand; obtain, prepare, and test cores taken from in-place work in accordance with ASTM C 42/C 42M.
 - i. Specimens shall consist of not less than 2-inch diameter cores or 2-inch cubes.

- b. When length of core is less than twice the diameter, apply correction factors in accordance with ASTM C 42/C 42M to obtain compressive strength of individual cores.
 - i. Do not contact or cause damage to circumferential prestressing in obtaining cores.
 - c. Average compressive strength of three cores taken from test panel equal or exceed 0.85 fc with no individual core less than 0.75 fc.
 - i. Average of three cubes taken from a panel shall equal or exceed f'c with no individual cube less than 0.88 fc.
 - d. Shotcrete strength will be based on results obtained from cores or sawed cubes.
 - 3. Use of data obtained from impact hammers, ultrasonic equipment, or nondestructive testing devices is not permitted.
 - a. However, these devices may be used for determining uniformity of shotcrete.
 - 4. Remove and replace shotcrete found not meeting tests, or cut cores and further test shotcrete, or repair and replace as approved by the STR.
 - 5. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

CONCRETE CURING**SECTION 03370****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Curing Compound
- B. Evaporation Retardant

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 03300

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes / Standards

- 1. American Society for Testing and Materials (ASTM)
 - a. C 1315
- 2. International Code Council (ICC)
 - a. IBC

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.

- 1. Curing Compound Manufacturer's Product Data, 2.1 A. 3.
- 2. Evaporation Retardant Manufacturer's Product Data, 2.1 B. 3.
- 3. Curing Methods Proposed for Each Type of Element, 3.1 C.

B. Deleted**1.7 DELIVERY, STORAGE AND HANDLING**

- A. See Section 01600 for general requirements.

PART 2 PRODUCTS**2.1 MATERIALS****A. Curing Compound:**

1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C 1315 Type I, Class A.
2. Manufacturers and Products:
 - a. BASF Construction Chemicals, Shakopee, MN; Kure 1315.
 - b. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
 - c. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
 - d. Vexcon Chemical, Inc.; Philadelphia, PA; Starseal 1315.
 - e. Dayton Superior; Safe Cure and Seal 1315 EF.
 - f. Or approved equal.
3. Submit Curing Compound Manufacturer's Product Data.

B. Evaporation Retardant:

1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
2. Manufacturers and Products:
 - a. Master Builders Co., Cleveland, OH; Confilm.
 - b. Euclid Chemical Co., Cleveland, OH; Eucobar.
 - c. Or approved equal
3. Submit Evaporation Retardant Manufacturer's Product Data.

PART 3 EXECUTION**3.1 CONCRETE CURING****A. General:**

1. Where surfaces are to receive coatings, painting, cementitious material, or other similar finishes, use only water curing procedures.
2. Use only moist curing procedures for tank structure except where allowed by SRR during cold weather placement.
3. Where curing compound cannot be used, water curing as described below or special methods using moisture shall be agreed upon by STR prior to placing concrete.
4. As required in Section 03300, if result of 7 or 14 day concrete shrinkage tests exceed established limits, extend period of moist curing specified below, by 14 additional days.

B. Use one of the following methods:**1. Walls and Columns:**

- a. Method 1: Leave concrete forms in place and keep surfaces of forms and concrete wet for 7 days.
- b. Method 2: Continuously sprinkle with water 100 percent of exposed surfaces for 7 days starting immediately after removal of forms.
- c. Method 3: Apply curing compound, where allowed, immediately after removal of forms.

2. Slabs:

- a. Method 1: Protect surface by water ponding for 7 days.
- b. Method 2: Cover with burlap or cotton mats and keep continuously wet for 7 days.

- c. Method 3: Cover with 1 inch layer of wet sand, earth, or sawdust, and keep continuously wet for 7 days.
- d. Method 4: Continuously sprinkle exposed surface for 7 days.
- e. Method 5: Apply curing compound, where allowed, immediately after final finishing when surface will no longer be damaged by traffic.

C. Submit Curing Methods Proposed for Each Type of Element.

3.2 EVAPORATION RETARDANT APPLICATION

- A. Use on flatwork when environmental conditions are anticipated to cause rapid drying of the concrete surface.
- B. Spray onto surface of fresh flatwork concrete immediately after screeding to react with surface moisture.
- C. Reapply as needed to ensure a continuous moist surface until final finishing is completed.

3.3 PRESTRESSED TANK CONCRETE CURING

- A. Keep concrete surfaces and form continuously moist for 7 days.
- B. Begin curing immediately after initial concrete set has occurred.
- C. Do not use curing compounds.

3.4 INSPECTION / EXAMINATION / TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

NONSHRINK GROUTING**SECTION 03600****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Nonshrink Grout

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 03100
- C. Section 03300

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

- A. Required Codes / Standards

- 1. American Society for Testing and Materials (ASTM)
 - a. C 939
 - b. C 1107/C 1107M
- 2. International Code Council (ICC)
 - a. IBC

- B. Regulations

- 1. None Specified in this Section

- C. Documents

- 1. None Specified in this Section

- D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 QUALIFICATIONS

- A. For grout suppliers not listed herein, provide completed 24 hour Evaluation of Nonshrink Grout Test Form and Procedures, attached at the end of this section.
 - 1. Utilize a Testing Laboratory qualified in accordance with Section 01450 to perform the evaluation.
 - 2. Submit Test Report For 24-Hour Evaluation Of Nonshrink Grout.

1.7 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. Test Report - Evaluation Of Nonshrink Grout, 1.6 A. 2.
 - 2. Category I ASTM C 1107 Test Report, 2.2 A. 3.c.
 - 3. Nonshrink Grout Category I Product Data, 2.2 A. 7.

4. Category II ASTM C 1107 Test Report, 2.2 B. 4.c.
5. Nonshrink Grout Category II Product Data, 2.2 B. 9.
6. Manufacturer's Certificate of Compliance, 2.2 C.
7. Nonshrink Grout Installation Instructions, 2.2 D.

B. Deleted

1.8 DELIVERY, STORAGE AND HANDLING

A. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 NONSHRINK GROUT SCHEDULE

A. Furnish nonshrink grout for applications in grout category in the following schedule:

Application	Temperature Range	Max. Placing Time	
	40 deg F to 100 deg F	20 Min.	Greater Than 20 Min.
Column baseplates single-story	I or II		II
Baseplates for columns over one story	II	II	II
Through-bolt openings	II	II	II

2.2 NONSHRINK GROUT

A. Category I:

1. Nonmetallic and nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Perform 24 Hour Evaluation Test in accordance with ASTM C 1107/C 1107M as modified herein:
 - a. Grout shall have flowable consistency.
 - b. Flowable for 15 minutes.
 - c. Submit Nonshrink Grout Category I ASTM C 1107 Test Report.
4. Grout shall not bleed at maximum allowed water.
5. Minimum strength of flowable grout, 3,000 psi at 3 days, 5,000 psi at 7 days, and 7,000 psi at 28 days.
6. Manufacturers and Products:
 - a. BASF Building Systems, Inc., Shakopee, MN; Construction Grout.
 - b. Euclid Chemical Co., Cleveland, OH; NS Grout.
 - c. Dayton Superior Corp., Kansas City, KS; 1107 Advantage Grout.
 - d. US MIX Co., Denver, CO; US Spec MP Grout.
 - e. L & M Construction Chemicals, Inc., Omaha, NE; Duragrout.
 - f. Or approved equal.

7. Submit Nonshrink Grout Category I Product Data that includes:
 - a. Recommended mixing method.
- B. Category II:
 1. Nonmetallic, nongas-liberating.
 2. Prepackaged natural aggregate grout requiring only the addition of water.
 3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
 4. Perform 24 Hour Evaluation Test in accordance with ASTM C 1107/C 1107M as modified herein:
 - a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C 939.
 - b. Temperatures of 40 degrees F, 80 degrees F, and 100 degrees F.
 - c. Submit Nonshrink Grout Category II ASTM C 1107 Test Report.
 5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
 6. Minimum strength of fluid grout, 3,500 psi at 1 day, 4,500 psi at 3 days, and 7,500 psi at 28 days.
 7. Maintain fluid consistency when mixed in 1 to 9 yard loads in ready-mix truck.
 8. Manufacturers and Products:
 - a. BASF Building Systems, Inc., Shakopee, MN; Master Flow 928.
 - b. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.
 - c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
 - d. Dayton Superior Corp., Kansas City, KS; Sure Grip High Performance Grout.
 - e. L & M Construction Chemicals, Inc., Omaha, NE; Crystex.
 - f. Or approved equal.
 9. Submit Nonshrink Grout Category II Product Data.
 - a. Recommended mixing method.
- C. Submit Nonshrink Grout Manufacturer's Certificate of Compliance for the following:
 1. Grout free from chlorides and other corrosion-causing chemicals.
 2. Nonshrink grout properties of Category II verifying expansion at 3 days or 14 days will not exceed the 28 day expansion limit.
- D. Submit Nonshrink Grout Installation Instructions that include:
 1. Proposed method for keeping existing concrete surfaces wet prior to placing grout.
 2. Forming method for fluid grout placements.
 3. Curing method for grout.

PART 3 EXECUTION

3.1 NONSHRINK GROUT

- A. Mix, place, and cure nonshrink grout in accordance with grout manufacturer's recommendations and SRR accepted Installation Instructions.

B. Through-Bolt Holes:

1. Provide nonshrink grout, Category II, where required by Section 03300.
2. Fill space with dry pack dense grout hammered in with steel tool and hammer.
3. Coordinate dry pack dense grout application with vinyl plug in Section 03100 and bonding agent in Section 03300.

3.2 INSPECTION, EXAMINATION, TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR Special Inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

3.3 ATTACHMENT

- A. 24 Hour Evaluation of Nonshrink Grout Test Form and Procedures

END OF SECTION

24 Hour Evaluation of Nonshrink Grout Test Form and Procedures

Attachment No. 03600-A
Revision No. 3
Spec/Req'n No. C-SPP-Z-00008
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(Test Lab Name)

(Address)

(Phone No.)

OBJECTIVE: Define standard set of test procedures for an independent testing laboratory to perform and complete within a 24-hour period.

SCOPE: Utilize test procedures providing 24-hour results to duplicate field grouting demands. Intent of evaluation is to establish grout manufacturer's qualifications.

PRIOR TO TEST: Obtain five bags of each type of grout.

1. From intended grout supplier for Project.
2. Five bags of grout shall be of same lot number.

ANSWER THE FOLLOWING QUESTIONS FOR GROUT BEING TESTED FROM LITERATURE, DATA, AND PRINTING ON BAG:

- | | |
|--|------------------|
| A. Product data and warranty information contained in company literature and data? | Yes_____ No_____ |
| B. Literature and bag information meet specified requirements? | Yes_____ No_____ |
| C. Water demands and limits printed on bag? | Yes_____ No_____ |
| D. Mixing information printed on the bag? | Yes_____ No_____ |
| E. Temperature restrictions printed on bag? | Yes_____ No_____ |

*Reject grout if one or more answers are noted NO.

24 Hour Evaluation of Nonshrink Grout Test Form and Procedures

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A. Bagged Material:

1. List lot numbers. _____
2. List expiration date. _____
3. Weigh bags and record weight. _____

Disqualify grout if bag weights have misstated measure plus or minus 2 pounds by more than one out of five bags. (Accuracy of weights is required to regulate amount of water used in mixing since this will affect properties.)

B. Mixing and Consistency Determination:

1. Mix full bag of grout in 10 gallon pail.
2. Use electric drill with a paddle device to mix grout (jiffy or jiffler type paddle).
3. Use maximum water allowed per water requirements listed in bag instructions.
4. Mix grout to maximum time listed on bag instructions.
5. In accordance with ASTM C 939 (flow cone) determine time of mixed grout through the flow cone. _____ seconds
6. Add water to attain 20 to 30 second flow in accordance with ASTM C 939.
7. Record time of grout through cone at new water demand. _____ seconds
8. Record total water needed to attain 20 to 30 second flow. _____ pounds
9. Record percent of water. _____ percent

C. When fluid grout is specified and additional water is required beyond grout manufacturer's listed maximum water, ASTM C 1107/C 1107M will be run at new water per grout ratio to determine whether grout passes using actual water requirements to be fluid. Use new water per grout ratio on remaining tests.

D. Bleed Test:

1. Fill two gallon cans half full of freshly mixed grout at ambient temperatures for each category and at required consistency for each.
2. Place one can of grout in tub of ice water and leave one can at ambient temperature.
3. Cover top of both cans with glass or plastic plate preventing evaporation.
4. Maintain 38 degrees F to 42 degrees F temperature with grout placed in ice and maintain ambient temperature for second container for 1 hour.
5. Visually check for bleeding of water at 15 minute intervals for 2 hours.
6. Perform final observation at 24 hours.

If grout bleeds a small amount at temperatures specified, grout will be rejected.

24 Hour Evaluation of Nonshrink Grout Test Form and Procedures

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E. Extended Flow Time and Segregation Test (for Category II):

1. Divide the remaining grout into two 3 gallon cans. Place the cans into the 40 degree F and 100 degree F containers and leave for 20, 40, and 60 minutes. Every 20 minutes remove and check for segregation or settlement of aggregate. Use a gloved hand to reach to the bottom of the can, if more than 1/4 inch of aggregate has settled to the bottom or aggregate has segregated into clumps reject the grout.
2. Right after the settlement test mix the grout with the drill mixer for 10 seconds. Take a ASTM C 939 flow cone test of grout and record flow time. Maintain this process for 1 hour at ambient temperatures of 40 degrees F and 100 degrees F.
 - a. 20 min _____, sec. @ 40 degrees F.
 - b. 40 min _____, sec. @ 40 degrees F.
 - c. 60 min _____, sec. @ 40 degrees F.
 - d. 20 min _____, sec. @ 100 degrees F.
 - e. 40 min _____, sec. @ 100 degrees F.
 - f. 60 min _____, sec. @ 100 degrees F.

All Category II grout that will not go through the flow cone with continuous flow after 60 minutes will be disqualified.

Qualified

Disqualified

F. 24 hour Strength Test:

1. Using grout left in mixing cans in accordance with ASTM C 1107/C 1107M for mixing and consistency determination test and for extended time flow test, make minimum of nine cube samples.
2. Store cubes at 70 degrees F for 24 hours.
3. Record average compressive strength of nine cubes at 24 hours.

Grout will be disqualified if 24 hour compressive strengths are less than 2,500 psi for grouts claiming fluid placement capabilities.

Grouts that have not been disqualified after these tests are qualified for use on the Project for the application indicated in Nonshrink Grout Schedule.

Signature of Independent Testing Laboratory

Date Test Conducted

REPAIR OF VERTICAL AND OVERHEAD CONCRETE SURFACES**SECTION 03720****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Repair Of Vertical and Overhead Concrete Surfaces

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 03300
- C. Section 03370

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standards

- 1. American Concrete Institute (ACI)
 - a. 506.2
- 2. American Society for Testing and Materials (ASTM)
 - a. 506.2
- 3. American Society for Testing and Materials (ASTM)
 - a. A 82/A 82M
 - b. A 185/A 185M
 - c. A 615/A 615M
 - d. C 78/C 78M
 - e. C 109/C 109M
 - f. C 157/C 157M
 - g. C 348
 - h. C 496/C 496M
 - i. C 531
 - j. C 805/C 805M
 - k. C 882/C 882M
 - l. C 1202
 - m. C 1583/C 1583M
 - n. D 4258
 - o. D 4259
- 4. International Code Council (ICC)
 - a. IBC

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. Abrasive Blasting: Surface preparation method that uses compressed air intermixed with an abrasive medium to clean surface of substrate concrete, exposed steel, and reinforcing steel.
 - 1. Compressed air and abrasive medium is projected at high speed through a nozzle directly at the surface.
 - 2. Method is used to remove corrosion by-products, laitance, or other materials that may inhibit bond of repair concrete.
- B. High-Pressure Water Blasting: Sometimes referred to as hydro-demolition.
 - 1. Uses water that may contain an abrasive medium, projected under high pressure and high velocity.
 - 2. Used for demolition, cutting, partial or full depth removal, cleaning, scarifying, or roughening of concrete surfaces, or removing existing coatings, for preparation of substrate concrete surfaces.
- C. Low-Pressure Spray Mortar: Mortar suitable to be applied by low-pressure spraying, and in small areas may be applied by hand troweling.
- D. New Concrete: Concrete less than 60 days old forming structures constructed as part of the Work.
- E. Rebound: Shotcrete material, mostly aggregates, that bounce off a surface against which shotcrete was projected.
- F. Structural Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than or equal to 3/8 inch deep, surface voids greater than or equal to 1 inch in diameter.
 - 1. Cracks in containment structures and that are 0.005 inch wide and wider, cracks that leak, and cracks in other structures that are 0.010 inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections.
- G. Surface Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids smaller than 3/8 inch deep and greater than 3/16 inch deep, surface voids greater than 5/8 inch and smaller than 1 inch in diameter.
- H. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Repair Mortar System Applicator:
 - a. Trained and experienced applicator endorsed by repair mortar system manufacturer.
 - b. For Repair System B, in lieu of recognition or certification, demonstrate application of repair mortar manufacturer's system and obtain Certification of Proper Installation, in accordance with Article Manufacturer's Services.
 - c. Submit Statement of Qualification - Repair Applicator.
 - 2. Repair Mortar System Manufacturer's Representative: As specified in Section 01640.
 - a. Submit Statement of Qualification - Repair Manufacturer's Representative.
 - 3. Shotcrete Nozzleman: Current ACI Certification.
 - a. Submit Current ACI Certification for Nozzleman.

B. Demonstration Mockup for Shotcrete Mortar or Low-Pressure Spray Mortar Repair System:

1. For each type of repair mortar system to be used, prepare one demonstration mockup in vertical orientation of at least 10 feet by 10 feet with average thickness, and containing reinforcement, representative of area being repaired on Project.
 - a. Alternatively, a repair area in each vertical and overhead orientation that is representative of area to be repaired in terms of size, thickness, and reinforcement, may be used for demonstration in lieu of mockups; subject to acceptance by STR.
2. Repair Mortar System Manufacturer's Demonstration:
 - a. Schedule time for manufacturer's demonstration of repair system proposed for Project.
 - b. Prepare mortar to specified consistency for testing and placement.
 - c. Cure portions of each type of surface to be repaired using proposed curing procedure and materials, including overhead and vertical applications.
 - d. Prepare surface area in advance of demonstration and obtain manufacturer's acceptance of preparation for each type of application.
 - e. Demonstrate the following:
 - i. Mixing and application equipment capabilities and procedures, including flow of material from nozzle or sprayer.
 - ii. Nozzle operator and person in charge of low-pressure sprayer, capabilities and ability to follow prescribed application procedures and properly operate equipment and apply surface repair materials.
 - f. Compression Strength Test: Make compression test samples from wet mortar during demonstration placement and deliver to testing laboratory for testing at 7 days and 28 days.
 - g. Tensile Bond Test: Test in situ for tensile bond at 7 days as specified in Paragraph Direct Tension Bond Test.

C. Demonstration Mockup for Hand-Applied System B or C Repair Mortar:

1. For each type of repair mortar system to be used, prepare one demonstration mockup in vertical orientation of average size and thickness, and containing reinforcement, representative of area being repaired on Project.
 - a. Alternatively, a repair area in each vertical and overhead orientation that is representative of area to be repaired in terms of size, thickness, and reinforcement, may be used for demonstration in lieu of mockups; subject to acceptance by STR.

D. Pre-Repair Conference:

1. Required Meeting Attendees:
 - a. Subcontractor.
 - b. Repair Subcontractor.
 - c. Technical representative for repair material manufacturer.
 - d. STR's representatives.
2. Schedule and conduct prior to incorporation of respective products into Project.
 - a. Notify STR of location and time.

3. Agenda shall include, but not limited to:
 - a. Review of field conditions.
 - i. Conduct field observations of the Work to be performed.
 - b. Based on above observations, repair material manufacturer's technical representative shall confirm material selection and make Project specific repair method recommendations.
 - c. Technical representative for repair material manufacturer shall review proposed surface preparation, material application, consolidation, finishing, curing, and protection of repair material from weather conditions.
 - d. Other specified requirements requiring coordination.

E. See Section 01400 for general requirements.

1.6 SUBMITTALS

A. Submit the following Engineering documents in accordance with Section 01330 and 01400.

1. Statement of Qualification - Repair Applicator, 1.5 A. 1.a.
2. Statement of Qualification - Repair Manufacturer's Representative, 1.5 A. 2.a.
3. Current ACI Certification for Nozzleman, 1.5 A. 3.a.
4. Product Data Sheets For Each Material Supplied, 2.9 A.
5. Mesh Manufacturer's Installation Instructions and Allowable Load Criteria, 2.9 B.
6. Repair Mortar System - Manufacturer's Preparation and Installation Instructions, 2.9 C.
7. Repair Mortar System Manufacturer's Proposed Modified Test Procedures, 2.9 D.
8. Manufacturer's Certificate of Compliance - Repair Mortar Systems, 2.9 E.
9. Manufacturer's Certificate of Compliance - Repair Mortar Systems Designed for Use on Horizontal Surfaces Exposed to Weather, 2.9 F.
10. Written Description of Equipment Proposed for Concrete Removal and Surface Preparation, 2.9 G.
11. Drawings Indicating Results of Sounding for Hollow Areas Including Location, Size, Estimated Quantity, of Hollow-Sounding Areas for Each Repair Location, 3.10 B.

B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

- A. Package repair mortar system products in moisture-resistant bags, pails, or moisture-resistant bulk bags.
- B. Deliver, store, and handle repair materials in accordance with manufacturer's printed instructions.
- C. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 SYSTEM A—SHOTCRETE MORTAR

A. Mortar Materials:

1. Blend of selected portland cements, microsilica, and specially graded aggregates and fibers applicable for vertical and overhead surfaces.

2. Materials shall not contain asbestos, chlorides, nitrates, added gypsum, added lime, or high aluminum cements.
 3. Noncombustible before and after cure.
 4. Furnish in factory proportioned unit.
 5. Workability from ¼ inch in depth and greater.
- B. Mixed Mortar Properties:
1. Working Time: 5 minutes to 10 minutes.
 2. Finishing Time: 10 minutes to 20 minutes.
 3. Color: Dark gray.
- C. Cured Mortar Properties:
1. Compressive strength for 2 inch cubes in accordance with ASTM C 109/C 109M, or 3 inch cubes in accordance with manufacturer's modification to ASTM C 109/C 109M:
 - a. 7 Days: 6,000 psi minimum.
 - b. 28 Days: 7,000 psi minimum.
 2. Flexural Strength (Modulus of Rupture), ASTM C 78/C 78M or ASTM C 348 (Modified) at 28 Days: 1,100 psi minimum.
 3. Splitting Tensile Strength, ASTM C 496/C 496M at 28 Days: 400 psi minimum.
 4. Chloride Ion Permeability Based on Charge Passed, ASTM C 1202 : 800 coulombs maximum.
 5. Mortar shall not produce a vapor barrier.
- D. Manufacturers and Products:
1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; Shotpatch 21F.
 2. Sika Corp., Lyndhurst, NJ; SIKACEM 103F.
 3. Euclid Chemical Co., Cleveland, OH; Eucoshot F.
 4. Or approved equal.

2.2 SYSTEM B—LOW-PRESSURE SPRAY MORTAR

- A. One- or two-component, cement based, fiber reinforced, shrinkage compensated, gray in color, with a minimum 30 minute working time.
- B. Cured materials mixed in accordance with manufacturer's instructions shall conform to the following criteria:
1. Compressive Strength, ASTM C 109/C 109M at 28 Days: 6,000 psi minimum.
 2. Flexural Strength, ASTM C 348 at 28 Days: 1,100 psi minimum.
 3. Slant Shear Bond Strength, ASTM C 882/C 882M Test Method Modified with No Bonding Agent, at 28 Days: 3,000 psi minimum.
 4. Direct Tensile Bond Strength, ASTM C 496/C 496M at 28 Days: 300 psi minimum.
 5. Drying Shrinkage, ASTM C 157/C 157M Modified at 28 Days or ASTM C 531 : 0.1 percent maximum.
 6. Chloride Ion Permeability Based on Charge Passed, ASTM C 1202: 800 coulombs maximum.
 7. System shall not produce a vapor barrier.

8. Sprayable, extremely low permeability, sulfate resistant, easy to use and requiring only addition of water.
9. Free of chlorides and other chemicals causing corrosion.

C. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; Emaco S88 CI.
2. Sika Corp., Lyndhurst, NJ; SikaRepair 224.
3. Or approved equal.

2.3 SYSTEM C—EPOXY REPAIR MORTAR

- A. 1 part Sika Sikadur 31 Hi-Mod Gel, or approved equal, mixed with 1 part by loose volume of oven-dried fine aggregate in accordance with manufacturer's directions.

2.4 SYSTEM D - TYPE V CONCRETE REPAIR MORTAR

- A. Form Tie Through Hole Type V Dry Pack Repair Mortar or Type V design mix as specified in Section 03300.

2.5 WATER

- A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances, meeting federal drinking water standards, as specified in Section 03300.

2.6 REINFORCEMENT

- A. Deformed Reinforcing Bars: ASTM A 615/A 615M, Grade 60, where welding is not required.
- B. Mesh Reinforcement: Welded wire fabric flat sheets with spacing of wires and wire size in accordance with ASTM A 185/A 185M, wire 75 ksi minimum tensile strength per ASTM A 82/A 82M, and repair mortar system manufacturer's recommendations.
- C. Tie Wire: 16-gauge, galvanized.
- D. Mesh Anchors:
1. Manufacturers and Products:
 - a. Powers Fastening, Inc., Brewster, NY; Tie Wire Version of Power-Stud.
 - b. Hilti Fastener Systems, Tulsa, OK; Kwik Bolt II HHDA, 1/4-inch ceiling hanger.
 - c. Or approved equal.

2.7 CEMENTITIOUS BONDING AGENT

- A. Cementitious adhesive, specifically formulated for bonding plastic portland cement concrete or mortar to hardened portland cement concrete.
1. Mixed Bonding Agent Properties:
 - a. Pot Life: 75 minutes to 105 minutes.
 - b. Contact Time: 24 hours.
 2. Cured Cementitious Adhesive Properties:
 - a. Splitting Tensile Strength, ASTM C 496/C 496M at 28 Days: 600 psi minimum.
 - b. Flexural Strength, ASTM C 348: 1,000 psi minimum.
 - c. Slant Shear Bond Strength, ASTM C 882/C 882M :
 - i. 2-Hour Open Time: 2,500 psi minimum.
 - ii. 24-Hour Open Time: 2,000 psi minimum.

- d. Bonding agent shall not produce a vapor barrier.
- e. Compatible with repair mortar system.

B. Manufacturers and Products:

- 1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; Emaco P24.
- 2. Sika Corp., Lyndhurst, NJ; Sika Armatec 110 EpoCem.
- 3. Euclid Chemical Co., Cleveland, OH; Dural Prep AC.
- 4. Or approved equal.

2.8 EVAPORATION RETARDANT

- A. As specified in Section 03370.

2.9 PRODUCT DOCUMENTATION

- A. Submit Product Data Sheets For Each Material Supplied.
- B. Submit Mesh Manufacturer's Installation Instructions and Allowable Load Criteria.
- C. Submit Repair Mortar System - Manufacturer's Preparation and Installation Instructions.
- D. Submit Repair Mortar System Manufacturer's Proposed Modified Test Procedures for ASTM C 109/C 109M and ASTM C 882/C 882M test methods.
- E. Submit Manufacturer's Certificate of Compliance that Proposed Repair Mortar Systems Meet or Exceed Specified Performance Criteria, in accordance with Section 01640, when tested in accordance with Article Field Quality Control.
- F. Submit Manufacturer's Certificate of Compliance that Repair Mortar Systems are Prepackaged, Shrinkage Compensated, Specially Designed for Use on Horizontal Surfaces Exposed to Weather in accordance with Section 01640.
- G. Submit Written Description of Equipment Proposed for Concrete Removal and Surface Preparation.

PART 3 EXECUTION

3.1 GENERAL

- A. Repair Surface Defective Areas in new concrete structures constructed under this Subcontract with applicable repair system in accordance with SDDR disposition.
- B. Concrete structural repairs within 8 inches from the inside face of the tank wall and bottom surface of the upper slab, and within 10 inches from the top surface of the tank bottom slab, repair systems shall be limited to the following:
 - a. System No. C epoxy repair mortar.
 - b. Type V concrete as specified in Section 03300 with Epoxy Bonding Agent.
 - c. As directed by the STR
- C. Provide SDDR, in accordance with Section 01250, with Drawings or Photographs Indicating Location, Size, Estimated Quantity, and Proposed Repair System for Each Repair Location.

3.2 PREPARATION

- A. Identify unsound and deteriorated concrete by sounding techniques or use of a rebound hammer per ASTM C 805/C 805M, or as directed by STR. Review proposed extent of repair with STR.

- B. Remove unsound, deteriorated, or otherwise defective areas of concrete from work areas.
 - 1. Use 8,000 psi minimum psi high-pressure water blasting machine, as appropriate to suit Site conditions.
 - 2. Remove concrete to abrade substrate concrete surface to a minimum amplitude roughness of 3/16 inch measured between high and low points with a 3-foot-long straightedge, in accordance with ASTM D 4259.
 - 3. Where final surface is required to be flush with existing adjacent surface, remove existing concrete depth as required for application of minimum thickness of repair mortar.
- C. Do not use power-driven jackhammers, chipping hammers, scabblers, or scarifiers unless water blasting is not permitted or practical due to Site conditions, or may cause other damage to equipment or facilities. In such cases where chipping hammers are required, limit size of chipping hammer to reduce formation of micro-fractures in substrate concrete surface.
- D. Following removal of unsound or deteriorated concrete, check substrate concrete surface by sounding techniques to identify unsound concrete remaining or resulting from use of chipping hammer.
- E. Remove unsound concrete to satisfaction of STR.
- F. Square edges of patch areas by sawing or chipping to avoid tapered shoulders or feathered edges. Avoid cutting embedded reinforcing steel. Roughen polished saw-cut edge by high-pressure water blasting.
- G. Remove concrete adjacent to reinforcing bar to a minimum of 1-inch clearance around reinforcing bar for application and bonding of new repair mortar to entire circumference of exposed reinforcing bar if one or more of the following surface conditions exist:
 - 1. 50 percent or more of circumference around reinforcing bar is exposed during concrete removal.
 - 2. 25 percent or more of circumference around reinforcing bar is exposed during concrete removal and corrosion is present to extent that more than 25 percent loss of section has occurred.
 - 3. Otherwise evident that bond between existing concrete and reinforcing bar has been destroyed or has deteriorated as determined by STR.
- H. Clean exposed reinforcing steel bars of loose rust and concrete splatter per recommendations of repair material manufacturer and in accordance with ASTM D 4258.
- I. Keep areas from which concrete has been removed free of dirt, dust, and water blasting waste slurry.
 - 1. Remove laitance and other bond inhibiting contaminants from prepared areas.
- J. Dampen repair areas at least 6 inches beyond area to receive repair mortar for at least 24 hours to provide saturated surface dry (SSD) condition without standing water at time of application of mortar, as required by and in accordance with repair mortar manufacturer's printed instructions.
- K. Collect and dispose of spent water and concrete debris from removal operations offsite in manner and location acceptable to SRR.

3.3 REINFORCEMENT INSTALLATION

- A. Provide reinforcement when existing reinforcement is not exposed and mortar application is more than 3 inches deep, unless otherwise shown on Drawings.

- B. Replace deteriorated reinforcing with new reinforcing equivalent in cross-sectional area to original reinforcing.
- C. Install mesh anchors in accordance with mesh manufacturer's instructions.
- D. Fasten reinforcement to chairs or mesh anchors with tie wire to prevent from moving during placement of repair mortar.
- E. Lap reinforcement mesh a minimum of one mesh spacing and securely fasten mesh to mesh anchors, or to reinforcement fastened to mesh anchors, with tie wire at intervals no more than 12 inches to prevent movement during application of repair mortar.

3.4 PROTECTION

- A. Protect adjacent surfaces, and equipment from being damaged by overshooting, rebound, and dust, as applicable for repair mortar system used

3.5 SYSTEM A—SHOTCRETE MORTAR APPLICATION

- A. Apply shotcrete mortar in accordance with manufacturer's instructions.
- B. Do not reuse rebound materials.
- C. Apply mortar utilizing dry mix process, in accordance with ACI 506.2.
- D. Shotcrete mortar shall emerge from nozzle in a steady, uninterrupted flow. If flow becomes intermittent, direct flow away from the Work until flow of mortar becomes constant.
- E. Applied Shotcrete Mortar: Minimum thickness of 1-1/2 inches to 2 inches of cover over existing reinforcement, or to level of surrounding concrete surface, whichever results in thicker coat.
- F. Nozzle Position: Hold nozzle approximately at right angles to and at a distance from surface in accordance with shotcrete repair mortar system manufacturer's instructions for type of application, nozzle, and air pressure used.
- G. Reinforcing Steel Encasement:
 - 1. Modify procedure of shooting shotcrete mortar to better direct material around reinforcement bars.
 - 2. Prevent shotcrete mortar from building up on reinforcement steel when shooting on, around, through, and behind steel to eliminate voids.
 - 3. Provide dense void-free encasement of reinforcement steel.
- H. Shotcreting More than One Layer: In accordance with shotcrete repair mortar system manufacturer's printed instructions.
 - I. Apply finish to exposed shotcrete mortar surface to match existing surface and in accordance with manufacturer's instructions.
 - 1. Leave exposed shotcrete mortar surface with natural gun finish.
- J. Rebound Removal: Continuously throughout shotcrete mortar application, remove rebound, sand, and miscellaneous debris, and dispose off Site at an approved disposal facility.
- K. Cure as specified in Article Curing Cementitious Repair Mortars.

3.6 SYSTEM B—LOW-PRESSURE SPRAY MORTAR APPLICATION

- A. Mix mortar in accordance with manufacturer's printed instructions.
- B. After priming prepared substrate surface per manufacturer's recommendations, apply mortar by low-pressure spraying equipment, unless noted otherwise.

C. Bonding Agent:

1. Use bonding agent for hand applied areas, in accordance with repair mortar manufacturer's instructions.
2. Application of repair mortar over bonding agent shall be completed within time frame recommended by bonding agent manufacturer.
3. Consult with manufacturer for optimum and minimum acceptable degrees of surface tackiness of coat.

D. Work mortar firmly and quickly into repair area.

E. Finish repair mortar to smooth even surface matching adjacent concrete surface with steel trowel finish.

F. Cure as specified in Article Curing Cementitious Repair Mortars.

3.7 SYSTEM C—EPOXY REPAIR MORTAR APPLICATION

A. Mix mortar in accordance with manufacturer's printed instructions.

B. Work mortar firmly and quickly into repair area.

1. Apply in lifts of one inch maximum.

C. Finish repair mortar to smooth even surface matching adjacent concrete surface with steel trowel finish.

3.8 SYSTEM D - TYPE V CONCRETE REPAIR APPLICATION

A. Apply epoxy bonding agent to prepared surface in accordance with manufacturer's instructions.

1. Do not apply more bonding agent than can be covered with concrete before bonding agent sets.

B. Install form with pouring spout.

C. Place concrete.

1. Strip forms after concrete has set and cure as specified.

D. Grind and remove extra concrete in pouring spout to even surface matching adjacent concrete.

3.9 CURING CEMENTITIOUS REPAIR MORTARS

A. Prior to curing, apply water fog to repair mortar system in accordance with repair mortar system manufacturer's printed instructions.

B. Cure in accordance with repair mortar manufacturer's printed instructions.

C. Where permitted by repair mortar manufacturer's printed instructions, commence water curing after repair mortar system application and when curing will not cause erosion of mortar.

D. Continuously water cure repair mortar system for a period of 7 days.

E. Do not cure using curing compound or membrane, unless method is part of repair mortar system manufacturer's printed instructions and approval is obtained from STR.

F. Cure intermediate layers of repair mortar in accordance with repair mortar manufacturer's printed instructions.

G. Where curing compound is permitted by repair mortar system manufacturer, apply curing compound in accordance with Section 03370.

3.10 FIELD QUALITY CONTROL

- A. Sounding for Hollow Areas:
 - 1. Light hammer tap repaired areas listening for hollow sound to determine areas that have not properly bonded to substrate concrete.
 - 2. Mark hollow areas for removal and replacement.
- B. Submit Drawings Indicating Results of Sounding for Hollow Areas Including Location, Size, and Estimated Quantity of Hollow-Sounding Areas for Each Repair Location.
- C. Testing laboratory retained by SRR will test the following:
 - 1. Compression Strength Test:
 - a. Testing will follow a "modified" ASTM C 109/C 109M.
 - b. A minimum of three production samples of mixed material will be obtained from each 200 square feet of mortar repair, and a minimum of three samples in total, whichever is greater, for testing at 7 days, and 28 days.
 - c. Record location where repair mortar is being applied at time production samples are obtained.
 - 2. Direct Tension Bond Test:
 - a. In situ bond testing will be performed in accordance with ASTM C 1583/C 1583M.
 - b. Bond Strength of Repair Mortar to Substrate Concrete: 300 psi minimum in direct tension without failure or movement.
 - c. Record locations of bond tests on each type of applied repair mortar tested.
- D. Retest mortar repairs that do not meet test requirements.
- E. Repair and fill holes using same repair mortar where core samples have been removed.

3.11 MORTAR REPAIR FAILED TEST

- A. Remove and replace unacceptable Work.
- B. Hollow Sounding Areas: Saw cut hollow sounding areas to a new square edge, remove unsound mortar repair.
 - 1. Prepare substrate surface and reapply repair mortar as specified herein above.
- C. Failed Compression Strength Test: Remove affected areas of repair mortar represented by failed compression strength test results.
 - 1. Prepare substrate surface and reapply repair mortar as specified herein above.
- D. Failed Bond Tests: Remove affected areas of repair mortar represented by failed bond test results.
 - 1. Prepare substrate surface and reapply repair mortar as specified herein above.
- E. Retest areas where repair mortar was removed and replaced, in accordance with test requirements specified herein above.

3.12 MANUFACTURERS' SERVICES

- A. Deleted
- B. Deleted

3.13 CLEANING

- A. Remove overshot shotcrete or low-pressure spray repair mortar and rebound materials as the Work proceeds.
 - 1. Remove waste materials, unsound material from concrete surfaces, material chipped from structure, and water used in preparation of repair areas, finishing, and curing, and dispose offsite at approved disposal site.

3.14 INSPECTION / EXAMINATION / TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

REPAIR OF HORIZONTAL CONCRETE SURFACES
SECTION 03722

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Repair Of Horizontal Concrete Surfaces

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 03300
- C. Section 03370

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standards

1. American Association of State Highway and Transportation Officials (AASHTO)
 - a. T 277
2. American Society for Testing and Materials (ASTM)
 - a. T 277
3. American Society for Testing and Materials (ASTM)
 - a. A 82/A 82M
 - b. A 185/A 185M
 - c. A 615/A 615M
 - d. C 109/C 109M
 - e. C 348
 - f. C 469/C 469M
 - g. C 496/C 496M
 - h. C 666/C 666M
 - i. C 805/C 805M
 - j. C 882/C 882M
 - k. C 1012/C 1012M
 - l. C 1202
 - m. C 1583/C 1583M
 - n. D 638
 - o. D 695
 - p. D 4258
 - q. D 4259
4. International Code Council (ICC)
 - a. IBC

B. Regulations

1. None Specified in this Section

C. Documents

1. None Specified in this Section

D. Drawings

1. None Specified in this Section

1.4 DEFINITIONS

- A. Abrasive Blasting: Surface preparation method that uses compressed air intermixed with an abrasive medium to clean surface of substrate concrete, exposed steel, and reinforcing steel.
1. Compressed air and abrasive medium is projected at high speed through a nozzle directly at the surface.
 2. Method is used to remove corrosion by-products, laitance, or other materials that may inhibit bond of repair concrete.
- B. High-Pressure Water Blasting: Sometimes referred to as hydro-demolition.
1. Uses water that may contain an abrasive medium, projected under high pressure and high velocity.
 2. Used for demolition, cutting, partial or full depth removal, cleaning, scarifying, or roughening of concrete surfaces, or removing existing coatings, for preparation of substrate concrete surfaces.
- C. New Concrete: Concrete less than 60 days old forming structures constructed as part of the Work.
- D. Structural Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than or equal to 3/8 inch deep, surface voids greater than or equal to 1 inch in diameter. Cracks in containment structures and that are 0.005 inch wide and wider, cracks that leak, and cracks in other structures that are 0.010 inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections.
- E. Surface Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids smaller than 3/8 inch deep and greater than 3/16 inch deep, surface voids greater than 5/8 inch and smaller than 1 inch in diameter.
- F. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE

- A. Qualifications:
1. Repair Mortar System Applicator: Trained and experienced applicator endorsed by repair mortar system manufacturer.
 - a. Submit Statement of Qualification - Repair Mortar System Applicator.
 2. Repair Mortar System Manufacturer's Representative: As specified in Section 01640.
 - a. Submit Statement of Qualification - Repair Mortar System Manufacturer's Representative.
- B. Pre-Repair Conference:
1. Required Meeting Attendees:
 - a. Subcontractor.
 - b. Repair Subcontractor.
 - c. Technical representative for repair material manufacturer.
 - d. STR's representatives.

2. Schedule and conduct prior to incorporation of respective products into Project.
 - a. Notify STR of location and time.
3. Agenda shall include, but not limited to:
 - a. Review of field conditions.
 - i. Conduct field observations of the Work to be performed.
 - b. Based on above observations, repair material manufacturer's technical representative shall confirm material selection and make Project specific repair method recommendations.
 - c. Technical representative for repair material manufacturer shall review proposed surface preparation, material application, consolidation, finishing, curing, and protection of repair material from weather conditions.
 - d. Other specified requirements requiring coordination.

C. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 1. Statement of Qualification - Repair Mortar System Applicator, 1.5 A. 1.a.
 2. Statement of Qualification - Repair Mortar System Manufacturer's Representative, 1.5 A. 2.a.
 3. Product Data Sheets For Each Material Supplied, 2.11 A.
 4. Manufacturer's Certificate of Compliance that Material Meets Requirements, 2.11 B.
 5. Repair Mortar System - Manufacturer's Preparation and Installation Instructions, 2.11 C.
 6. Manufacturer's Certificate of Compliance that Proposed Repair Mortar Systems Meet or Exceed Specified Performance Criteria, 2.11 D.
 7. Manufacturer's Certificate of Compliance that Repair Mortar Systems are Prepackaged, Shrinkage Compensated, Specially Designed for Use on Horizontal Surfaces Exposed to Weather, 2.11 E.
 8. Written Description of Equipment Proposed for Concrete Removal and Surface Preparation, 2.11 F.
 9. Drawings Indicating Results of Sounding for Hollow Areas Including Location, Size, Estimated Quantity, of Hollow-Sounding Areas for Each Repair Location, 3.7 B.

B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

- A. Package repair mortar system products in moisture-resistant bags, pails, or moisture-resistant bulk bags.
- B. Deliver, store, and handle repair materials in accordance with manufacturer's printed instructions.
- C. See Section 01600 for general requirements.

PART 2 PRODUCTS**2.1 SYSTEM NO. 1—EPOXY REPAIR MORTAR**

- A. 1 part Sika Sikadur 31 Hi-Mod Gel, or approved equal, mixed with 1 part by loose volume of oven-dried fine aggregate in accordance with manufacturer's directions.

2.2 SYSTEM NO. 2—HIGH EARLY STRENGTH REPAIR MORTAR

- A. One- or two-component, fast-setting, high early strength repair mortar.
- B. Compressive Strength, ASTM C 109/C 109M :
 - 1. 2 Hours: 1,500 psi minimum.
 - 2. 1 Day: 4,500 psi minimum.
 - 3. 7 Days: 8,000 psi minimum.
 - 4. 28 Days: 9,000 psi minimum.
- C. Flexural Strength, ASTM C 348 :
 - 1. 1 Day: 850 psi minimum.
 - 2. 7 Days: 1,000 psi minimum.
 - 3. 28 Days: 1,100 psi minimum.
- D. Modulus of Elasticity, ASTM C 469/C 469M :
 - 1. 1 Day: 3.8 by 10^6 psi minimum.
 - 2. 28 Days: 4.5 by 10^6 psi minimum.
- E. Slant Shear Bond Strength, ASTM C 882/C 882M :
 - 1. 1 Day: 2,500 psi minimum.
 - 2. 7 Days: 2,900 psi minimum.
 - 3. 28 Days: 3,100 psi minimum.
- F. Splitting Tensile Strength, ASTM C 496/C 496M :
 - 1. 1 Day: 850 psi minimum.
 - 2. 7 Days: 1,200 psi minimum.
 - 3. 28 Days: 1,300 psi minimum.
- G. Freeze-thaw Resistance, ASTM C 666/C 666M, Procedure A, at 300 Cycles: 98 percent RDM.
- H. Chloride Ion Permeability Based on Charge Passed, ASTM C 1202 or AASHTO T 277, 28 Days: 960 coulombs maximum.
- I. Manufacturers and Products:
 - 1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; Emaco T415.
 - 2. Euclid Chemical Co., Cleveland, OH; VersaSpeed.
 - 3. Or approved equal.

2.3 SYSTEM NO. 3—SHRINKAGE COMPENSATED REPAIR MORTAR

- A. One- or two-component cement-based, flowable, shrinkage compensated repair mortar system.
- B. Compressive Strength, ASTM C 109/C 109M:
 - 1. 1 Day: 2,500 psi minimum.
 - 2. 7 Days: 6,000 psi minimum.
 - 3. 28 Days: 8,000 psi minimum.

- C. Flexural Strength, ASTM C 348 at 28 Days: 770 psi minimum.
 - D. Modulus of Elasticity, ASTM C 469/C 469M at 28 Days: 5.9×10^6 psi minimum.
 - E. Slant Shear Bond Strength, ASTM C 882/C 882M Modified:
 - 1. 7 Days: 2,150 psi minimum.
 - 2. 28 Days: 3,000 psi minimum.
 - F. Freeze-thaw Resistance, ASTM C 666/C 666M, Procedure A, at 300 Cycles: 97.0 percent RDM.
 - G. Chloride Ion Permeability Based on Charge Passed, ASTM C 1202 at 28 Days: 650 coulombs maximum.
 - H. Sulfate Resistance, ASTM C 1012/C 1012M after 6 Months: 0.01 percent length change maximum.
 - I. Manufacturers and Products:
 - 1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; Emaco S66 CI.
 - 2. Euclid Chemical Co., Cleveland, OH; Eucocrete Supreme.
 - 3. Or approved equal.
- 2.4 SYSTEM NO. 4— TYPE V CONCRETE REPAIR MORTAR
- A. Form Tie Through Hole Type V Dry Pack Repair Mortar or Type V design mix as specified in Section 03300.
- 2.5 WATER
- A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances, meeting federal drinking water standards, as specified in Section 03300.
- 2.6 REINFORCEMENT
- A. Deformed Reinforcing Bars: ASTM A 615/A 615M, Grade 60, where welding is not required.
 - B. Mesh Reinforcement: Welded wire fabric flat sheets with spacing of wires and wire size in accordance with ASTM A 185/A 185M, wire 75 ksi minimum tensile strength per ASTM A 82/A 82M, and repair mortar system manufacturer's recommendations.
 - C. Tie Wire: 16-gauge, galvanized.
 - D. Mesh Anchors:
 - 1. Manufacturers and Products:
 - a. Powers Fastening, Inc., Brewster, NY; Tie Wire Version of Power-Stud.
 - b. Hilti Fastener Systems, Tulsa, OK; Kwik Bolt II HHDA, 1/4-inch ceiling hanger.
 - c. Or approved equal.
- 2.7 CEMENTITIOUS BONDING AGENT
- A. Cementitious adhesive, specifically formulated for bonding plastic portland cement concrete or mortar to hardened portland cement concrete.
 - 1. Mixed Bonding Agent Properties:
 - a. Pot Life: 75 minutes to 105 minutes.
 - b. Contact Time: 24 hours.

2. Cured Cementitious Adhesive Properties:
 - a. Splitting Tensile Strength, ASTM C 496/C 496M at 28 Days: 600 psi minimum.
 - b. Flexural Strength, ASTM C 348: 1,000 psi minimum.
 - c. Slant Shear Bond Strength, ASTM C 882/C 882M :
 - i. 2-Hour Open Time: 2,500 psi minimum.
 - ii. 24-Hour Open Time: 2,000 psi minimum.
 - d. Bonding agent shall not produce a vapor barrier.
 - e. Compatible with repair mortar system.

B. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; Emaco P24.
2. Sika Corp., Lyndhurst, NJ; Sika Armatex 110 EpoCem.
3. Euclid Chemical Co., Cleveland, OH; Dural Prep AC.
4. Or approved equal.

2.8 EPOXY BONDING AGENT

- A. Two-component, moisture insensitive, 100 percent solids epoxy resin.
- B. Tensile Strength, ASTM D 638, at 14 Days: 4,400 psi minimum.
- C. Elongation at Break, ASTM D 638: 1.49 percent minimum.
- D. Compressive Strength, ASTM D 695, at 28 Days for Application Temperature of 73 Degrees F to 77 Degrees F: 8,000 psi minimum.
- E. Bond Strength, ASTM C 882/C 882M, at 14 Days: 1,800 psi minimum.
- F. Pot Life, at 73 Degrees F to 77 Degrees F: 75 minutes minimum.
- G. Manufacturers and Products:
 1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; Concrevic Liquid LPL when ambient temperature is 73 degrees F or higher.
 2. Or approved equal.

2.9 EVAPORATION RETARDANT

- A. As specified in Section 03370.

2.10 CURING COMPOUND

- A. As specified in Section 03370.

2.11 PRODUCT DOCUMENTATION

- A. Submit Product Data Sheets For Each Material Supplied.
- B. Submit Manufacturer's Certificate of Compliance that Material Meets Requirements of ASTM C 928/C 928M in accordance with Section 01640.
- C. Submit Repair Mortar System - Manufacturer's Preparation and Installation Instructions.
- D. Submit Manufacturer's Certificate of Compliance that Proposed Repair Mortar Systems Meet or Exceed Specified Performance Criteria, in accordance with Section 01640, when tested in accordance with Article Field Quality Control.

- E. Submit Manufacturer's Certificate of Compliance that Repair Mortar Systems are Prepackaged, Shrinkage Compensated, Specially Designed for Use on Horizontal Surfaces Exposed to Weather in accordance with Section 01640.
- F. Submit Written Description of Equipment Proposed for Concrete Removal and Surface Preparation.

PART 3 EXECUTION

3.1 GENERAL

- A. Repair Surface Defective Areas in new concrete structures constructed under this Subcontract with applicable repair system in accordance with SDDR disposition.
- B. Concrete structural repairs within 8 inches from the inside face of the tank wall and bottom surface of the upper slab, and within 10 inches from the top surface of the tank bottom slab, repair systems shall be limited to the following:
 - 1. System No. 1 epoxy repair mortar.
 - 2. Type V concrete as specified in Section 03300 with Epoxy Bonding Agent.
 - 3. As Directed by the STR
- C. Provide SDDR, in accordance with Section 01250, with Drawings or Photographs Indicating Location, Size, Estimated Quantity, and Proposed Repair System for Each Repair Location.

3.2 PREPARATION

- A. Identify unsound and deteriorated concrete by sounding techniques or use of a rebound hammer per ASTM C 805/C 805M, or as directed by STR.
 - 1. Review proposed extent of repair with STR.
- B. Remove unsound, deteriorated, or otherwise defective areas of concrete from work areas.
 - 1. Use 8,000 psi minimum psi high-pressure water blasting machine, as appropriate to suit Site conditions.
 - 2. Remove concrete to abrade substrate concrete surface to a minimum amplitude roughness of 3/16 inch measured between high and low points with a 3-foot-long straightedge, in accordance with ASTM D 4259.
 - 3. Where final surface is required to be flush with existing adjacent surface, remove existing concrete depth as required for application of minimum thickness of repair mortar.
- C. Do not use power-driven jackhammers, chipping hammers, scabblers, or scarifiers unless water blasting is not permitted or practical due to Site conditions, or may cause other damage to equipment or facilities. In such cases where chipping hammers are required, limit size of chipping hammer to reduce formation of micro-fractures in substrate concrete surface.
- D. Following removal of unsound or deteriorated concrete, check substrate concrete surface by sounding techniques to identify unsound concrete remaining or resulting from use of chipping hammer.
- E. Remove unsound concrete to satisfaction of STR.
- F. Square edges of patch areas by sawing or chipping to avoid tapered shoulders or featheredges. Avoid cutting embedded reinforcing steel.
 - 1. Roughen polished saw-cut edge by high-pressure water blasting.

- G. Remove concrete adjacent to reinforcing bar to a minimum of 1-inch clearance around reinforcing bar for application and bonding of new repair mortar to entire circumference of exposed reinforcing bar if one or more of the following surface conditions exist:
 - 1. 50 percent or more of circumference around reinforcing bar is exposed during concrete removal.
 - 2. 25 percent or more of circumference around reinforcing bar is exposed during concrete removal and corrosion is present to extent that more than 25 percent loss of section has occurred.
 - 3. Otherwise evident that bond between existing concrete and reinforcing bar has been destroyed or has deteriorated as determined by STR.
- H. Clean exposed reinforcing steel bars of loose rust and concrete splatter per recommendations of repair material manufacturer and in accordance with ASTM D 4258.
- I. Keep areas from which concrete has been removed free of dirt, dust, and water blasting waste slurry. Remove laitance and other bond inhibiting contaminants from prepared areas.
- J. Substrate Concrete Surface in Areas to Receive Repair Mortar System: Dampen repair areas at least 6 inches beyond area to receive repair mortar for at least 24 hours to provide saturated surface dry (SSD) condition without standing water at time of application of mortar, as required by and in accordance with repair mortar manufacturer's printed instructions.
- K. Spalled Joints:
 - 1. Saw cut edge 1 inch deep and 6 inches back from old joint.
 - 2. Remove unsound concrete and concrete between saw cut and joint.
 - 3. Place wood or fiber spacer to thickness of joint at joint line.
- L. Overlays:
 - 1. Square cut edges to a minimum of ¼ inch deep.
 - 2. Do not feather edge area.
 - 3. Perform special preparation recommended by mortar manufacturer.
- M. Collect and dispose of spent water and concrete debris from removal operations offsite in manner and location acceptable to SRR.

3.3 REINFORCEMENT INSTALLATION

- A. Provide reinforcement when existing reinforcement is not exposed and mortar application is more than 4 inches deep, unless otherwise shown on Drawings.
- B. Replace deteriorated reinforcing with new reinforcing equivalent in cross-sectional area to original reinforcing.
- C. Install mesh anchors in accordance with mesh manufacturer's instructions.
- D. Fasten reinforcement to chairs or mesh anchors with tie wire to prevent from moving during placement of repair mortar.
- E. Lap reinforcement mesh a minimum of one mesh spacing and securely fasten mesh to mesh anchors, or to reinforcement fastened to mesh anchors, with tie wire at intervals no more than 12 inches to prevent movement during application of repair mortar.

3.4 PROTECTION

- A. Protect adjacent surfaces, and equipment from spillage of repair mortar and dust, as applicable for repair mortar system used.

3.5 APPLICATION

A. General:

1. Repair Mortar System No. 1: Patches, joints, or overlays 1/4 inch to 3 inches thick. Return to service in 3 hours to 2 days.
2. Repair Mortar System No. 2: Patches, joints, or overlays 1/2 inch to 3 inches thick. Return to service in 3 hours to 7 days.
3. Repair Mortar System No. 3: Patches, joints, or overlays 1 inch thick or greater. Return to service in 7 days or more.
4. Repair Mortar System No. 4: Patches or overlays 3 inches thick or greater. Return to service in 7 days or more.

B. Repair Mortar System No. 1:

1. Remove standing water from prepared area.
2. Work material firmly into bottom and sides of patch to ensure a good continuous bond.
3. Apply in lifts of one inch maximum.
4. Level repair mortar and screed to elevation of existing concrete.
5. Finish to same texture as existing concrete around patch.

C. Repair Mortar System Nos. 2 or 3:

1. Remove standing and free water from prepared area.
2. Apply bond scrub coat of mortar to prepared surface in accordance with manufacturer's instructions.
 - a. Do not apply more scrub coat of mortar than can be covered with repair mortar before scrub coat begins drying.
3. Immediately place mixed repair mortar into prepared area from one side to the other side.
4. Work material firmly into bottom and sides of patch to ensure a good continuous bond.
5. Level repair mortar and screed to elevation of existing concrete.
6. Finish to same texture as existing concrete around patch.

D. Repair Mortar System No. 4:

1. Remove standing water from prepared area.
2. Apply epoxy bonding agent to prepared surface in accordance with manufacturer's instructions.
 - a. Do not apply more bonding agent than can be covered with concrete before bonding agent sets.
3. Place concrete and level and screed to elevation of existing concrete.
4. Finish to same texture as existing concrete around patch.

E. Joint Repair:

1. Remove joint spacer when repair mortar is hard enough that a pointed trowel will penetrate surface less than 1/2 inch.

2. When repair mortar is cured and ready for use, fill joint in accordance with repair mortar system manufacturer's instructions.

3.6 CURING

- A. Apply curing compound in accordance with Section 03370 to cementitious repair materials.

3.7 FIELD QUALITY CONTROL

- A. Sounding for Hollow Areas:
 1. Chain drag or light hammer tap repaired areas listening for hollow sound to determine areas that have not properly bonded to substrate concrete.
 2. Mark hollow areas for removal and replacement.
- B. Submit Drawings Indicating Results of Sounding for Hollow Areas Including Location, Size, and Estimated Quantity of Hollow-Sounding Areas for Each Repair Location.
- C. Testing laboratory retained by SRR will test the following:
 1. Compression Strength Test:
 - a. Testing will follow a "modified" ASTM C 109/C 109M.
 - b. A minimum of three production samples of mixed material will be obtained from each 200 square feet of mortar repair, and a minimum of three samples in total, whichever is greater, for testing at 7 days, and 28 days.
 - c. Record location where repair mortar is being applied at time production samples are obtained.
 2. Direct Tension Bond Test:
 - a. In situ bond testing will be performed in accordance with ASTM C 1583/C 1583M.
 - b. Bond Strength of Repair Mortar to Substrate Concrete: 300 psi minimum in direct tension without failure or movement.
 - c. Record locations of bond tests on each type of applied repair mortar tested.
- D. Retest mortar repairs that do not meet test requirements.
- E. Repair and fill holes using same repair mortar where core samples have been removed.

3.8 MORTAR REPAIR FAILED TEST

- A. Remove and replace unacceptable Work.
- B. Hollow Sounding Areas: Saw cut hollow sounding areas to a new square edge, remove unsound mortar repair.
 1. Prepare substrate surface and reapply repair mortar as specified herein above.
- C. Failed Compression Strength Test: Remove affected areas of repair mortar represented by failed compression strength test results.
 1. Prepare substrate surface and reapply repair mortar as specified herein above.
- D. Failed Bond Tests: Remove affected areas of repair mortar represented by failed bond test results.
 1. Prepare substrate surface and reapply repair mortar as specified herein above.
- E. Retest areas where repair mortar was removed and replaced, in accordance with test requirements specified herein above.

3.9 MANUFACTURERS' SERVICES

- A. Deleted
- B. Deleted

3.10 CLEANING

- A. Remove excess repair mortar materials as the Work proceeds. Remove waste materials, unsound material from concrete surfaces, material chipped from structure, and water used in preparation of repair areas, finishing, and curing, and dispose offsite at approved disposal site.

3.11 INSPECTION / EXAMINATION / TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

CRACK REPAIR EPOXY INJECTION GROUTING
SECTION 03740

PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Epoxy Injection Grouting

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 03300
- C. Section 03720

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standards

- 1. American Association of State Highway and Transportation Officials (AASHTO)
 - a. T 237
- 2. American Society for Testing and Materials (ASTM)
 - a. C 882/C 882M
 - b. D 570
 - c. D 638
 - d. D 648
 - e. D 695
- 3. International Code Council (ICC)
 - a. IBC

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. Crack: Complete or incomplete separation of concrete into two or more parts produced by breaking or fracturing.
- B. Crack Injection: Method of sealing or repairing cracks by injecting a polymer.
- C. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE**A. Qualifications for Epoxy Injection Staff:**

- 1. Manufacturer's Site Representative:
 - a. Capable of instructing successful methods for restoring concrete structures utilizing epoxy injection process.

- b. Understands and is capable of explaining technical aspects of correct material selection and use.
 - c. Experienced in the operation, maintenance, and troubleshooting of application equipment.
- 2. Injection crew and job foreman shall provide written and verifiable evidence showing compliance with the following requirements:
 - a. Licensed and certified by epoxy manufacturer.
 - b. Minimum 3 years' experience in successful epoxy injection for at least 10,000 linear feet of successful crack injection including 2,000 linear feet of wet crack injection to stop water leakage.
- B. Submit Epoxy Manufacturer's Statement of Qualification for Site Representative.
- C. Submit Epoxy Manufacturer's Statement of Qualification for Injection pump operating technician.
- D. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01300 and 01400.
 - 1. Statement of Qualification for Site Representative, 1.5 B.
 - 2. Statement of Qualification for Injection pump operating technician, 1.5 C.
 - 3. Epoxy Adhesive Manufacturer's Product Data, 2.5 A.
 - 4. Epoxy Adhesive Manufacturer's Recommended Surface Preparation Procedures and Application Instructions, 2.5 B.
 - 5. Manufacturer's Certificate of Compliance with Certified Test Results, 2.5 C.
 - 6. Manufacturer's Technical Data for Metering, Mixing, and Injection Equipment, 2.5 D.
 - 7. Installation Instructions for Repairing Core Holes, 2.5 E.
 - 8. Statement of Qualification for Injection Applicator, 2.5 F.
- B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

- A. Packing and Shipping: Package adhesive material in new sealed containers and label with following information:
 - 1. Manufacturer's name.
 - 2. Product name and lot number.
 - 3. ANSI Hazard Classification.
 - 4. ANSI recommended precautions for handling.
 - 5. Mix ratio by volume.
- B. Storage and Protection: Store adhesive containers at ambient temperatures below 110 degrees F and above 45 degrees F.
- C. See Section 01600 for general requirements.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Materials, equipment, and accessories specified in this Section:
1. BASF Building Systems, Shakopee, MN; SCB Concrese Series.
 2. Sika Corp., Lyndhurst, NJ; Sikadur Series.
 3. Euclid Chemical Co., Cleveland, OH; Euco Series.
 4. Or approved equal.

2.2 EPOXY ADHESIVE

- A. Two-component A and B structural epoxy adhesive for injection into cracks or other voids in concrete structures for bonding or grouting.
- B. Adhesive Properties:

Property	Test Method	Acceptance
7-day, Tensile Strength, psi	ASTM D 638	5,000 min.
Tensile Elongation @ Break, percent	ASTM D 638	1.0% min.
Compressive Yield Strength, 7 days @ 73°F, psi	ASTM D 695 ^a	8,000 min.
Compressive Modulus, psi	ASTM D 695 ^a	1.5x10 ⁵ min.
Heat Deflection Temperature, °F	ASTM D 648 ^a	120 min. ^a
Water absorption @ 24 hours, Maximum %	ASTM D 570	1.0
Bond Strength @ 2 days psi	ASTM C 882	1,000 min.
Bond Strength @ 14 days psi	ASTM C 882	1,500 min.
Cured 3 days @ 40 deg F—Wet Concrete		3,500 min.
Cured 1 day @ 77 deg F—Dry Concrete		5,000 min.
Cured 3 days @ 77 deg ± 3 deg F		5,000 min.
^a Cure test specimens so that peak exothermic temperature of adhesive does not exceed 100°F.		
^b See referenced specifications for preparation method of test specimens.		

2.3 SURFACE SEAL

- A. Sufficient strength and adhesion for holding injection fittings firmly in place, and to resist pressures preventing leakage during injection.
- B. Capable of removal after injection adhesive has cured.

2.4 SOURCE QUALITY CONTROL

- A. Test Requirements: Perform tests for each batch of adhesive.

B. Pot Life Test:

1. Condition Components A and B to required temperature.
2. Measure components in ratio of Component B as stated on manufacturer's label into an 8 fluid ounce paper cup.
3. Start stopwatch immediately and mix components for 60 seconds using wooden tongue depressor, take care to scrape sides and bottom of cup periodically.
4. Probe mixture once with tongue depressor every 30 seconds, starting 2 minutes prior to minimum specified pot life.
5. Pot Life Definition: Time at which a soft stringy mass forms in center of cup.

2.5 EPOXY ADHESIVE DOCUMENTATION

- A. Submit Epoxy Adhesive Manufacturer's Product Data that includes physical and chemical properties
- B. Submit Epoxy Adhesive Manufacturer's Recommended Surface Preparation Procedures and Application Instructions.
- C. Submit Manufacturer's Certificate of Compliance with Certified Test Results for each batch of epoxy adhesive.
- D. Submit Manufacturer's Technical Data for Metering, Mixing, and Injection Equipment.
- E. Submit Installation Instructions for Repairing Core Holes with epoxy grout.
- F. Submit Statement of Qualification for Injection Applicator.

PART 3 EXECUTION**3.1 GENERAL**

- A. Repair cracks by injection of epoxy adhesive.
 1. Repair cracks in containment structures that are 0.005 inch wide and wider, cracks that leak, and cracks in other structures that are 0.010 inch wide and wider.
- B. Provide SDDR, in accordance with Section 01250, with Drawings or Photographs Indicating Location, Size, Estimated Quantity, and Proposed Repair System for Each Repair Location.

3.2 PREPARATION

- A. Free cracks from loose matter, dirt, laitance, oil, grease, salt, and other contaminants.
- B. Clean cracks in accordance with epoxy adhesive manufacturer's instructions.
- C. Clean surfaces adjacent to cracks from dirt, dust, grease, oil, efflorescence, and other foreign matter detrimental to bond of surface seal system.
- D. Do not use acids and corrosives for cleaning, unless neutralized prior to injecting epoxy.

3.3 APPLICATION

- A. Sealing: Apply surface seal in accordance with manufacturer's instructions to designated crack face prior to injection.
 1. Seal surface of crack to prevent escape of injection epoxy.

B. Entry Ports:

1. Establish openings for epoxy entry in surface seal along crack.
2. Determine space between entry ports equal to thickness of concrete member to allow epoxy to penetrate to the full thickness of the wall.
3. Provide a means to prevent concrete dusts and fines from contaminating the crack or ports when drilling.
4. Space entry ports closer together to allow adjustment of injection pressure to obtain minimum loss of epoxy to soil at locations where:
 - a. Cracks extend entirely through wall.
 - b. Backfill of walls on one side.
 - c. Difficult to excavate behind wall to seal both crack surfaces.
5. Core drill to verify epoxy depth where only one side of wall is exposed.

C. Epoxy Injection:

1. Store epoxy at minimum of 70 degrees F.
2. Start injection into each crack at lowest elevation entry port.
3. Continue injection at first port until adhesive begins to flow out of port at next highest elevation.
4. Plug first port and start injection at second port until adhesive flows from next port.
5. Inject entire crack with same sequence.

D. Finishing:

1. Cure epoxy adhesive after cracks have been completely filled to allow surface seal removal without draining or runback of epoxy material from cracks.
2. Remove surface seal from cured injection adhesive.
3. Finish crack face flush with adjacent concrete.
4. Indentations or protrusions caused by placement of entry ports are not acceptable.
5. Remove surface seal material and injection adhesive runs and spills from concrete surfaces.

3.4 EQUIPMENT

- A. Portable, positive displacement type pumps with in-line metering to meter and mix two adhesive components, and inject mixture into crack.

B. Pumps:

1. Electric or air powered with interlocks providing positive ratio control of proportions for the two components at nozzle.
2. Primary injection pumps for each material of different mix ratio, including a standby backup pump of similar ratio.
3. Capable of immediate compensation for changes in resins.
4. Do not use batch mix pumps.

- C. Discharge Pressure: Automatic pressure controls capable of discharging mixed adhesive at pressures up to 200 psi, plus or minus 5 percent, and able to maintain pressure.

- D. Automatic Shutoff Control: Provide sensors on both Component A and B reservoirs for stopping machine automatically when only one component is being pumped to mixing head.
- E. Proportioning Ratio Tolerance: Maintain epoxy adhesive manufacturer's prescribed mix ratio within a tolerance of plus or minus 5 percent by volume at discharge pressure up to 160 psi.
- F. Ratio/Pressure Check Device:
 - 1. Two independent valved nozzles capable of controlling flow rate and pressure by opening or closing valve to restrict material flow.
 - 2. Pressure gauge capable of sensing pressure behind each valve.

3.5 FIELD QUALITY CONTROL

- A. Epoxy Adhesive Two Component Ratio Tests:
 - 1. Disconnect mixing head and pump two adhesive components simultaneously through ratio check device.
 - 2. Adjust discharge pressure to 160 psi for both adhesive components.
 - 3. Simultaneously discharge both adhesive components into separate calibrated containers.
 - 4. Compare amounts simultaneously discharged into calibrated containers during same time period to determine mix ratio.
 - 5. Complete test at 160 psi discharge pressure and repeat procedure for 0 psi discharge pressure.
 - 6. Run ratio test for each injection unit at beginning and end of each injection work day, and when injection work has stopped for more than 1 hour.
 - 7. Document and maintain complete accurate records of, ratios and pressure checks.
- B. Injection Pressure Test:
 - 1. Disconnect mixing head of injection equipment and connect two adhesive component delivery lines to pressure check device.
 - 2. Pressure Check Device:
 - a. Two independent valved nozzles capable of controlling flow rate and pressure by opening or closing of valve.
 - b. Pressure gauge capable of sensing pressure buildup behind each valve.
 - 3. Close valves on pressure check device and operate equipment until gauge pressure on each line reads 160 psi.
 - 4. Stop pumps and observe pressure; do not allow pressure gauge to drop below 150 psi within 3 minutes.
 - 5. Run pressure test for each injection equipment unit:
 - a. Beginning and end of each injection work day.
 - b. When injection work has stopped for more than 45 minutes.
 - 6. Check tolerance to verify equipment capable of meeting specified ratio tolerance.

C. Crack Injection Tests:

1. Crack injection tests may be required by the STR if initial crack epoxy injection grouting does not provide acceptable liquid tightness test performance.
 - a. Initial Cores:
 - i. 4-inch diameter for a minimum depth of 3 inches, taken from STR selected locations.
 - ii. Take three cores in first 100 linear feet of crack repaired and one core sample for each 500 linear feet thereafter.
 - b. Provide suitable containers for storage, curing, and transportation of test specimens.
 - c. Methods of Testing Cores:
 - i. Penetration: Visual examination.
 - ii. Bond Strength/Compression Test: Concrete failure prior to adhesive failure.
 - d. Test Requirements:
 - i. Penetration: Minimum of 90 percent of crack shall be full of epoxy adhesive.
 - ii. Bond Strength/Compression Test: Concrete failure before adhesive failure, or 6,500 psi with no failure of either concrete or adhesive.
 - e. Evaluation and Acceptance of Tests:
 - i. If initial cores fail either by lack of penetration or bond strength, crack repair work shall not proceed further until areas represented by cores are reinjected or repaired and retested for acceptance.
 - ii. Obtain verifying core samples, number and location as selected by STR, after rework of areas represented by failed initial cores is complete.
 - f. Core Hole Repair:
 - i. Correct work as result of testing upon notification from STR.
 - ii. Repair initial and verifying core holes in accordance with Section 03720.
 - iii. Finish surface to blend with adjacent concrete.
 - D. Include Field Testing reports with the weekly Quality Control Report in accordance with Section 01400.
- 3.6 INSPECTION / EXAMINATION / TESTING AND OBSERVATION**
- A. Perform Field Testing in accordance with Section 01400.
 - B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 1. Subcontractor responsibilities and related information are included in Section 01810.
 - C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

WELDING AND NDE**SECTION 05050****PART 1 GENERAL****1.1 SECTION INCLUDES**

A. Welding

1.2 RELATED SECTIONS

A. Division 1 – All Sections

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes and Standard

1. American Society of Mechanical Engineers (ASME)

a. B31.3

b. Boiler and Pressure Vessel Code

i. Section V

ii. Section IX

2. American Society for Nondestructive Testing Inc. (ASNT)

a. SNT-TC-1A

3. American Welding Society (AWS)

a. A2.4

b. A3.0/A3.0M

c. D1.1/D1.1M

d. QC1

4. International Code Council (ICC)

a. IBC

B. Regulations

1. None Specified in this Section

C. Documents

1. None Specified in this Section

D. Drawings

1. None Specified in this Section

1.4 DEFINITIONS

A. CJP: Complete Joint Penetration.

B. CWI: Certified Welding Inspector.

C. MT: Magnetic Particle Testing.

D. NDE: Nondestructive Examination.

E. NDT: Nondestructive Testing.

F. PJP: Partial Joint Penetration.

G. PQR: Procedure Qualification Record.

- H. PT: Liquid Penetrant Testing.
 - I. RT: Radiographic Testing.
 - J. UT: Ultrasonic Testing.
 - K. VT: Visual Testing.
 - L. WPQ: Welder/Welding Operator Performance Qualification.
 - M. WPS: Welding Procedure Specification.
 - N. See Section 01100 for general requirements.
- 1.5 QUALITY ASSURANCE
- A. See Section 01400 for general requirements.
- 1.6 SUBMITTALS
- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. Structural Welder/Welding Operator Performance Qualifications, 1.7 A.
 - 2. Process Piping Welder/Welding Operator Performance Qualifications, 1.7 B.
 - 3. Certified Welding Inspector Credentials, 1.7 C. 2.
 - 4. Testing Agency: Personnel Credentials, 1.7 D. 1.
 - 5. Shop and Field Process Sleeve / Process Piping WPS with PQR, 2.2 A. 3.
 - 6. Process Sleeve / Process Piping NDT / NDE Procedure Specifications, 2.2 A. 4.
 - 7. Shop and Field Non Process Sleeve / Process Piping Welds WPS with PQR, 2.2 A. 5.
 - B. Deleted
- 1.7 QUALIFICATIONS
- A. Prepare and Submit Structural Welder/Welding Operator Performance Qualifications (WPQ): In accordance with AWS D1.1/D1.1M (Annex N Forms).
 - B. Prepare and Submit Process Piping Welder/Welding Operator Performance Qualifications (WPQ): In accordance with ASME BPVC Section IX.
 - C. Certified Welding Inspector (CWI): Certified in accordance with AWS QC1, and having prior experience with specified welding codes.
 - 1. Alternate welding inspector qualifications require approval by STR.
 - 2. Submit Certified Welding Inspector Credentials.
 - D. Testing Agency: Personnel performing tests shall be a minimum NDT Level II certified in accordance with ASNT SNT-TC-1A.
 - 1. Submit Testing Agency: Personnel Credentials.
- 1.8 DELIVERY, STORAGE AND HANDLING
- A. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

- A. CWI shall be present whenever shop welding is performed.
 - 1. For process sleeve and process pipe welds, CWI shall perform inspection, as necessary, prior to assembly, during assembly, during welding, and after welding.
 - 2. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:
 - a. Verifying conformance of specified job material and proper storage.
 - b. Monitoring conformance with approved WPS.
 - c. Monitoring conformance of WPQ.
 - d. Inspecting weld joint fit-up and performing in-process inspection.
 - e. Providing 100 percent visual inspection of welds.
 - 3. Include CWI Reports in Weekly submittal of Quality Control Report in accordance with Section 01400.

2.2 WELDING DOCUMENTATION

- A. Prepare Shop and Field Weld Procedure Specifications (WPS): In accordance with AWS D1.1/D1.1M (Annex N Forms) for shop or field welding.
 - 1. For process sleeve and process pipe welds, prepare Nondestructive Testing (NDT) / Nondestructive Examination (NDE) procedure specifications in accordance with ASME BPVC Section V.
 - 2. Welding Data (Shop and Field): Assemble welding data together with shop drawings as a complete package.
 - a. Show on Shop Drawings or weld map complete information regarding base metal specification designation, location, type, size, and extent of welds with reference called out for WPS and NDE numbers in tails of combined welding and NDE symbols as indicated in AWS A2.4.
 - b. Distinguish between shop and field welds.
 - c. Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal.
 - i. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.
 - d. For pipe fittings, provide a joint weld beveling diagram.
 - i. Refer to AWS D1.1/D1.1M, Annex P Local Dihedral Angle that can be used to calculate bevels for weld joint details of intersecting pipes.
 - e. Welding and NDE symbols shall be in accordance with AWS A2.4.
 - f. Welding terms and definitions shall be in accordance with AWS A3.0/A3.0M.
 - 3. Submit Shop and Field Process Sleeve / Process Piping WPS with PQR per ASME BPVC Section IX.
 - 4. Submit Process Sleeve / Process Piping NDT / NDE Procedure Specifications
 - 5. Submit Shop and Field Non Process Sleeve / Process Piping Welds WPS with PQR

PART 3 EXECUTION**3.1 GENERAL**

- A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in Attachment 05050-A.

3.2 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

A. Weld Inspection Criteria:

1. Selection of welds to be tested, unless 100 percent NDT is specified herein, shall be as agreed upon between STR and Subcontractor.
2. Unless otherwise specified, perform NDT of welds at a frequency as shown below and in the Attachment 05050-A in accordance with referenced welding codes as follows. In case there is a conflict, higher frequency level of NDT shall apply.
 - a. Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
 - b. All Welds: 100 percent VT.
 - c. CJP Groove, Butt Joint Welds: 10 percent random RT.
 - d. All other CJP Groove Welds: 10 percent random UT.
3. Weld Acceptance:
 - a. VT:
 - i. Structural Pipe and Tubing: AWS D1.1/D1.1M, Paragraph 6.9, Visual Inspection, Tubular Connections.
 - ii. All Other Structural Steel: AWS D1.1/D1.1M, Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
 - iii. Stud Connections: AWS D1.1/D1.1M, Paragraph 7.8.1.
 - iv. For Process Sleeves / Process Piping: ASME B31.3
 - b. PT or MT:
 - i. Perform on fillet and PJP groove welds in stair tower construction in accordance with AWS D1.1/D1.1M, Paragraph 6.10.
 - ii. Acceptance shall be in accordance with VT standards specified above.
 - c. UT: Perform on CJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 6.13.3, Class R indications.
 - d. RT: Perform on CJP groove butt joint welds in accordance with AWS D1.1/D1.1M, Paragraph 6.12.1.

3.3 FIELD QUALITY CONTROL

- A. Subcontractor's CWI shall be present whenever field welding is performed. CWI shall perform inspection, as necessary, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:
1. Verify conformance of specified job material and proper storage.
 2. Monitor conformance with approved WPS.
 3. Monitor conformance of WPQ.
 4. Inspect weld joint fit-up and perform in-process inspection.
 5. Provide 100 percent visual inspection of all welds.
 6. Supervise nondestructive testing personnel and evaluating test results.

7. Maintain records and prepare report confirming results of inspection and testing comply with the Work.
8. Include CWI Reports in Weekly submittal of Quality Control Report in accordance with Section 01400.

3.4 WELD DEFECT REPAIR

- A. Repair and retest rejectable weld defects until sound weld metal has been deposited in accordance with appropriate welding codes.

3.5 INSPECTION, EXAMINATION, TESTING, AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

3.6 ATTACHMENT

- A. Welding and Nondestructive Testing.

END OF SECTION

Welding and Nondestructive Testing

Attachment No. 05050-A
Revision No. 3
Spec/Req'n No. C-SPP-Z-00008
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Specification Section	Governing Welding Codes or Standards	Submit WPS	Submit WPQ	Onsite CWI Req'd	Submit Written NDT Procedure Specifications	NDE / NDT Requirements
05500, Metal Fabrications Structural Steel	AWS D1.1/D1.1M, Structural Welding Code-Steel	Yes	Yes	Yes	Yes	100% VT 10% PT or MT for PJP and fillet welds and 10% UT or RT for CJP welds in stair tower construction
05520 Metal Railings	AWS D1.1/D1.1M, Structural Welding Code - Steel	No	No	No	No	100% VT
05530 Metal Gratings	AWS D1.1/D1.1M, Structural Welding Code - Steel	No	No	No	No	100% VT
05500 Metal Fabrications Process Sleeve / Process Piping	ASME B31.3 AWS D1.1/D1.1M, Structural Welding Code	Yes	Yes	No	Yes	100% VT

METAL FABRICATIONS**SECTION 05500****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Anchor Bolts and Anchor Sleeves
- B. Concrete Drilled Anchors
- C. Welded Anchor Studs
- D. Embedded Steel Support Frames For Grating
- E. Pipe Sleeves/Piping, Ports, And Penetration Plugs
- F. Sidewalk Doors
- G. Ladders
- H. Steel Stairs
- I. Accessories

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 09900

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes / Standards

- 1. American Galvanizers Association (AGA)
 - a. Inspection of Products Hot-Dip Galvanized After Fabrication,
 - b. Quality Assurance Manual,
- 2. American Ladder Institute (ALI)
 - a. Deleted
- 3. American Petroleum Institute (API)
 - a. SPEC 5L
- 4. American Society of Mechanical Engineers (ASME)
 - a. B16.5
 - b. B16.9
 - c. B16.21
- 5. American Society for Testing and Materials (ASTM)
 - a. A 36/A 36M
 - b. A 53/A 53M
 - c. A 105/A 105M
 - d. A 108
 - e. A 123/A 123M
 - f. A 143 /A 143M
 - g. A 153/A 153M
 - h. Deleted

- i. Deleted
- j. A 234/A 234M
- k. A 307
- l. A 325
- m. A 384/A 384M
- n. A 385/A 385M
- o. A 489
- p. A 500/A 500M
- q. A 513/A 513M
- r. Deleted
- s. A 563
- t. A 653/A 653M
- u. A 780
- v. A 992/A 992M
- w. C 881/C 881M
- x. Deleted
- y. D 1330
- z. Deleted
- aa. F 436
- bb. F 593
- cc. F 594
- dd. F 844
- ee. F 1554
- ff. A 513/A 513M
- 6. American Welding Society (AWS)
 - a. D1.1/D1.1M
- 7. American Water Works Association (AWWA)
 - a. Deleted
- 8. International Code Council (ICC)
 - a. ES AC 193
 - b. IBC
- 9. Society for Protective Coatings (SSPC)
 - a. SP 1
 - b. SP 7
 - c. A 380
 - d. A 967.
 - e. F 593
 - f. F 594
- B. Regulations
 - 1. Deleted
 - 2. 29 CFR PT 1910.24

C. Documents

1. None Specified in this Section

D. Drawings

1. None Specified in this Section

1.4 DEFINITIONS

A. See Section 01100 for general requirements.

B. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.

C. Exterior Area: Location not protected from the weather by a building or other enclosed structure.

D. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered. Water-holding structures include all structures for which liquid tightness testing is required, regardless of final contents.

1.5 QUALITY ASSURANCE

A. See Section 01400 for general requirements.

B. Qualifications:

1. Adhesive Anchor Installers: Trained and certified by manufacturer.

- a. Submit Adhesive Anchor Installer Certification.

2. Galvanized Coating Applicator:

- a. Company specializing in hot-dip galvanizing after fabrication and following procedures of the AGA Quality Assurance Manual.

1.6 SUBMITTALS

A. Submit the following Engineering documents in accordance with Section 01330 and 01400.

1. Adhesive Anchor Installer Certification, 1.5 B. 1.a.
2. Anchor Manufacturer's Product Data, 2.3 D. 1.
3. Anchor Manufacturer's Installation Procedures, 2.3 D. 2.
4. Current Anchor Test Data or ICC-ES Evaluation Report, 2.3 D. 3.
5. Hot-Dip Galvanizing Certificate of Compliance, 2.11 E. 9.
6. Metal Fabrication Shop Drawings, 2.11 I.
7. Deleted

B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

A. See Section 01600 for general requirements.

B. Factory assemble items specified herein, as much as practical.

1. Package and tag assemblies that have to be shipped unassembled in manner that will protect materials from damage and will facilitate identification and field assembly.

C. Protect painted coatings and hot-dip galvanized finishes from damage due to metal banding and rough handling.

1. Use padded slings and straps.

- D. Store fabricated items in dry area and not in direct contact with ground.
 - 1. Exterior storage of fabricated items, in accordance with Section 01600, is acceptable upon STR concurrence.

PART 2 PRODUCTS

2.1 GENERAL

- A. Unless noted otherwise, meet the following requirements:
 - 1. Steel Wide Flange Shapes: ASTM A 992/A 992M
 - 2. Other Steel Shapes and Plates: ASTM A 36/A 36M
 - 3. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B
 - 4. Structural Steel Tubing: ASTM A 500/A 500M, Grade B
 - 5. Stainless Steel Anchor Bolts: ASTM F 593, AISI Type 316, Condition CW
 - 6. Stainless Steel Nuts: ASTM F 594, AISI Type 316, Condition CW
 - 7. Steel Bolts and Nuts:
 - a. Carbon Steel: ASTM A 307 bolts, with ASTM A 563 nuts
 - b. High-Strength: ASTM A 325, Type 1 bolts, with ASTM A 563 nuts
 - c. Anchor Bolts and Rods: ASTM F 1554, Grade 36 bolts, with ASTM A 563 nuts
 - d. Eyebolts: ASTM A 489
 - e. Threaded Rods: ASTM A 36/A 36M
 - f. Flat Washers (Unhardened): ASTM F 844
 - g. Flat and Beveled Washers (Hardened): ASTM F 436
 - 8. Welded Anchor Studs: ASTM A 108, Grades C-1010 through C-1020
- B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel and zinc-plated steel material types as indicated in Fastener Schedule at end of this Section.

2.2 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

- A. Cast-In-Place Anchor Bolts:
 - 1. Headed type, unless noted otherwise on Drawings.
 - 2. Material type and protective coating as shown in Fastener Schedule at end of this Section.
- B. Anchor Bolt Sleeves:
 - 1. Plastic:
 - a. Single unit construction with corrugated sleeve.
 - b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
 - c. Material: High density polyethylene.
 - d. Manufacturer:
 - i. Sinco Products, Inc., Middletown, CT, or approved equal.
 - 2. Fabricated Steel: ASTM A 36/A 36M.

2.3 CONCRETE DRILLED ANCHORS

A. General:

1. AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel as shown in Fastener Schedule at end of this Section.
2. Post installed anchor systems used in concrete shall be approved by an ICC-ES Evaluation Report for conformance to ICC IBC requirements for use in cracked concrete and shall be suitable for long-term loads as well as for wind and seismic loads.

B. Torque-Controlled Expansion Anchors (Wedge Anchors):

1. Anchors used in sustained tension applications (such as overhead or cantilevered applications) shall comply with the requirements of ICC ES AC 193.
2. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; Kwik Bolt TZ (KB-TZ) Anchors.
 - b. ITW Ramset/Red Head, Addison, IL; Trubolt + Wedge Anchors.
 - c. Powers Fasteners, Inc, Brewster, NY; Power-Stud +SD2 or +SD1 Anchors.
 - d. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt or Strong-Bolt 2 Wedge Anchors.
 - e. Wej-It Fastening Systems, Tulsa, OK; ANKR-Tite CCAT Wedge Anchor.
 - f. Or approved equal.

C. Adhesive Anchors:

1. Threaded Rod:
 - a. Diameter as shown on Drawings.
 - b. Length as required, to provide minimum depth of embedment.
 - c. Clean and free of grease, oil, or other deleterious material.
2. Adhesive:
 - a. Meet requirements of ASTM C 881/C 881M.
 - b. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
 - c. Disposable, self-contained cartridge system capable of dispensing both components in the proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
 - d. Mixed Adhesive: Nonsag light paste consistency with ability to remain in a 1-inch diameter overhead drilled hole without runout.
 - e. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
3. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; HIT-RE 500-SD or HIT-HY 150 MAX-SD Adhesive Anchor System.
 - b. Powers Fasteners, Inc., Brewster, NY; PE1000+ Epoxy Adhesive Anchor System (1/2 inch to 7/8 inch diameter anchors).
 - c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-XP Epoxy Adhesive Anchor.
 - d. Or approved equal.

D. Concrete Drilled Anchors:

1. Submit Anchor Manufacturer's Product Data.
2. Submit Anchor Manufacturer's Installation Procedures.
3. Submit Current Anchor Test Data or ICC-ES Evaluation Report.

2.4 WELDED ANCHOR STUDS

A. Headed anchor studs (HAS) or threaded anchor studs (TAS), as indicated on Drawings.

1. Carbon Steel: ASTM A 108, Standard Quality Grades 1010 through 1020, inclusive either semikilled or killed aluminum or silicon dioxidation, unless noted otherwise.

B. Manufacturers:

1. Nelson Stud Welding, FabriSteel Co., Elyria, OH.
2. Stud Welding Associates, Inc., Elyria, OH.
3. Or approved equal.

2.5 EMBEDDED STEEL SUPPORT FRAMES FOR GRATING

A. Steel angle support frames to be embedded in concrete shall be galvanized steel, ASTM A 36/A 36M.

B. Welded anchors for support frames shall also be galvanized steel.

2.6 PIPE SLEEVES, PORTS, AND PENETRATION PLUGS

A. ASTM A 53/A 53M, Grade B, Schedule 40 steel pipe sleeves for diameters 2 1/2 inch and greater with continuously welded 1/4 inch-thick seep ring with outside diameter 4 inches greater than sleeve outside diameter unless noted otherwise on Drawings.

1. Sleeves shall be Schedule 80 for 2 inch diameter and smaller.
2. Grout and inspection ports shall conform to API SPEC 5L, Grade X52, or ASTM A 513/A 513M with matching properties, with a minimum wall thickness of 1/4 inch.
3. Deleted

B. Flanges shall be forged carbon steel, ASTM A 105/A 105M, ASME B16.5 Class 150, flat faced, unless noted otherwise on Drawings.

C. Fittings shall be wrought carbon steel butt-welding, ASTM A 234/A 234M, Grade WPB meeting the requirements of ASME B16.9.

D. Deleted

E. Bolting:

1. Flanges: Carbon steel, ASTM A 307, Grade A, hex head bolts and ASTM A 563, Grade A, hex head nuts, galvanized.
2. Deleted

F. Gaskets:

1. Flanges: 1/8 inch thick, homogeneous black rubber (EPDM), hardness 60 (Shore A), rated to 250 degrees F, continuous, and conforming to ASME B16.21 and ASTM D 1330, Steam Grade unless noted otherwise on Drawings.
 - a. Blind flanges shall use a gasket covering entire inside face with gasket cemented to blind flange.
2. Deleted

G. Thread Lubricant for Pipe Sizes 2 inches and Smaller: Teflon tape or joint compound that is insoluble in water.

2.7 Deleted

2.8 Deleted

2.9 STEEL STAIRS

- A. Steel framing members for stairs shall be hot-dip galvanized after fabrication in accordance with ASTM A 123/A 123M.
- B. Bolts for steel framing shall be galvanized in accordance with ASTM A 153/A 153M.
- C. Commercial stair products may be submitted for use in lieu of the fabricated crossover stairs shown on the Drawings for access over piping supported on the tank roof.

2.10 ACCESSORIES

A. Antiseizing Lubricant for Stainless Steel Threaded Connections:

- 1. Resists washout.
- 2. Manufacturers and Products:
 - a. Bostik, Middleton, MA; Neverseez.
 - b. Saf-T-Eze Div., STL Corp., Lombard, IL; Anti-Seize.
 - c. Or approved equal.

B. Deleted

2.11 FABRICATION

A. General:

- 1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
- 2. Furnish necessary rabbets, lugs, and brackets so work can be assembled.
- 3. Conceal fastenings where practical; where exposed, flush countersink.
- 4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
- 5. Grind cut edges smooth and straight.
 - a. Round sharp edges to small uniform radius.
 - b. Grind burrs, jagged edges, and surface defects smooth.
- 6. Fit and assemble in largest practical sections for delivery to Site.

B. Materials:

- 1. Use steel shapes, unless noted otherwise.
- 2. Steel to be hot-dip galvanized: Limit silicon content to less than 0.04 percent for aluminum-killed steel or to between 0.15 and 0.25 percent for silicon-killed steel.

C. Welding:

- 1. Weld connections and grind exposed welds smooth.
 - a. When required to be watertight, make welds continuous.
- 2. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
- 3. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 5.
- 4. Welded Anchor Studs: Prepare surface to be welded and weld with stud welding gun in accordance with AWS D1.1/D1.1M, Section 7, and manufacturer's instructions.
- 5. Complete welding and any required inspection or examination before applying finish or galvanizing.

D. Painting:

1. Abrasive blast and shop prime with epoxy primer as specified in Section 09900 unless noted otherwise. Coat surfaces of galvanized steel fabricated items to be in direct contact with concrete, grout, or dissimilar metals, as specified in Section 09900, unless noted otherwise.
2. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless noted otherwise.
3. Do not apply protective coating to galvanized steel framing, unless noted otherwise.

E. Galvanizing:

1. Fabricate steel to be galvanized in accordance with ASTM A 143 /A 143M, ASTM A 384/A 384M, and ASTM A 385/A 385M.
 - a. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
2. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A 385/A 385M.
3. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
4. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
5. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A 123/A 123M.
6. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A 153/A 153M.
 - a. Oversize holes to allow for zinc alloy growth.
 - b. Shop assemble bolts and nuts.
7. Galvanized steel sheets in accordance with ASTM A 653/A 653M.
8. Galvanize components of bolted assemblies separately before assembly.
 - a. Galvanizing of tapped holes is not required.
9. Submit Hot-Dip Galvanizing Certificate of Compliance that includes:
 - a. Galvanizer signature,
 - b. Description of material processed,
 - c. ASTM standard used for coating.

F. Watertight Seal: Where required or shown, furnish neoprene gasket of a type that is satisfactory for use in contact with sewage.

1. Cover full bearing surfaces.

G. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation.

1. Make corners square and opposite sides parallel.

H. Accessories: Furnish as required for a complete installation.

1. Fasten by welding or with galvanized steel bolts or screws.

I. Prepare and Submit Metal Fabrication Shop Drawings that include:

- a. Metal fabrications, including welding and fastener information.
- b. Specific instructions for concrete anchor installation, including drilled hole size, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

2.12 SOURCE QUALITY CONTROL

- A. Visually inspect all fabrication welds and correct any deficiencies.
 - 1. Steel: AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
- B. Deleted

PART 3 EXECUTION

3.1 INSTALLATION OF METAL FABRICATIONS

- A. General:
 - 1. Install metal fabrications plumb or level, accurately fitted, free from distortion or defects.
 - 2. Install rigid, and neat in appearance.
 - 3. Install manufactured products in accordance with manufacturer's recommendations.
 - 4. Obtain STR approval prior to field cutting steel members or making adjustments not scheduled.
- B. Pipe Sleeves:
 - 1. Provide where pipes pass through concrete.
 - 2. Provide a center flange for water stoppage.
 - 3. Provide a rubber caulking sealant or a modular mechanical unit to form a watertight seal in the annular space between pipes and sleeves.

3.2 CAST-IN-PLACE ANCHOR BOLTS

- A. Accurately locate and hold anchor bolts in place with templates at the time concrete is placed.
- B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.
- C. Minimum Bolt Size: ½ inch diameter by 12 inches long, unless noted otherwise.

3.3 CONCRETE DRILLED ANCHORS

- A. Begin installation only after concrete or masonry to receive anchors has attained design strength.
- B. Install in accordance with manufacturer's instructions.
- C. Provide minimum embedment, edge distance, and spacing as follows, unless noted otherwise by anchor manufacturer's instructions or on Drawings:

Anchor Type	Min. Embedment (bolt diameters)	Min. Edge Distance (bolt diameters)	Min. Spacing (bolt diameters)
Wedge	6	6	12
Adhesive	9	9	13.5

- D. Use only drill type and bit type and diameter recommended by anchor manufacturer.
 - 1. Clean hole of debris and dust with brush and compressed air.
- E. When embedded steel or rebar is encountered in the drill path, slant drill to clear obstruction.
 - 1. If drill must be slanted more than 10 degrees to clear obstruction, notify STR for direction on how to proceed.

F. Adhesive Anchors:

1. Do not install adhesive anchors when temperature of concrete is below 40 degrees F (14 degrees F for Hilti HIT-HY 150 MAX-SD) or above 100 degrees F.
2. Remove any standing water from hole with oil-free compressed air.
 - a. Inside surface of hole shall be dry where required by manufacturer's instructions.
3. Do not disturb anchor during recommended curing time.
4. Do not exceed maximum torque as specified in manufacturer's instructions.

G. Prestressed Concrete: Do not use drilled anchors in prestressed or post-tensioned concrete members unless specifically noted on Drawings or specified.

3.4 Deleted

3.5 ELECTROLYTIC PROTECTION

A. Galvanized Steel:

1. Coat surfaces of galvanized steel fabricated items to be in direct contact with concrete, grout, or dissimilar metals, as specified in Section 09900, unless noted otherwise.
2. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless noted otherwise.
3. Allow coating to dry before installation of the material.
4. Protect coated surfaces during installation.

B. Stainless Steel:

1. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.
2. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.
3. Remove contamination using cleaning and passivation methods in accordance with requirements of ASTM A 380 and ASTM A 967.
4. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.
5. After treatment, visually inspect surfaces for compliance.

3.6 REPAIR OF GALVANIZED STEEL

A. Repair of Damaged Hot-Dip Galvanized Coating:

1. Conform to ASTM A 780.
2. For minor repairs at abraded areas,
 - a. Use organic zinc-rich paint containing a minimum of 90 percent by weight of zinc dust pigment in the dried film.
 - b. Apply to a minimum dry film thickness of 4 mils.
 - c. The damaged galvanized coating shall weather a minimum of 6 months prior to repairs, or surface shall be prepared for painting by solvent cleaning per SSPC SP 1 and brush blast cleaning per SSPC SP 7 in accordance with Section 09900.
3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A 780.
4. Use magnetic gauge to determine that thickness is equal to or greater than the base galvanized coating.

3.7 FASTENER SCHEDULE

A. Unless noted otherwise on the Drawings, provide fasteners as follows:

1. Anchor Bolts Cast Into Concrete for Structural Steel, Metal Fabrications and Castings
 - a. Exterior Areas
 - i. Hot-dip galvanized steel headed anchor bolts.
 - b. Interior and Corrosive Areas
 - i. Stainless steel headed anchor bolts with fusion bonded coating, see Section 09900.
2. Anchor Bolts Cast Into Concrete for Equipment Bases
 - a. Exterior Areas:
 - i. Hot-dip galvanized steel headed anchor bolts.
 - b. Interior and Corrosive Areas
 - i. Stainless steel headed anchor bolts with fusion bonded coating, unless otherwise specified with equipment, see Section 09900.
3. Drilled Anchors for Metal Components to Cast-in-Place Concrete (e.g., Ladders, Handrail Posts, Electrical Panels, and Equipment)
 - a. Interior, Exterior, and Corrosive Areas
 - i. Hot-dip galvanized adhesive anchors.
4. Connections for Structural Steel Framing
 - a. Exterior Areas
 - i. High-strength steel bolted connections.
 - ii. Use hot-dip galvanized high-strength bolted connections for galvanized steel framing members.
5. All Others
 - a. Exterior Areas
 - i. Stainless steel fasteners.

B. Antiseizing Lubricant: Use on all stainless steel threads.

C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

3.8 INSPECTION, EXAMINATION, TESTING AND OBSERVATION

A. Perform Field Testing in accordance with Section 01400.

1. Welded Anchor Studs:
 - a. At start of each production period, perform the following test to determine proper generator, control unit, and stud welding gun settings, in accordance with AWS D1.1/D1.1M, Chapter 7:
 - i. Weld two test studs and visually inspect for full 360 degree flash.
 - ii. Bend test studs 30 degrees from vertical for headed anchor studs (HAS).
 - iii. Torque test threaded anchor studs (TAS) studs per AWS D1.1/D1.1M, Section 7.6.6.2.
 - iv. Test Stud Acceptability: No failure of welds.
If weld fails, repeat test until two consecutive test studs pass.

- b. During production, if visual inspection reveals that weld does not exhibit full 360 degree flash or that stud has been repaired by welding, perform the following test in accordance with AWS D1.1/D1.1M, Chapter 7:
 - i. HAS studs: bend stud approximately 15 degrees from vertical, away from missing portion of flash.
 - ii. TAS studs; torque test per AWS D1.1/D1.1M, Section 7.6.6.2.
Stud Acceptability: No cracks in weld.
Leave bent studs in bent position.
 - iii. Replace failed studs.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

METAL RAILINGS**SECTION 05520****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Railings and Accessories

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 05050
- C. Section 05500
- D. Section 09900

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes / Standards**1. American Society for Testing and Materials (ASTM)**

- a. A 36/A 36M
- b. A 123/A 123M
- c. A 153/A 153M
- d. A 325
- e. A 500/A 500M
- f. A 563
- g. Deleted
- h. B 26/B 26M
- i. F 912

2. International Code Council (ICC)

- a. IBC

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. Railings: This term shall include guardrail systems, handrail systems, platform railing system, ramp-rail system, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.
- B. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, ramps, or stairs to prevent miscellaneous items from falling through.
- C. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. Metal Railings Manufacturer's Product Data, 2.3 A.
 - 2. Metal Railings Manufacturer's Installation Instructions, 2.3 B.
 - 3. Metal Railing Shop Drawings, 2.3 C.
- B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

- A. See Section 01600 for general requirements.
- B. Maintain protective wrapping until railing is completely installed.

PART 2 PRODUCTS

2.1 GALVANIZED STEEL RAILINGS

- A. Pipe railings/ round HSS: ASTM A-53 Grade B HD Galvanized 1-1/2" CS pipe for hand rail material.
- B. Accessories, including railing components, flanges, handrail brackets, anchor plates shall conform to the following:
 - 1. Slip-on / bolt-on Structural Pipe Fittings:
 - a. Aluminum – magnesium alloy 5350 manufactured in accordance with ASTM B 26/B 26M.
 - b. Manufacturer and Product:
 - i. Hollaender Manufacturing Co.; Cincinnati, OH; Speed – Rail.
 - ii. Or approved equal.
 - 2. Deleted
 - 3. Deleted
 - 4. Toeboards and Accessories:
 - a. ASTM A 36/A 36M steel, hot-dip galvanized.
 - 5. Fasteners: Galvanized steel.
 - a. Set screws shall conform to ASTM F 912 with JS600 zinc plating.

2.2 ANCHOR BOLTS AND FASTENERS

- A. Locknuts, Washers, and Screws:
 - 1. Elastic Locknuts, Steel Flat Washers, Round Head Machine Screws (RHMS): Galvanized steel.
 - 2. Flat Washers: Molded nylon.
- B. Bolts and Nuts for Bolting Handrail to Metal Beams: ASTM A 325 bolts with ASTM A 563 nuts, hot-dipped galvanized in accordance with ASTM A 153/A 153M.
- C. Deleted

2.3 DOCUMENT SUBMITTALS

- A. Submit Metal Railings Manufacturer's Product Data.
- B. Submit Metal Railings Manufacturer's Installation Instructions.

- C. Prepare and Submit Metal Railing Shop Drawings that include the following:
 - 1. Project-specific scaled plans and elevations of railings and detail drawings.
 - 2. Indicate railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.

2.4 FABRICATION OF GALVANIZED STEEL RAILINGS

- A. Shop Assembly:
 - 1. Post spacing and railing details shall be as shown on the Drawings.
 - 2. Post to Baseplate Connection: Field fit-up is required as shown on the Drawings.
 - a. Field weld posts to baseplates or embeds.
 - 3. Deleted
 - 4. Handrail Post Bolted to Metal:
 - a. Field fit-up is required.
 - b. Field measure and weld post to baseplate as an alternative to field cutting.
 - 5. Remove burrs from cut edges.
 - 6. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with finished surfaces smooth.
 - 7. Cover exposed ends of steel pipe by welding 1/8 inch minimum thickness steel plate in place or use prefabricated disk fittings.
 - 8. Welding:
 - a. In accordance with Section 05050.
 - b. Thoroughly fuse without undercutting or overlap.
 - c. Remove splatter, grind exposed welds to blend, and contour surfaces to match those adjacent.
 - d. Grind welds prior to hot-dip galvanizing of railing sections.
 - 9. Furnish explosion prevention holes at closed ends of pipes.
 - 10. Form and assemble joints exposed to weather to prevent water and moisture from penetrating.
- B. Shop/Factory Finishing: After fabrication, hot-dip galvanize components in accordance with ASTM A 123/A 123M.
- C. Tolerances:
 - 1. Cut pipe square within 2 degrees and to lengths within 1/8 inch.
 - 2. Welding: Miter and cope intersections of posts and rails within 2 degrees, fit to within 0.020 inch, and perform continuous welds around joints.
 - 3. Repair of Defective Work: Remove stains and replace defective Work.

PART 3 EXECUTION

3.1 GENERAL

- A. Where required, provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on the actual structure.
 - 1. Deleted
 - 2. Deleted
- B. Modification to structure not permitted where handrail is attached.

3.2 RAILING INSTALLATION

A. Protection from Entrapped Water:

1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
2. Bends and elbows occurring at low points; drill weep holes of ¼ inch diameter at lowest possible elevations, one hole per post or rail.
 - a. Drill hole in the plane of the rail.

B. Expansion Joints:

1. Maximum intervals of 60 feet on center in horizontal rails.
 - a. Expansion joints at structural movement joints shall be as shown on Drawings.
2. Slip joint with internal sleeve extending 2 inches beyond each side of joint.
 - a. Provide ½ inch slip joint gap to allow for expansion.
3. Fasten to one side using 3/8 inch diameter set-screw.
 - a. Place set-screw at bottom of pipe.
4. Locate joints within 12 inches of posts.
 - a. Locate expansion joints in rails that span expansion joints in structural walls and floors supporting the posts.

C. Setting Posts:

1. Surface Mounted:
 - a. Bolt post baseplate connectors firmly in place.
 - b. Deleted

D. Posts and Rails:

1. Set posts plumb and aligned to within 1/8 inch in 12 feet.
2. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.
3. Install posts and guardrails in same plane.
 - a. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along handrail.
 - b. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
4. Stair handrails shall be continuous without interruption in accordance with ICC IBC.

E. Toeboard:

1. Provide at railings, except where 4 inch or higher concrete curbs are installed, at gates, or on stairways unless noted otherwise on Drawings.
2. Accurately measure in field for correct length; after handrail post installation cut and secure to posts.
3. Dimension between bottom of toeboard and walking surface not to exceed ¼ inch or be less than 1/16 inch.
4. Install plumb and aligned to within 1/8 inch in 12 feet.
5. Toeboards: Where required, provide slotted holes for expansion and contraction at post supports.

3.3 FIELD FINISHING

- A. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces as specified in Section 09900.
 - 1. Treatment of Field Welds for Galvanized Steel Railings: Touch up welds by application of organic zinc rich paint to dry film thickness of 10 mils as specified in Section 05500.

3.4 CLEANING

- A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.
- B. Do not use acid solution, steel wool, or other harsh abrasive.

3.5 INSPECTION, EXAMINATION, TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

METAL GRATINGS

SECTION 05530

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grating

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 05500

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes / Standards

- 1. American Society for Testing and Materials (ASTM)
 - a. A 36/A 36M
 - b. A 1011/A 1011M
- 2. International Code Council (ICC)
 - a. IBC
- 3. National Association of Architectural Metal Manufacturers (NAAMM)
 - a. MBG 531

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE

- A. See Section 01400 for general requirements.

1.6 SUBMITTALS

- A. Submit the following Engineering documents in accordance with Section 01330 and 01400.
 - 1. Manufacturer's Product Data for Metal Grating, Grating Clips, Anchors, Accessories, and Other Manufactured Products Specified, 2.5 A.
 - 2. Metal Grating Detailed Installation Instructions, 2.5 B.
 - 3. Metal Grating Special Handling and Storage Requirements, 2.5 C.
- B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

- A. Insofar as is practical, factory assemble items.
- B. Package and clearly tag parts and assemblies that are, due to necessity, shipped unassembled.
- C. See Section 01600 for general requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Materials, equipment, and accessories specified in this section shall be products of:
 - 1. Alabama Metal Industries Corporation (AMICO), Birmingham, AL.
 - 2. IKG Industries, Houston, TX.
 - 3. Ohio Gratings, Inc., Canton, OH.
 - 4. Seidelhuber Metal Products, Inc., South San Francisco, CA.
 - 5. Or approved equal.

2.2 GRATING MATERIALS

- A. Carbon Steel:
 - 1. Bearing Bars, Banding, and Rectangular Cross Bars: ASTM A 1011/A 1011M commercial steel Type II for hot rolled carbon steel sheet and strip, or ASTM A 36/A 36M.
 - 2. Cross Bars made from Wire Rods: Not Permitted.
 - 3. Finish: Galvanized after fabrication.

2.3 METAL BAR GRATING

- A. General Requirements:
 - 1. Maximum Service Load:
 - a. Light Duty (Type A): 100 psf uniformly distributed load.
 - 2. Maximum Deflection: Span/240 or ¼ inch, whichever is less.
 - 3. Bearing Bar Spacing:
 - a. Light Duty: 1-3/16 inch maximum, center-to-center.
 - 4. Cross Bar Spacing: 4 inches maximum, center-to-center.
 - 5. Bearing Bars, Cross Bars and Banding: Minimum thickness as specified in NAAMM MBG 531 or as shown on Drawings.
- B. Grating Materials: Galvanized steel welded, rectangular bar grating fabricated by electro-forging cross bars to bearing bars.
- C. Surface:
 - 1. Serrated.
 - 2. Bearing bar depth shown on Drawings includes ¼ inch allowance maximum for serrations to maintain specified load carrying capacity of grating.

D. Stair Treads:

1. Material and Type: Same as grating material and grating type as furnished for connecting walkway or work surface.
2. Nosings: Integral ribbing and serrated edge on one long axis of tread, or nonslip abrasive on each tread along one long edge.
3. Carrier Plate or Angle: Furnish at each end for connection to stair stringers.

2.4 ACCESSORIES

A. Embedded Frames: As indicated on Drawings and as specified in Section 05500.

B. Grating Clamps:

1. Use at flanged beam and bolted angle frame supports.
2. Removable from above grating walkway surface.
3. Provide hat bracket, recessed bolt, and bottom clamp of same material as grating.
4. Manufacturers and Products:
 - a. Direct Metals Company, LLC, Kennesaw, GA; Grating Clamp.
 - b. Grating Fasteners, Inc., Harvey, LA; G-Clip.
 - c. Or approved equal.

C. Anchor Stud and Saddle Clip:

1. Use at embedded angle frame supports with stud anchor and nut recessed below top of grating surface.
2. Removable from above grating walkway surface.
3. Provide Type 316 stainless steel welded threaded stud anchor, nut, washer, and saddle clip.
4. Manufacturers and Products:
 - a. Welded Stud Anchor:
 - i. Nelson Stud Welding, Inc., Elyria, OH.
 - ii. Stud Welding Associates, Inc. Elyria, OH.
 - iii. Or approved equal.
 - b. Saddle Clip:
 - i. Direct Metals Company, LLC, Kennesaw, GA; Saddle Clip.
 - ii. Grating Fasteners, Inc., Harvey, LA; Saddle Clip.
 - iii. Struct-Fast, Inc., Baltimore, MD; Gratefast.
 - iv. Or approved equal.

2.5 GRATING DOCUMENTATION

A. Submit Manufacturer's Product Data for Metal Grating, Grating Clips, Anchors, Accessories, and Other Manufactured Products Specified.

1. Include manufacturer's specifications, coatings, surface treatment, and finishes.

B. Submit Metal Grating Detailed Installation Instructions and include Diagrams that show:

1. Dimensions, weight, size, and location of connections to adjacent grating, supports, and other work.
2. Details of anchorage to supports to prevent displacement from traffic impact.

C. Submit Metal Grating Special Handling and Storage Requirements.

2.6 FABRICATION

A. General:

1. In accordance with NAAMM MBG 531.
 2. Conceal fastenings where practical.
 3. Drill metalwork and countersink holes as required for attaching hardware or other materials.
 4. Cutouts:
 - a. Fabricate in grating sections for penetrations indicated.
 - b. Arrange to permit grating removal without disturbing items penetrating grating.
 - c. Edge band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
 5. Do not notch bearing bars at supports to maintain elevation.
 6. Field measure areas to receive grating.
 - a. Verify dimensions of new fabricated supports, and fabricate to dimension required for specified clearances.
 7. Section Length: Sufficient to prevent section from falling through clear opening when oriented in the span direction and one end is touching either the concrete or the vertical leg of grating support.
 8. Minimum Bearing: 1 inch unless otherwise shown on Drawings.
 9. Banding and Toe Plates: Same material as grating and welded to bearing bars in accordance with requirements of NAAMM MBG 531.
- B. Metal Bar Grating: A single grating section shall be not less than 1.5 feet or greater than 3 feet in width, or weigh more than 150 pounds.
- C. Supports:
1. Same material as grating.
 2. Coordinate dimensions and fabrication with grating to be supported.
 3. Coordinate dimensions with increased depth due to serrations.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Until grating sections are securely fastened in place, area shall be appropriately barricaded or flagged to alert people working in the area of potential fall hazard.
- B. Install manufactured products in accordance with manufacturer's recommendations.
- C. Install supports such that grating sections have a solid bearing on both ends, and that grating sections will not rock or wobble under design loads.
- D. Install grating supports plumb and level as applicable.
- E. Install sections of welded frames with anchors to straight plane without offsets.
- F. Field locate and install fasteners to fit grating layout.
- G. Anchor grating securely to supports using minimum of four fastener clips and bolts per grating section.
- H. Each grating or plank section shall be easily removable and replaceable.
 - I. Completed installation shall be rigid and neat in appearance.
- J. Protect painted and galvanized surfaces during installation.

3.2 INSPECTION, EXAMINATION, TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

END OF SECTION

CHEMICAL RESISTANT COATINGS**SECTION 09850****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Chemical Resistant Coating (CRC)

1.2 RELATED SECTIONS

- A. Division 1 – All Sections

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes / Standards

- 1. American Society for Testing and Materials (ASTM)
 - a. D 4263
 - b. F 1869
 - c. F 2170
- 2. International Code Council (ICC)
 - a. IBC
- 3. International Concrete Repair Institute (ICRI)
 - a. 310.2
- 4. National Fire Protection Association
 - a. 101
- 5. National Association of Corrosion Engineers (NACE)
 - a. SP0188
- 6. Society for Protective Coatings (SSPC)
 - a. SP 13

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

- A. CRC: Chemical Resistant Coating. A mixture of liquid resin-based material, setting agent, and filler designed to be applied and allowed to cure to a hard state.
- B. CRCDS: Chemical Resistant Coating Data Sheet
- C. MDFT: Minimum Dry Film Thickness.
- D. Mil: One thousandth of an inch.
- E. See Section 01100 for general definitions.

1.5 QUALITY ASSURANCE

A. Qualifications

1. Submit CRC Manufacturer's Qualifications:
 - a. Manufacturer's Experience: Minimum 5 years manufacturing proposed products.
 - b. Include a list of references substantiating experience.
2. Submit CRC Applicator Qualifications:
 - a. Applicator's Experience: Minimum 3 years applying proposed products.
 - b. Include a list of references substantiating experience.
 - c. Certification from system manufacturer showing current status as an approved applicator.

B. Applicator Quality Control Plan

1. Applicator shall maintain an in-house quality control program that monitors surface preparation, coating application, and quality control testing for coating and lining operations.
2. Level of experience, quality assurance program, and quality control testing by the applicator shall meet the minimum requirements specified herein, the system manufacturer's instructions, and related government regulations.
3. Perform quality control inspection and testing.
4. Monitor all environmental, surface preparation, application and quality control testing compliance at the locations where coating work is undertaken.

C. See Section 01400 for general requirements.

1.6 SUBMITTALS

A. Submit the following Engineering documents in accordance with Section 01330.

1. CRC Manufacturer's Qualifications, 1.5 A. 1.
2. CRC Applicator Qualifications, 1.5 A. 2.
3. CRC Data Sheet, 2.1 D.
4. System Manufacturer's Installation Instructions, 2.1 D. 4.
5. Scaled Detail Drawings - CRC Application, 2.1 D. 5.
6. Treatment of Penetrations Instructions, 3.4 N. 2.
7. System Manufacturer's Specific Cleaning and Preparation Procedures, 3.5 B.
8. Field Inspection and Test Reports, 3.7 C.
9. CRC System Manufacturer's Certificate of Proper Installation, 3.8 C.

B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

- A. Obtain MSDS for all paint products, including paints, coatings, thinners, reducers, and other chemicals.
- B. See Section 01600 for general requirements.

1.8 SERVICE CONDITIONS

A. Temperature:

1. Minimum: 20 °F (-6 °C)
2. Maximum: 158 °F (70 °C)

- B. Relative Humidity range: 20% to 100% (Condensing)
- C. Grout pH: Approximately 13.7

1.9 PROJECT CONDITIONS

- A. Do not apply paint in temperatures or moisture conditions outside of system manufacturer's recommended maximum or minimum allowable.
- B. Substrate: Dry.
- C. CRC shall not be applied until tank has successfully passed the leak test.

PART 2 PRODUCTS

2.1 COATING SYSTEM

- A. Material Quality: Manufacturer's highest quality products and suitable for intended exposure.
- B. Compatibility: Only compatible materials from a single manufacturer shall be used.
- C. The following coating systems, or equivalent, shall be applied to the interior walls, columns, and floor of the tank.
 - 1. Deleted
 - 2. TL-45-S High Build Novolac Epoxy Tank Lining (Blome International), consisting of:
 - a. Surface out with 83 MP (if needed, check primer sequence with vendor).
 - b. Prime with 75 (2-4 mils) – add carbon to create conductive primer.
 - c. 2 coats of TL-45S with fabric embed between coats; film thickness 30-40 per coat. Use .5-.75 chopped strand mat.
 - 3. Deleted
 - 4. Deleted
 - 5. The following coating system or equivalent shall be applied per manufacture's recommendation at wall/floor, wall/wall, and floor/floor interface flexible water-stop construction joints to allow for movement.
 - a. Blome International EC-66 High Performance Flexible Epoxy Coating with Blome International EC-60 Engineering Fabric.
 - 6. Allowable Movement
 - a. Wall/floor: wall movement 1.125 inches outward, 0.5 inches inward (radially), and 0.5 inches circumferentially (tangent to the wall).
 - b. Wall/wall: 0.375 inches apart/gap.
 - c. Floor/floor: 0.375 inches apart/gap.
 - 7. The coating system shall remain fully functional during the movement and after any contraction/return (back to 0 inches).
 - a. Design small scale test mock ups (not part of the actual SDU) to demonstrate coating system application and ability to accommodate the allowable movement for all types of construction joints without failure.
 - b. Wall/floor joint mock up shall also be demonstrated with the combined allowable radial and circumferential movement at the same time.
 - 8. Protective floor coverings and coatings shall meet the minimum Critical Radiant Flux requirements of NFPA 101 and ICC IBC, whichever is more restrictive, but shall be Class I or noncombustible in nuclear facilities.

- D. Submit CRC Data Sheet (CRCDS), Attachment 09850-A, for the proposed CRC systems.
1. Attach Material Safety Data Sheets (MSDS) for each product submitted.
 2. Indiscriminate submittal of manufacturer's literature only is not acceptable.
 3. Append the following information to each CRCDS:
 - a. Manufacturer provided sample as an 8 inch square with complete system proposed for use showing thickness and finish.
 - b. Manufacturer's technical data sheets.
 - c. Chemical resistance test results for exposure to service conditions.
 - i. Provide specific chemical resistance data for chemicals not listed in the manufacturer's standard data sheets.
 4. Submit System Manufacturer's Installation Instructions.
 5. Submit Scaled Detail Drawings - CRC Application showing installation plan, including configuration details for the following:
 - a. Expansion joints and structural isolation joints.
 - b. Construction joints.
 - c. Cracks.
 - d. Wall base details.
 - e. Equipment bolts (when installed before or after CRC application).
 - f. Metal angle frames at trenches, gratings, or hatches.
 - g. Transition and termination detail at edge of CRC system.
 - h. Deleted
 - i. Other details specific to the structure(s) being coated.

PART 3 EXECUTION

3.1 SYSTEM MANUFACTURER CONCURRENCE

- A. Unless otherwise shown or specified, apply coatings in accordance with the coating manufacturer's instructions.
- B. Area to be coated:
1. All concrete interior wall surfaces below the bottom of the interior concrete roof slab.
 - a. Terminate CRC at the roof as specified herein.
 2. All interior concrete floor surfaces.
 3. Extend the coating from the floor 24 inches up each roof support column, and terminate as specified herein.

3.2 MOCKUP:

- A. Before proceeding with work under this section, finish one complete space showing surface preparation, material application, quality of work, and special details for each type of coating system used.
- B. Procedure:
1. Prepare, prime and coat one section of concrete, 10 feet by 10 feet, at a location acceptable to SRR.
 2. Leave one-quarter of the surface exposed to allow observation of the surface preparation.
 3. Apply primer to three-quarters of remaining surface.

4. Apply base coat to one-half of the primed surface.
5. Apply fiberglass mat or Engineered fabric and finish coat to one quarter of the surface with the base coat; leaving one quarter of bare prepared concrete, one quarter with primer, one quarter with base coat, and one quarter with the finished system.
 - a. Mockup shall include concrete cuts for coating terminations, one example of a penetration, and joint detail.
6. After SRR review and approval, sample spaces or items shall serve as a standard for similar work throughout the Project.
 - a. Leave mockup in place to serve as a reference and standard for the remaining work.
 - b. At completion of Project, clean and prepare all surfaces that are not complete and finish coat the mockup area for incorporation into the work.

3.3 SURFACE PREPARATION:

- A. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of the system manufacturer whose product is to be applied.
- B. Provide STR a minimum 3 days advance notice prior to start of surface preparation and system application work.
- C. Perform work only in presence of an STR designated SRR representative, unless STR grants prior approval to perform work without SRR representative.
- D. Schedule inspection through STR in advance for cleaned surfaces and system application work.
- E. Concrete Surfaces:
 1. Do not begin until 30 days after concrete has been placed.
 2. Remove grease, oil, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent, or other suitable cleaning methods.
 3. Secure system manufacturer's recommendations for additional preparation, if required, for excessive bug holes exposed after blasting.
- F. Prepare surfaces in accordance with SSPC SP 13.
 1. Minimum surface profile shall meet ICRI 310.2 CSP 3 to 5, or higher, if required by the system manufacturer.
- G. Provide a smooth surface for application of the CRC system.
 1. Grind off fins and other projections.
 2. Repair defective areas to provide smooth uniform appearance.
 3. Fill holes and cracks with system manufacturer's recommended materials to produce an even surface for application of systems.
- H. Ensure surfaces are dry prior to coating, as required by the system manufacturer.
 1. Test for moisture using plastic sheets in accordance with ASTM D 4263.
 2. If the test indicates evidence of moisture, conduct tests to determine quantity of water present in accordance with ASTM F 1869.
 - a. Moisture content shall not exceed 3 pounds per 1,000 square feet in a 24 hour period.
 3. All tests using electronic moisture meters shall conform to ASTM F 2170.

3.4 APPLICATION

- A. Install coating systems in accordance with system manufacturer's printed instructions.
- B. Primer: Apply moisture-resistant, penetrating primer in accordance with the system manufacturer's written recommendations.
- C. Surfacer/Filler: If required, apply surfacer/filler to concrete with methods recommended by the system manufacturer as required to provide a surface that is a continuous, smooth, void-free surface.
 - 1. Force material into voids and irregularities, and remove excess filler before the material sets.
- D. Cove corners at horizontal intersections, and reinforce as specified in the Article titled Joints.
- E. Apply base coat in accordance with the system manufacturer's printed instructions.
 - 1. Back-roll first coat to work coating into the surfacer to produce a smooth and level surface and minimize pinholes.
- F. Saturate and place fiberglass or Engineered fabric reinforcement in accordance with the system manufacturer's printed instructions.
 - 1. Roughen saturant coat after it has cured, remove protrusions and imperfections, and remove all dust and other contaminants before application of topcoat.
- G. Apply topcoat in accordance with the system manufacturer's printed instructions.
 - 1. Lightly back roll finish coat as recommended by the system manufacturer to produce a smooth finish and eliminate pinholes.
 - 2. Provide the minimum number of coats required for each coating system, regardless of application method.
 - 3. Do not apply succeeding coats until previous coat has cured in accordance with the system manufacturer's recommendations.
- H. Observe system manufacturer's published recoat windows.
 - 1. If recoat window is exceeded, mechanically abrade before recoating in accordance with the system manufacturer's directions and as approved by the STR.
- I. Holiday Prevention for Concrete Coatings: Follow system manufacturer's written instructions related to application during decreasing substrate temperature conditions, adequate surface preparation (opening of bugholes) and other application techniques that may be necessary to reduce the potential for outgassing and formation of pinholes during coating application and cure.
- J. Film Thickness:
 - 1. Provide specified thickness of material.
 - a. Use screeds or wet film gauges to monitor thickness during application.
 - 2. Visually inspect all coated surfaces to ensure proper and complete coverage has been obtained.
 - 3. After repaired and recoated areas have sufficiently dried, coating thickness tests may be conducted by SRR to verify thickness complies with the system manufacturer's recommendations.
- K. Provide temporary facilities and enclosures as necessary to protect work areas during the preparation, application and curing.

L. Mixing:

1. Thoroughly mix epoxy resin coatings until homogeneous in accordance with system manufacturer's instructions.
2. Mix only components furnished by system manufacturer.

M. Joints:

1. Provide continuous sealant, backing material, and joint-lining treatment recommended by the system manufacturer at all expansion, isolation, and construction joints.

N. Penetrations:

1. Coat over or around equipment anchors, base plates, pipes, and similar items installed in areas receiving CRC to maintain continuous liquid tight seal.
2. Submit Treatment of Penetrations Instructions.

O. Terminations:

1. Conform to system manufacturer's details.
2. Terminate leading edges of the coating system in saw cuts $\frac{1}{4}$ inch wide by $\frac{1}{4}$ inch deep, or dimensions as required by the system manufacturer.
3. Prime and extend coating into saw cut.
 - a. Do not fill saw cut with epoxy surfacer/filler.
 - b. Saw cut shall be provided by CRC Applicator.

3.5 UNSATISFACTORY APPLICATION

- A. If an item has an improper appearance or insufficient film thickness, the surface shall be cleaned, prepared, and top-coated as required to achieve proper appearance and/or thickness.
- B. Submit System Manufacturer's Specific Cleaning and Preparation Procedures.

3.6 DAMAGED COATINGS

- A. Damaged coatings, pinholes, and holidays shall have the edges feathered and repaired in accordance with the recommendations of the system manufacturer.
- B. All finish coats, including touchup and damage-repair coats, shall be applied in a manner that will present a uniform texture and color-matched appearance.
- C. All visible areas of chipped, peeled, or abraded coatings shall be hand or power sanded.
 1. Prime and finish coat these in accordance with these Specifications and the system manufacturer's recommendations.

3.7 FIELD QUALITY CONTROL

- A. Inspection: Inspect finished system for complete, uniform coverage of specified area.
 1. Evidence of defects include improper thickness, hardness, exposed fibers, and appearance.
- B. Holiday Testing:
 1. All surfaces lined with CRC shall be electrically checked with high voltage holiday test equipment to determine the location of discontinuities:
 - a. Do not perform electrical inspection until the CRC is sufficiently cured, as determined by the system manufacturer.
 - b. Provide suitable electrical contact to reinforcing steel.
 - c. Verify conductivity of electrical contact by touching the second, ungrounded, electrode to another metallic ground connected to the concrete structure.

- d. Perform electrical inspection testing in accordance with NACE SP0188.
 - e. Perform all electrical tests at 100 volts/mil for the minimum approved thickness of the lining material.
- 2. Repair all lining defects in accordance with the system manufacturer's written instructions.
- 3. After repaired and recoated areas have dried sufficiently, retest each.
- C. Submit Field Inspection and Test Reports.

3.8 MANUFACTURER'S SERVICES

- A. Provide system manufacturer's representative at Site for installation assistance, inspection, and Manufacturer's Certificate of Proper Installation.
- B. System manufacturer's representative shall visit the project site at the following intervals:
 - 1. Initial trip for preconstruction conference and inspection of surface preparation on which CRC system is to be placed.
 - 2. Two days of initial installation of CRC system.
 - 3. At completion for Certification of Proper Installation.
 - 4. Deleted.
 - 5. Deleted
 - 6. Deleted
- C. Submit CRC System Manufacturer's Certificate of Proper Installation.

3.9 INSPECTION, EXAMINATION, TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 - 1. Subcontractor responsibilities and related information are included in Section 01810.
- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

3.10 ATTACHMENT

- A. Chemical Resistant Coating Data Sheet (CRCDS).

END OF SECTION

Chemical Resistant Coating Data Sheet (CRCDS)

Attachment No. 09850-A
Revision No. 3
Spec/Req'n No. C-SPP-Z-00008
Page 9 of 10

Complete this CRCDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats).
Include all components of a given coating system on a single CRCDS.

CRC System Number (from Spec.):		
CRC System Title (from Spec.):		
CRC Supplier:		
Representative:		
Surface Preparation:		
CRC Material (Generic)	Product Name/Number (Proprietary)	Min. Coats, Coverage

Chemical Resistant Coating Data Sheet (CRCDS)

Attachment No. 09850-A
Revision No. 3
Spec/Req'n No. C-SPP-Z-00008
Page 10 of 10

Complete and attach manufacturer's Technical Data Sheet to this CRCDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

Temperature/RH	50/50	70/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

Provide manufacturer's recommendations for the following:

Mixing Ratio: _____

Maximum Permissible Thinning: _____

Ambient Temperature Limitations: min.: _____ max.: _____

Surface Temperature Limitations: min.: _____ max.: _____

Surface Profile Requirements: min.: _____ max.: _____

Surface Moisture Limitations: max.: _____

Attach additional sheets detailing manufacturer's recommended storage requirements and holiday testing procedures.

PAINTING AND COATING

SECTION 09900

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coating Systems

1.2 RELATED SECTIONS

- A. Division 1 – All Sections
- B. Section 05500

1.3 REFERENCE

NOTE: Refer to Section 01100 for guidance on appropriate document editions to use.

A. Required Codes / Standards

- 1. International Code Council (ICC)
 - a. IBC
- 2. National Fire Protection Association
 - a. 101
- 3. Society for Protective Coatings (SSPC)
 - a. PA 2
 - b. PA Guide 10
 - c. SP 1
 - d. SP 2
 - e. SP 3
 - f. SP 5
 - g. SP 6
 - h. SP 7
 - i. SP 10
 - j. SP 11
 - k. SP 12

B. Regulations

- 1. None Specified in this Section

C. Documents

- 1. None Specified in this Section

D. Drawings

- 1. None Specified in this Section

1.4 DEFINITIONS

A. Terms

- 1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
- 2. MDFT: Minimum Dry Film Thickness, mils.
- 3. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
- 4. Mil: Thousandth of an inch.

5. PDS: Product Data Sheet.
6. PSDS: Paint System Data Sheet.
7. PVC: Polyvinyl Chloride.
8. SFPG: Square Feet per Gallon.
9. SFPGPC: Square Feet per Gallon per Coat.
10. SP: Surface Preparation.

B. See Section 01100 for general requirements.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
2. Perform surface preparation and painting in accordance with recommendations of the following:
 - a. Paint manufacturer's instructions.
 - b. SSPC PA Guide 10, Guide to Safety and Health Requirements for Industrial Painting Projects
 - c. Federal, state, and local agencies having jurisdiction.

B. See Section 01400 for general requirements.

1.6 SUBMITTALS

A. Submit the following Engineering documents in accordance with Section 01330 and 01400.

1. Paint System Data Sheet (PSDS), 2.6 A.
2. Painting and Coating Product Data Sheet, 2.6 B.
3. Painting and Coating Detailed Chemical and Gradation Analysis for Each Proposed Abrasive Material, 2.6 C.
4. Painting and Coating Manufacturer's Certificate of Compliance, 2.6 D.
5. Painting and Coating Manufacturer's Certification Stating Factory Applied Coating System Meets or Exceeds Requirements, 2.6 E. 1.
6. Painting and Coating Manufacturer's Written Verification that Material is Suitable for the Intended Use, 2.6 F.
7. Painting and Coating Finish Coating Manufacturer's Written Confirmation that Materials are Compatible, 2.6 G. 1.
8. Painting and Coating Manufacturer's Written Instructions, 2.6 H.

B. Deleted

1.7 DELIVERY, STORAGE AND HANDLING

A. Shipping:

1. Where precoated items are to be shipped to the Site, protect coating from damage.
 - a. Batten coated items to prevent abrasion.
2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.

2. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.

C. See Section 01600 for general requirements.

1.8 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.
2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.
- B. Minimum of 5 years' verifiable experience in manufacture of specified product.
- C. Each of the following manufacturers is capable of supplying most of the products specified herein:
 1. Carboline Coatings, St. Louis, MO.
 2. ICI Devoe / International Coatings, Houston, TX.
 3. Sherwin Williams, Cleveland, OH.
 4. Tnemec Company, Kansas City, MO.
 5. Or approved equal.

2.2 ABRASIVE MATERIALS

- A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.3 PAINT MATERIALS

A. General:

1. Manufacturer's highest quality products suitable for intended service.
2. Compatibility: Only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats.
3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.
4. Protective coverings and coatings shall meet the maximum flame spread and smoke development requirements of NFPA 101 and ICC IBC, whichever is more restrictive, but shall be Class A or noncombustible in nuclear facilities.

B. Products:

1. Acrylic Latex: Single-component, finish as required
2. Bituminous Paint: Single-component, coal-tar pitch based
3. Epoxy Primer—Ferrous Metal: Anticorrosive, converted epoxy primer containing rust-inhibitive pigments

4. Epoxy Primer—Other: Epoxy primer, high-build, as recommended by coating manufacturer for specific galvanized metal, copper, or nonferrous metal alloy to be coated
5. Fusion Bonded Coating: 100% solids, thermosetting, fusion bonded, dry powder epoxy, suitable for the intended service
6. High Build Epoxy: Polyamidoamine epoxy, minimum 69% volume solids, capability of 4 to 8 MDFT per coat
7. Polyurethane Enamel: Two-component, aliphatic or acrylic based polyurethane; high gloss finish

2.4 MIXING

- A. Multiple-Component Coatings:
 1. Prepare using each component as packaged by paint manufacturer.
 2. No partial batches will be permitted.
 3. Do not use multiple-component coatings that have been mixed beyond their pot life.
 4. Furnish small quantity kits for touchup painting and for painting other small areas.
 5. Mix only components specified and furnished by paint manufacturer.
 6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.
- B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

2.5 SHOP FINISHES

- A. Shop Blast Cleaning: Reference Paragraph, Shop Coating Requirements.
- B. Surface Preparation: Provide STR minimum 7 days advance notice to start of shop surface preparation work and coating application work.
- C. Shop Coating Requirements:
 1. When required by equipment Specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
 2. Where manufacturer's standard coating is not suitable for intended service condition, SRR may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish.
 - a. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat.
 - b. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

2.6 PAINTING AND COATING DOCUMENTATION

- A. Submit a Painting and Coating Paint System Data Sheet (PSDS), Attachment 09900-A, for each paint system and include:
 1. Technical and performance information that demonstrates compliance with Specification.
 - a. Indiscriminate submittal of only manufacturer's literature is not acceptable.

- B. Submit a Painting and Coating Product Data Sheet (PDS), Attachment 09900-B, for each product and include:
 - 1. Manufacturer's technical data sheets,
 - 2. Technical and performance information that demonstrates compliance with Specification.
 - a. Indiscriminate submittal of only manufacturer's literature is not acceptable.
 - 3. Paint colors available (where applicable).
- C. Submit a Painting and Coating Detailed Chemical and Gradation Analysis for Each Proposed Abrasive Material.
- D. Submit Painting and Coating Manufacturer's Certificate of Compliance, in accordance with Section 01640.
- E. Factory Applied Coatings
 - 1. Submit a Painting and Coating Manufacturer's Certification Stating Factory Applied Coating System Meets or Exceeds Requirements.
- F. Submit Reservoir Painting and Coating Manufacturer's Written Verification that Material is Suitable for the Intended Use.
- G. When the manufacturer of finish coating differs from that of shop primer,
 - 1. Obtain and Submit the Painting and Coating Finish Coating Manufacturer's Written Confirmation that Materials are Compatible.
- H. Submit Painting and Coating Manufacturer's Written Instructions and include application details for each type of paint.
- I. Provide copies of paint system submittals to the coating applicator.

PART 3 EXECUTION

3.1 GENERAL

- A. Provide STR minimum 7 days' advance notice to start of field surface preparation work and coating application work.
- B. Perform the work only in presence of STR, unless STR grants prior approval to perform the work in STR's absence.
- C. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with STR.

3.2 EXAMINATION

- A. Factory Finished Items:
 - 1. Schedule inspection with STR before repairing damaged factory-finished items delivered to Site.
 - 2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer.
 - a. Carefully blend repaired areas into original finish.
 - b. If required to match colors, provide full finish coat in field.
- B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied.
 - 1. The more stringent requirements shall apply.

3.3 PROTECTION OF ITEMS NOT TO BE PAINTED

- A. Remove, mask, or otherwise protect surfaces not specified elsewhere to be painted.
- B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.
- C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.
- D. Mask openings in motors to prevent paint and other materials from entering.
- E. Protect surfaces adjacent to or downwind of work area from overspray.

3.4 SURFACE PREPARATION

A. Field Abrasive Blasting:

- 1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.
- 2. Refer to coating systems for degree of abrasive blasting required.
- 3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.

B. Concrete Surface Preparation:

- 1. Where indicated, meet requirements of Specifications summarized below:
 - a. SSPC SP 2, Hand Tool Cleaning: Removal of loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.
 - b. SSPC SP 3, Power Tool Cleaning: Removal of loose mill scale, loose paint, and other loose detrimental foreign matter, using power-assisted hand tools.
 - c. SSPC SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
 - d. SSPC SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.
- 2. Hand tool clean areas that cannot be cleaned by power tool cleaning.
- 3. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.

C. Surface Contamination Testing:

- 1. A surface contamination analysis test shall be performed every 100 square feet by means of a Chlor Test CSN Salts or approved equivalent.
- 2. Surface with chloride levels exceeding 3 µg/square centimeter for submerged surfaces and 5 µg/square centimeter for exposed surfaces shall be treated with a liquid soluble salt remover equivalent to CHLOR*RID (CHLOR*RID International, Chandler, AZ).
- 3. Follow manufacturer's recommendations and procedures for the use of this product to remove the surface contamination.

D. Metal Surface Preparation:

1. Where indicated, meet requirements of Specifications summarized below:
 - a. SSPC SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.
 - b. SSPC SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.
 - c. SSPC SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using power-assisted hand tools.
 - d. SSPC SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.
 - e. SSPC SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
 - f. SSPC SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.
 - g. SSPC SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
 - h. SSPC SP 11, Power Tool Cleaning to Bare Metal: Removal of visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter using power-assisted hand tools capable of producing suitable surface profile. Slight residues of rust and paint may be left in lower portion of pits if original surface is pitted.
 - i. SSPC SP 12, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating: Surface preparation using high-pressure and ultrahigh-pressure water jetting to achieve specified surface cleanliness condition. Surface cleanliness conditions are defined in SSPC SP 12 and are designated WJ-1 through WJ-4 for visual surface preparation definitions and SC-1 through SC-3 for nonvisual surface preparation definitions.
2. The words "solvent cleaning", "hand tool cleaning", "wire brushing", and "blast cleaning", or similar words of equal intent in these Specifications or in paint manufacturer's specification refer to the applicable SSPC Specification.
3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required.
 - a. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.
4. Hand tool clean areas that cannot be cleaned by power tool cleaning.
5. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.

6. Welds and Adjacent Areas:
 - a. Prepare such that there is:
 - i. No undercutting or reverse ridges on weld bead.
 - ii. No weld spatter on or adjacent to weld or any area to be painted.
 - iii. No sharp peaks or ridges along weld bead.
 - b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
7. Preblast Cleaning Requirements:
 - a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
 - b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
 - c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.
8. Blast Cleaning Requirements:
 - a. Type of Equipment and Speed of Travel: Designed to obtain specified degree of cleanliness.
 - i. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
 - b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.
 - c. Use only dry blast cleaning methods.
 - d. Do not reuse abrasive, except for designed recyclable systems.
 - e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.
9. Post-Blast Cleaning and Other Cleaning Requirements:
 - a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting.
 - i. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
 - b. Paint surfaces the same day they are blasted.
 - i. Reblast surfaces that have started to rust before they are painted.
- E. Galvanized Metal Surface Preparation:
 1. Remove soil, cement spatter, and other surface dirt with appropriate hand or power tools.
 2. Remove oil and grease by wiping or scrubbing surface with suitable solvent, rag, and brush.
 - a. Use clean solvent and clean rag for final wiping to avoid contaminating surface.
 3. Obtain and follow coating manufacturer's recommendations for additional preparation that may be required.
- F. Plastic Surface Preparation:
 1. Hand sand plastic surfaces to be coated with medium grit sandpaper to provide tooth for coating system.

2. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.

3.5 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.
2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
5. STR will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.
6. Repair or replace surface damaged by blast cleaning.

B. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.
2. Meet requirements of SSPC SP 1.

3.6 APPLICATION

A. General:

1. The intention of these Specifications is for new, interior and exterior metal surfaces to be painted, whether specifically mentioned or not, except as specified otherwise.
 - a. Do not paint exterior concrete surfaces, unless specifically indicated.
2. Apply coatings in accordance with these Specifications and paint manufacturers' printed recommendations and special details.
 - a. The more stringent requirements shall apply.
 - b. Allow sufficient time between coats to ensure thorough drying of previously applied paint.
3. Vacuum clean surfaces free of loose particles.
 - a. Use tack cloth just prior to applying next coat.
4. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
5. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
6. Keep paint materials sealed when not in use.
7. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Galvanized Metal:

1. Galvanized surfaces (behind building panels or walls) do not require painting, unless specifically indicated on the Drawings.
2. Prepare surface and apply primer in accordance with System No. 10 specification.
3. Apply intermediate and finish coats of the coating system appropriate for the exposure.

C. Film Thickness and Coverage:

1. Number of Coats:
 - a. Minimum required without regard to coating thickness.
 - b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Application Thickness:
 - a. Do not exceed coating manufacturer's recommendations.
 - b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
 - a. Perform with properly calibrated instruments.
 - b. Recoat and repair as necessary for compliance with Specification.
 - c. Coats are subject to inspection by STR and coating manufacturer's representative.
4. Visually inspect plastic surfaces to ensure proper and complete coverage has been attained.
5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
6. Apply additional coats as required to achieve complete hiding of underlying coats.
 - a. Hiding shall be so complete that additional coats would not increase the hiding.

3.7 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

- A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from STR before starting work in question.
- B. System No. 4 Exposed Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer— Ferrous Metal	1 coat, 2.5 MDFT
	High Build Epoxy	1 coat, 4 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

1. Use on the following items or areas:
 - a. Exposed metal surfaces, located inside or outside of structures and exposed to weather including exterior surfaces of sidewalk doors.

C. System No. 7 Concrete Encased Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	High Build Epoxy	2 coats, 16 MDFT

1. Use on the following items or areas:
 - a. Use on concrete encased ferrous metals including pipe sleeves.

D. System No. 9 Special Coatings - Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer—Ferrous Metal	1 coat, 2.5 MDFT
	High Build Epoxy	2 coats, 16 MDFT

1. Use on the following items or areas:
 - a. Interior surfaces of sidewalk doors.

E. System No. 10 Galvanized Metal Conditioning:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Galvanized Metal Surface Preparation	Epoxy Primer—Other	As recommended by coating manufacturer Remaining coats as required for exposure

1. Use on the following items or areas:
 - a. Galvanized surfaces requiring painting.
 - b. After application of System No. 10, apply finish coats as required for exposure.

F. System No. 25 Exposed PVC:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Plastic and FRP Surface Preparation	Acrylic Latex Semigloss	2 coats, 320 SFPGPC

1. Use on the following items or areas:
 - a. All exposed-to-view PVC surfaces.

G. System No. 27 Dissimilar Metal Insulation:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1)	Prime in accordance with manufacturer's recommendations	
	Bituminous Paint	1 coat, 10 MDFT

1. Use on galvanized steel surfaces embedded or in contact with concrete, grout, or dissimilar metals.

H. System No. 29 Fusion Bonded Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Fusion Bonded Coating 100% Solids Epoxy	1 or 2 coats, 7 MDFT

1. Use on the following items:
 - a. Stainless steel anchor bolts where required by Section 05500.

I. Concrete Surfaces

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	High Build Epoxy	2 coats, 16 MDFT

1. Use on the following items or areas:
 - a. Grout Level Markers at tank columns as shown on attachment 09900-C. Do not blast on or near liner. Coating system shall be compatible with liner system TL-S High Build Novolac Epoxy Tank Lining (Blome International).

3.8 COLORS

- A. Provide as selected by STR.
- B. Proprietary identification of colors is for identification only.
 1. Selected manufacturer may supply matches.
- C. Equipment Colors: Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.

3.9 FIELD QUALITY CONTROL

- A. Testing Equipment:
 1. Provide magnetic type dry film thickness gauge to test coating thickness specified in mils, as manufactured by Nordson Corp., Anaheim, CA, Mikrotest, or approved equal.

B. Testing:**1. Thickness and Continuity Testing:**

- a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2.
 - i. Check each coat for correct millage.
 - ii. Do not make measurement before a minimum of 8 hours after application of coating.
- b. After repaired and recoated areas have dried sufficiently, retest each repaired area.
 - i. Final tests may also be conducted by STR.

C. Inspection: Leave staging and lighting in place until STR has inspected surface or coating.

1. Replace staging removed prior to approval by SRR.
2. Provide additional staging and lighting as requested by STR.

D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage.
 - a. Obtain specific surface preparation information from coating manufacturer.
2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Feather edges and repair in accordance with recommendations of paint manufacturer.
2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges.
 - a. Follow with primer and finish coat.
 - b. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.10 MANUFACTURER'S SERVICES**A. Deleted****3.11 CLEANUP**

- A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.
- B. Upon completion of the work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.
- C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.12 INSPECTION, EXAMINATION, TESTING AND OBSERVATION

- A. Perform Field Testing in accordance with Section 01400.
- B. Provide for SRR special inspection, professional observation, and testing, in accordance with ICC IBC Chapter 17 requirements, as provided in the Statement of Special Inspections Plan on the Drawings and Section 01810.
 1. Subcontractor responsibilities and related information are included in Section 01810.

- C. SRR quality assurance oversight inspection: Inspection, examination and testing by SRR as stated in Section 01400.

3.13 ATTACHMENTS

- A. Paint System Data Sheet (PSDS).
- B. Product Data Sheet (PDS).
- C. Grout Level Markers.

END OF SECTION

Paint System Data Sheet

Attachment No. 09900-A
Revision No. 3
Spec/Req'n No. C-SPP-Z-00008
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Complete this PSDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single PSDS.

Paint System Number (from Spec.):		
Paint System Title (from Spec.):		
Coating Supplier:		
Representative:		
Surface Preparation:		
Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats, Coverage

Product Data Sheet

Attachment No. 09900-B
Revision No. 3
Spec/Req'n No. C-SPP-Z-00008
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Complete and attach manufacturer's Technical Data Sheet to this PDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

Temperature/RH	50/50	70/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

Provide manufacturer's recommendations for the following:

Mixing Ratio: _____

Maximum Permissible Thinning: _____

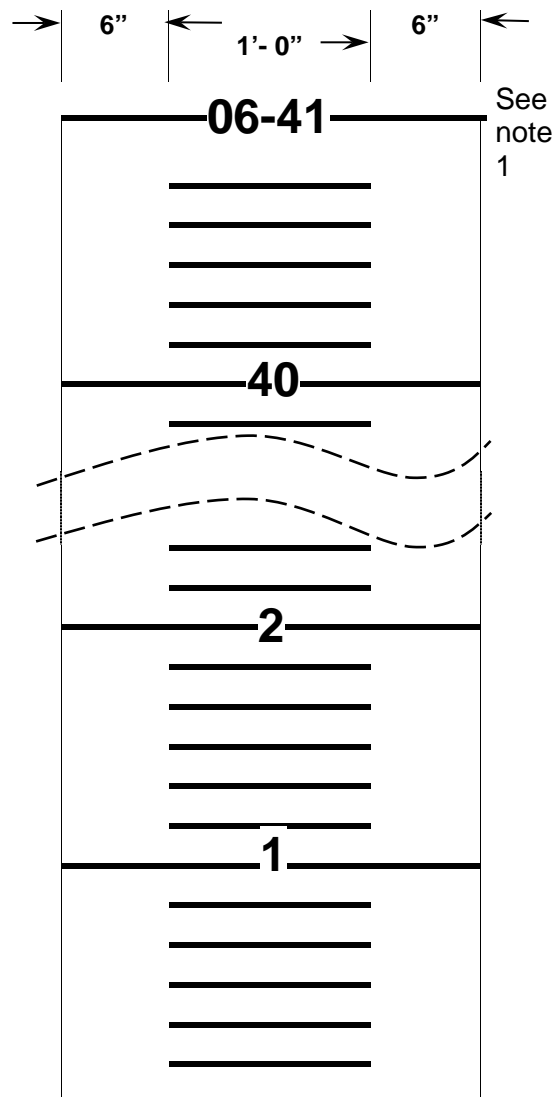
Ambient Temperature Limitations: min.: _____ max.: _____

Surface Temperature Limitations: min.: _____ max.: _____

Surface Profile Requirements: min.: _____ max.: _____

Grout Level Markers

Attachment No. 09900-C
Revision No. 3
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Typical Interior Column Elevation
Showing Grout Level Markers
Not to Scale

NOTES:

1. Paint 06-41 elevation line on interior wall using non-reflective paint (over interior coating). Elevation line shall be 1 inch thick, black, all around with numbers at 10 feet intervals.
2. Paint scale on interior column using non-reflective paint. The background shall be white per dimensions given. Elevation numbers and lines shall be black.
3. Provide elevation numbers centered at 1 ft. intervals as shown. Numbers shall be 3 inches high. Scale shall be oriented such that numbers are visible from 2 cameras. Top line shall align with the wall 06-41 elevation line.
4. Elevation lines shall be 1 inch thick by 1 ft. long and placed at 2 inch intervals as shown.

ROOF COATINGS

SECTION 09915

DELETED

END OF SECTION